Monitoring report form
(Version 05.1)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.

MONITORING REPORT		
Title of the project activity	Puebla Landfill Gas to Energy Project	
UNFCCC reference number of the project activity	6335	
Version number of the monitoring report	1	
Completion date of the monitoring report	15/06/2015	
Monitoring period number and duration of this monitoring period	1, 01/10/2012 – 30/09/2013	
Project participant(s)	Rellenos Sanitarios RESA	
Host Party	Mexico	
Sectoral scope(s)	13. Waste handling and disposal	
Selected methodology(ies)	ACM001 Ver. 11 "Consolidated baseline and monitoring methodology for landfill gas project activities"	
Selected standardized baseline(s)	Baseline as per the applied consolidated baseline and monitoring methodology.	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	229,131 tCO_2e	
Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period	GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012	GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards
	3,500	13,300

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The Puebla Landfill Gas to Energy Project is promoted by "Rellenos Sanitarios RESA (RESA)", the Project Developer) who manages the landfill site (the Chiltepeque landfill) in the State of Puebla, Mexico (the Host Country). The Chiltepeque landfill started operation in 1995 and is expected to continue operations until 2022.

The purpose of the Project is to develop the landfill gas (LFG) collection and utilization system, aimed at capturing methane (CH_4) from the LFG released by the Chiltepeque landfill and to utilize it to generate electricity. The project will be developed in two phases: a) Phase I – LFG collection and flaring, and b) Phase II – electricity generation. The landfill consists of two sections, A and B. About 6.9 million metric tonnes of waste have been disposed of in section A of the landfill until November 2010. It is anticipated that this section will receive another 1.5 million metric tonnes of waste until 2013. After 2013, waste deposition will continue in section B of the landfill. The proposed project activity will be implemented on section A only. It is expected to reduce emissions by approximately 1.3 million metric tonnes of CO_2 equivalent over the crediting period of 10 years.

Currently there is no system in place to actively capture or flare the LFG. The LFG is vented to the atmosphere. The situation prior to the implementation of the proposed project activity (venting of the landfill gas generated) is the same as the baseline scenario.

The proposed project will reduce greenhouse gas emissions from the decomposition of municipal solid waste that would have been otherwise emitted to the atmosphere. Furthermore, the captured landfill gas, which contains approximately 50% CH_4 by volume, will be combusted to generate electricity which will be fed into the national power grid, the Interconnected National System (SIN). The electricity generated from the LFG will reduce greenhouse gas emissions from fossil fuel-based electricity generation. The proposed project will thus reduce greenhouse gas emissions in two ways:

1) Eliminate a significant portion of methane (CH4), which has a 25 times higher global warming potential than carbon dioxide (CO_2), and which would otherwise be emitted to the atmosphere.
All LFG collected but not used for electricity generation will be flared.

2) Displace fossil fuel-based electricity generation that would have otherwise emitted CO_2.

The emission reduction of this monitoring period is 16,800 tCO_2.

A.2. Location of project activity

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The Chiltepeque site is located approximately 12 km to the northeast of the Puebla City core in the State of Puebla (Figure 1). The city of Puebla is located approximately 107 km southeast of Mexico City.

Section A of the landfill site occupies an area of 32 ha[1] divided into eight cells. Access to the site is from the west. The landfill site is located in an area of natural rolling hills with abundance of trees and other variety of vegetation of native species. There is a large industrial park and a military base located approximately 8 km and 3 km, respectively, from the landfill site. There is no concentration of residents in the proximity of the landfill site. The geographical coordinates of the entrance of the site are:

[1] 27.94 ha according to document "Resolución Manifestación de Impacto Ambiental" (Environmental Impact Study Resolution), page 2; plus 4.1 ha according to document "Proyecto de Ampliación" (Expansion Project), page 113.

Latitude 18.982833° N and longitude -98.139664° W.

Figure No. 1 - Location of the State of Puebla, Mexico[2]

Figure No. 2 – Aerial photo of the Chiltepeque Landfill[3]

[2] Source: http://www.pickatrail.com/jupiter/location/north_america/mexico/puebla.htm
[3] Source: Google Earth Map.

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate whether the Party involved wishes to be considered as project participant (yes/no)
Mexico (host)	Rellenos Sanitarios RESA (Private entity)	No

A.4. Reference of applied methodology and standardized baseline

>>
The approved consolidated baseline and monitoring methodology applied in the proposed project activity is the ACM0001 "Consolidated baseline and monitoring methodology for landfill gas project activities" Version 11, EB 47, Annex 6.

Sectoral scope: 13. Waste handling and disposal.

As stated in the registered PDD:

For the calculation of the baseline emissions Version 05.1.0 of the "Tool to determine methane emissions avoided from disposal of waste at solid waste disposal site" has been used.

For the calculation of the CO2 emission factor of the Interconnected National System (SIN) to determine baseline emissions from electricity generation, Version 02.2.1 of the "Tool to calculate the emission factor for an electricity system" has been used.

For the calculation of project emissions, the following tools have been used:

- Version 01 of the "Tool to determine project emissions from flaring gases containing methane"
- Version 02 of the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion"
- Version 01 of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"

A.5. Crediting period of project activity

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The project has applied with a fixed crediting period of 10 years 0 m.

The crediting period was determined as: 01 October 2012 – 30/September 2022.

A.6. Contact information of responsible persons/entities

>>
Rellenos Sanitarios RESA (Project Participant)
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Col. San Pedro de los Pinos
México, D.F., C.P. 03800

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Ms. Cristina Mejía (Administrative contact)
E-mail: macristina111@prodigy.net.mx
Ph. + 52 222 246 5502

Mr. Edgar Jiménez (Technical & Operational contact)
E-mail: edgargpe1@gmail.com
Ph. + 52 222 246 5502

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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In order to actively capture and flare the LFG from the existing landfill, a state-of-the-art LFG management system has been implemented in phase 1, including surface cover, landfill capture system and enclosed flares.

In phase 2, LFG engines will be installed in order to generate electricity from the LFG, at the time of the first monitoring period 01/10/2012 – 30/09/2013 this phase has not take place.

Surface Cover

Each of the closed landfill cells is covered with adequate surface cover to prevent release of the LFG into the atmosphere and to enable its efficient recovery for flaring and/or utilization. As part of its contract with the municipality, the RESA has a mandate to provide a basic cover over the accumulated waste to avoid waste littering and to provide odour control. However, this cover is not sufficient for LFG recovery. A modified surface cover with the following components has been provided as final cover at the time of closure of each cell:

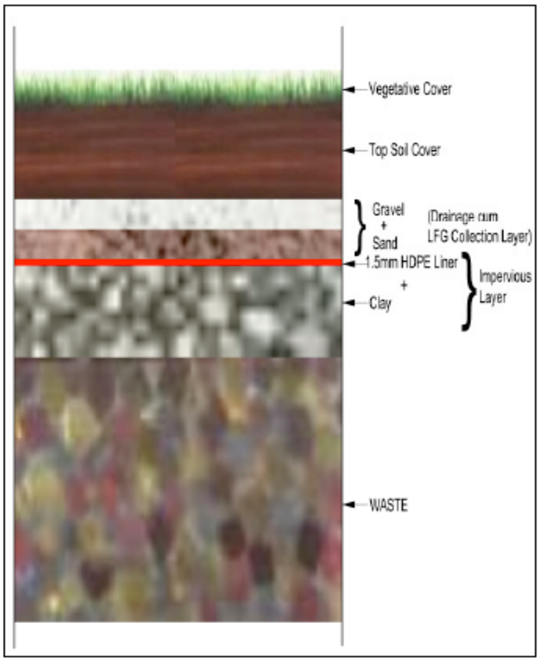

Figure No. 3 – Schematic of the Surface Cover

Top Soil - Vegetative layer made up of 45 cm thick topsoil as the topmost layer. The soil for this layer has been transported from approved borrows pits suitable for growing vegetation and developing landscaping.

LFG Collection cum Drainage Layer - A layer of granular soil with a permeability coefficient (k) greater than 10-2 cm/sec of 30 cm thickness is laid below the top soil to accommodate a network

of header and feeder pipes for LFG collection and to act also as a drainage layer.

Impervious Layer - An impervious layer consisting of a clay layer of 45 cm thickness with a 1.5 mm thick HDPE (high density polyethylene) liner has been provided to prevent LFG from being released into the atmosphere and infiltration of water into the closed cell.

LFG Capture System

LFG extraction wells - A Gas well design has been developed as per the guidelines specified in USEPA CFR Test Method 2E "Determination of LFG Production Flow Rate"[4]. LFG collection wells are 500 mm diameter wells to be drilled, down to 75% of the depth of the landfill. To extract the LFG, 15 - cm diameter HDPE pipe is inserted into the extraction well, with perforations along two-thirds the length of the pipe from the bottom.

To facilitate the lateral movement of the LFG and also to provide lateral pressure, the annular core are filled with 2.5 cm to 4 - cm size gravels. The top of the well is sealed with bentonite and capped (Figure 4). The spacing between any two-extraction wells is not more than twice the radius of influence of the wells.

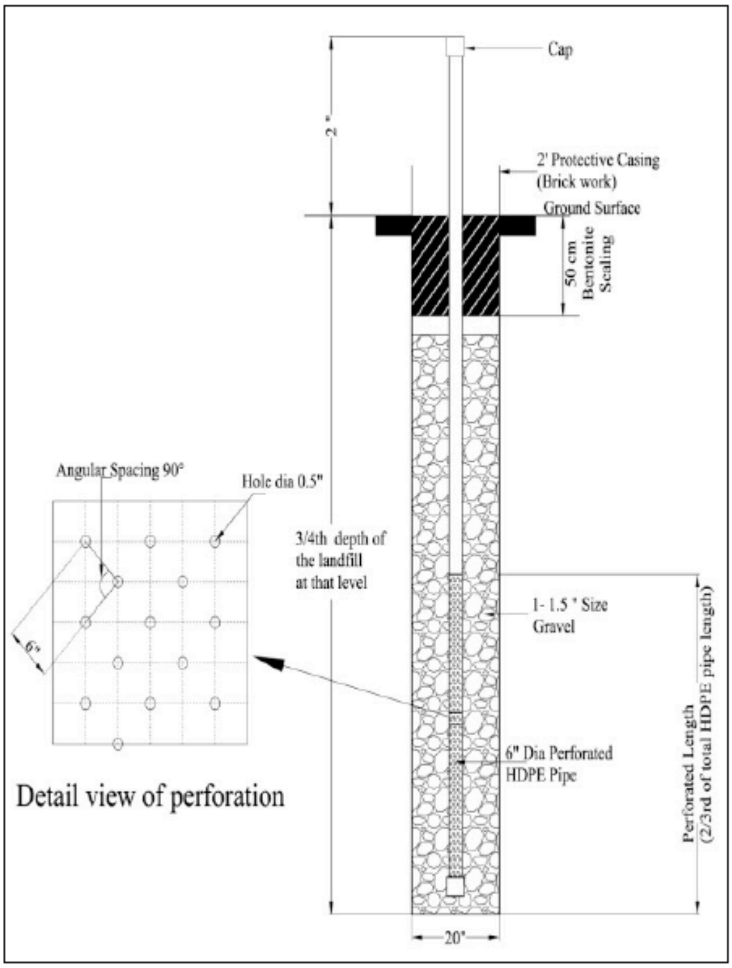

Figure No. 4 – Schematic Diagram of the LFG Extraction Well

4 http://www.epa.gov/ttn/emc/promgate/m-02e.pdf

Gas piping Network - It is installed a gas collection network comprising an adequate number of inter-connected headers (200 mm HDPE pipes) and feeder pipes (150 mm HDPE pipe). The gas is actively extracted from the wells using a vacuum. The gas extracted from each individual well flows through a feeder pipe into a header. The pipes are to be made of HDPE. This is to compensate for the corrosive nature of LFG and its condensate.

LFG Flare

In project phase I, the collected LFG is combusted in an enclosed flare.

In phase II, only the LFG, which is not used for electricity generation will be flared. The basic flare arrangement for the Chiltepeque landfill is shown below (Figure 5).

The enclosed type flare assembly comprises:

- Condensate Knock out: The condensate knock out vessel removes the solid debris from the LFG in addition to the moisture. As the LFG cools, the condensate accumulates in the gas collection pipe and needs to be removed before gas enters the flare unit for combustion.

- Gas Blowers: The LFG from the gas wells is extracted with several vacuum blowers.

- Flare System: The flare system includes a minimum of two enclosed flares, each with a capacity of approximately 500 to 1200 m^3/h. Details of the flare system and its components are shown in Figure 5:

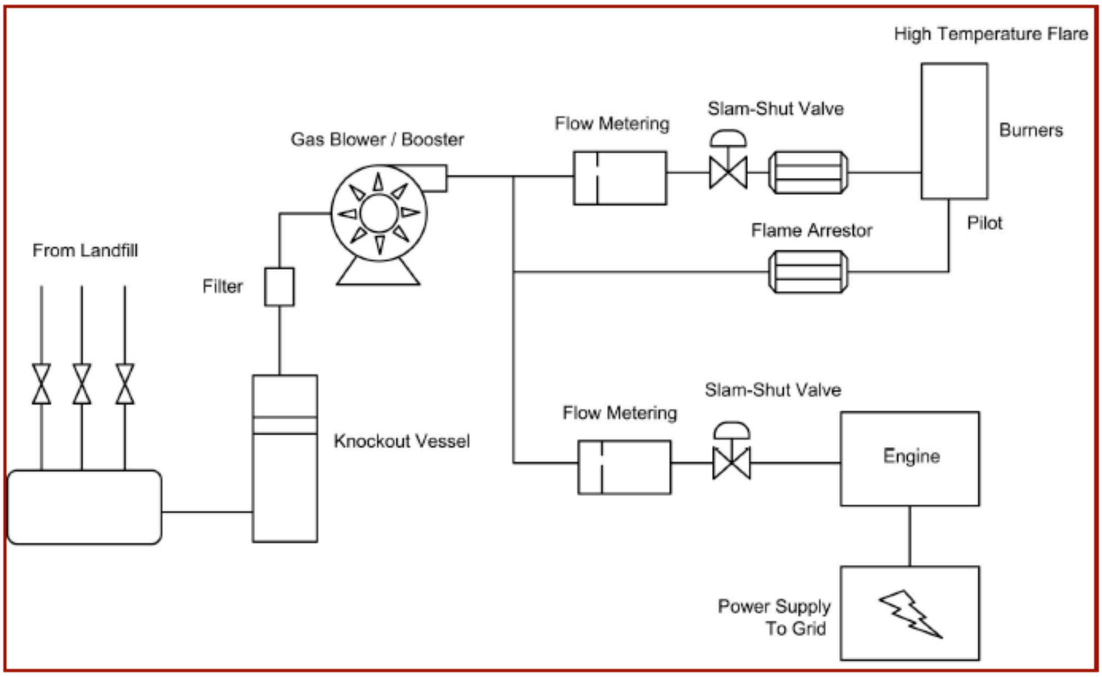

Figure No. 5 – Combustion Scheme for LFG Engines at the Chiltepeque Landfill

Equipment	Details[5]
Blowers	
Capacity	528 m^3/h per blower
Motor	15 HP
Enclosed Flares	
Capacity	500 to 1200 m^3/h per flare
Operating temperature	760 – 870 ºC
Efficiency	Minimum 98%

Table No. 1 – Technical specification of the blowers and flares

Diesel Generator

The diesel generator will provide electricity to the LFG collection and flaring system until the project is connected to the Interconnected National System (SIN) or electricity is generated on-site from the landfill gas. According to RESA, the diesel generator may have a capacity between approximately 0.03 MW and 0.05 MW.

Diesel Generator	Details[6]
Capacity	Approx. 0.03 to 0.05 MW
Quantity	1
Diesel consumption	7.6 to 14.2 l/h

Table No. 2 – Technical specification of the diesel generator

LFG Power Plant

The LFG power plant shall consist of one set of LFG engines. The set will comprise two generators, each with a nominal capacity of 1.6 MW but with a real capacity of 1.355 MW as calculated by the equipment provider according to the project location's altitude above sea level. The generators will be connected to a transformer station from where electricity is supplied to the Interconnected National System (SIN). The LFG engines shall enter into operation on 01/11/2015.

Generator set	Details[7]
Number of generators set	2
Type	G3520C with DM5740 (Caterpillar)
Nominal capacity (Technical specifications)	1.6 MW per generator
Capacity on-site	1.355 MW per generator
Efficiency	40.1%

Table No. 2 – Technical specification of the diesel generator

The flares will be used either during closure or during maintenance of the LFG engines or for combustion of LFG collected in excess of gas engine capacity.

[5] According to the technical specifications provided by John Zink.

[6] According to indications by the provider (document: Diesel_consumption.pdf)

[7] According to the technical specifications provided by Caterpillar/Madisa.

B.2. Post-registration changes

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

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No temporary deviations from registered monitoring plan, applied methodology or applied standardize baseline have been applied.

B.2.2. Corrections

>>
No corrections have been applied.

B.2.3. Changes to start date of crediting period

>>
To changes to the start of crediting period have been applied.

B.2.4. Inclusion of a monitoring plan to the registered PDD that was not included at registration

>>
No inclusion of a monitoring plan to the registered PDD that was not included at registration has been applied.

B.2.5. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

>>
No permanent changes from registered monitoring plan, applied methodology or applied standardize baseline have been applied.

B.2.6. Changes to project design of registered project activity

>>
No changes to project design of registered project activity have been applied.

B.2.7. Types of changes specific to afforestation or reforestation project activity

>>
Not applicable.

SECTION C. Description of monitoring system

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According to ACM0001, the monitoring methodology is based on direct measurement of the amount of LFG captured and destroyed by flaring and utilized to produce electricity. The monitoring plan provides for continuous measurement of the quantity and quality of LFG flared.

The main variables that are determined are:

- The quantity of methane actually captured $MD_{project,y}$,
- The quantity of methane sent to the flare ($MD_{flared,y}$),
- The quantity of methane used to generate electricity ($MD_{electricity,y}$), and
- The quantity of methane generated ($MD_{total,y}$).

The methodology also measures:

- The energy generated by the use of LFG ($EL_{LFG,y}$),
- The energy consumed by the project activity from the Interconnected National System (SIN) ($EC_{PJ,j,y}$), and

- The fossil fuel consumption ($FC_{PJ,j,y}$).

All monitored parameters are listed and described in Section E.2. Figure 6 shows the monitored parameters to determine the quantity of methane destroyed by the project activity:

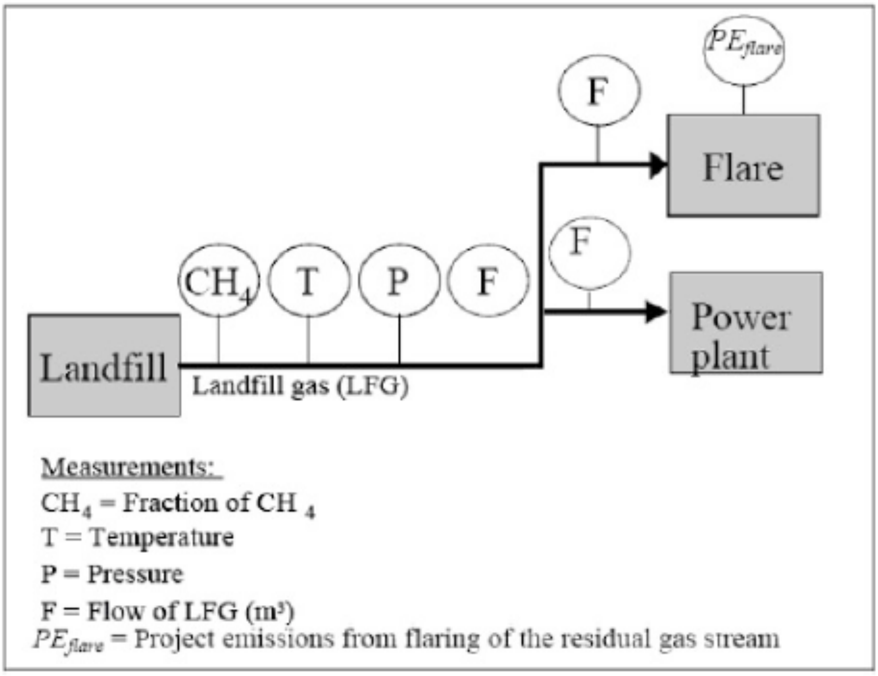

Figure No. 6 - Parameters to be monitored to determine the quantity of methane destroyed by the project activity.

Operational/management structure and responsibilities

The project is implemented and managed by RESA who nominated a project director who is responsible for the project management, monitoring and quality control.

Part of the monitoring data is measured online and stored directly in RESA's databases. The responsible project manager will be in charge of observing the online measurements and aggregating the data. The data monitored online are also sent via internet connection to the provider of the monitoring equipment (Landtec) who will analyze and store the data in order to be able detect any equipment failure or other irregularities.

The field technicians perform activities such as monitoring and adjusting LFG extraction wells, checking operations o the blower and flare, recording data which is not measured online, routine maintenance of collection system components, preparing daily logs, completing check lists, sending the data sheets to the project manager and informing the project manager of any irregularities observed in the field.

The project manager is responsible for reviewing, analyzing and archiving the monitoring data collected manually, reviewing and analyzing the data monitored online, making any recommendations and/or implementing system adjustments to maximize methane capture and destruction, scheduling of maintenance and calibration activities, coordinating with the provider of the online monitoring equipment (Landtec) and the manufacturers/providers of equipment in general in case of any irregularity, reporting operation and monitoring data regularly to the project director.

The following figure shoes the organizational structure for the operation and management of the project activity:

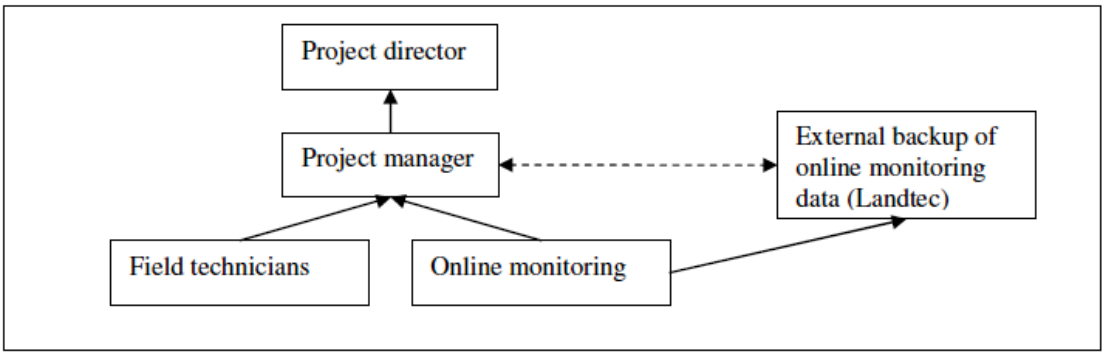

Figure No. 7 - Operational and management structure

Training

The responsible staff has received training from the equipment providers with regard to the operation, maintenance and calibration of the equipment, as well as an internal training with regard to the collection of monitoring data.

Calibration and maintenance

The monitoring equipment undergoes regular maintenance and calibration according to the manufacturers' recommendations.

Monitoring frequency

Indicated in section D.2. of this monitoring report based in section B.7.1 of the registered PDD.

Data analysis

The collected data is reviewed and analyzed on a daily basis by the project manager in order to be able to quickly detect any irregularities with regard to the project operation, monitoring equipment or data collection and to take corrective actions.

Data recording

All collected data is stored onsite in a database. The data monitored online is also stored by the provider of the online monitoring system (Landtec).

All data is archived electronically with frequent data backup. This information will be kept for two years after the crediting period or for two years after the last issuance of CERs for this project activity, whichever occurs later.

Reporting

The project manager prepares periodic reports including key data and analysis results and presents them to the project director.

Emergency procedures

Emergency prevention through design measures, appropriate operation & maintenance schedule and regular inspection are essential to reduce the probability of occurrence of any eventualities on project site. However, it is not possible to totally eliminate such eventualities and random failures of equipment or human errors, omissions and unsafe acts cannot be ruled out. An essential part of

project operation control is therefore also the mitigation of the effects of any emergency at the earliest.

LFG is primarily methane and carbon dioxide, along with non-methane volatile organic compounds (NMVOC) that can ignite and explode under certain circumstances. Methane is explosive when present in the range of five percent (lower explosive limit, LEL) to 15 percent (upper explosive limit, UEL) by volume in air. Hence an emergency response programme is required in case of:

a) Elevated gas levels being detected by presence of gas odour or by automatic monitoring system.

b) Fire and explosion.

Gas leakage alerts within the project site shall be made by the Automatic Monitoring System. On detecting methane gas in excess of 0.5% volume (5000 ppm) or carbon dioxide in excess of 1.5% volume (15000 ppm) the automatic monitoring system will automatically activate the alarm and emergency response program can be initiated. Following actions should be taken in case of leakage/ fire.

Basic Actions

- Take immediate steps to stop gas leakage/fire.
- Stop all operations and ensure closure of all isolation valves.
- As gas fires develop and spread quickly, so all out efforts should be made to contain the spread of leakage/fire.
- Plant personnel without any specific duties should assemble at the nominated place.
- All vehicles except those that are required for emergency use should be moved away from the operating area in an orderly manner at pre nominated route.
- Electrical system except the lighting and fire fighting system should be isolated.
  If the feed to the fire cannot be cut off, the fire must be controlled and not extinguished.
- Start water spray systems in the areas involved in or exposed to secondary fire risks.
- In case of leakage of LFG without fire and inability to stop the flow, take all precautions to avoid source of ignition and most importantly, evacuate persons from the downwind area-crosswind would be the best option (shortest path to safety). Actions necessary for H2S may be taken.
- Block all roads in the adjacent area and enlist police support for the purpose, if warranted.

Actions in the event of fire:

- Basic actions as detailed above.
- Extinguishing fires: A small fire at a point of leakage should be extinguished by enveloping with a water spray or a suitable smothering agent such as CO2. However, LFG fire should not, unless under exceptional circumstances, be extinguished until the escape of product has been stopped. If escaping gas cannot be stopped, water should be directed at the point of leakage to assist rapid dispersion. Ensure that static charge is not generated in the LFG vapor cloud - solid jets of water into the cloud should be avoided. Fog nozzles should be used instead.
- Fire fighting personnel working in or close to un-ignited vapor clouds or close to fire, must be protected continuously by water sprays. Fire fighters should advance towards the fire downwind if possible. Care should be taken to avoid H2S Exposure.
- In case the only valve that can be used to stop the leakage is surrounded by fire, it may be possible to close it manually. The person attempting the closure should be continuously

protected by water sprays, fire entry suit, water jet blanket etc. The person must be equipped with a safety belt and a manned lifeline.

Leakage of LFG from pipeline without fire

- Cordon off the area around 20 meters radius so that no vehicle or source of ignition approached the area. Attempt to close the control/ manual valve.
- Avoid getting entrapped in the cloud vapor.
- Warn the surrounding areas to put off all naked flames.
- In case water is used, ensure effluent is treated before disposal.

SECTION D. Data and parameters

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

The following figure shows the constants fixed ex-ante for the project activity:

Parameter	SI Unit	Description	Value
MM_{CH4}	kg/kmol	Molecular mass of methane	16.04
MM_{CO}	kg/kmol	Molecular mass of carbon monoxide	28.01
MM_{CO2}	kg/kmol	Molecular mass of carbon dioxide	44.01
MM_{O2}	kg/kmol	Molecular mass of oxygen	32.00
MM_{H2}	kg/kmol	Molecular mass of hydrogen	2.02
MM_{N2}	kg/kmol	Molecular mass of nitrogen	28.02
AM_C	kg/kmol (g/mol)	Atomic mass of carbon	12.00
AM_H	kg/kmol (g/mol)	Atomic mass of hydrogen	1.01
AM_O	kg/kmol (g/mol)	Atomic mass of oxygen	16.00
AM_N	kg/kmol (g/mol)	Atomic mass of nitrogen	14.01
P_n	Pa	Atmospheric pressure at normal conditions	101,325
R_u	Pa m^3/kmol K	Universal ideal gas constant	8,314.472
T_n	K	Temperature at normal conditions	273.15
MF_{O2}	Dimensionless	O_2 volumetric fraction of air	0.21
GWP_{CH4}	tCO_2/tCH_4	Global warming potential of methane	21
MV_n	m^3/kmol	Volume of one mole of any ideal gas at normal temperature and pressure	22.414
$\rho_{CH4,n}$	kg/m^3	Density of methane gas at normal conditions	0.716
$NA_{i,j}$	Dimensionless	Number of atoms of element j in component i, depending on molecular structure	

Figure No. 8 – Constants determined ex-ante for the project activity[8]

Parameters determined for baseline emissions

Data/parameter:	D_{CH4}
Unit	tCH_4/m^3CH_4
Description	Methane Density
Source of data	ACM0001 Ver. 11

[8] The GW of the CH_4 has been updated to 25 as per the latest information available of the IPCC.

Value(s) applied)	At standard temperature and pressure the density of methane is 0.0007168 tCH_4/m^3CH_4.
Choice of data or measurement methods and procedures	Value as provided in the methodology ACM0001.
Purpose of data	Baseline emissions
Additional comments	-

Data/parameter:	**$BE_{CH4,SWDS,y}$**
Unit	tCO_2e
Description	Methane generation from the landfill in the absence of the project activity at year y
Source of data	Calculated as per the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”.
Value(s) applied)	Refer to Annex 3 of the registered PDD.
Choice of data or measurement methods and procedures	As per the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”.
Purpose of data	Baseline emissions
Additional comments	Used for ex ante estimation of the amount of methane that would have been destroyed/combusted during the year.

Data/parameter:	**Regulatory requirements relating to landfill gas**
Unit	-
Description	Regulatory requirements relating to landfill gas
Source of data	Publicly available information of the host country’s regulatory requirements relating to landfill gas
Value(s) applied)	-
Choice of data or measurement methods and procedures	No methane is captured and destroyed/combusted at the Chiltepeque landfill in the absence of the project activity. According to applicable mandatory laws and regulations there is no obligation to capture and destroy/combust methane generated through the deposition of waste in landfills. This has been explained in more detail in section B.4 of the registered PDD.
Purpose of data	Baseline emissions
Additional comments	The information though recorded annually, is used for changes to the adjustment factor (AF) or directly $MD_{BL,y}$ at renewal of the credit period. Relevant regulations for LFG project activities shall be updated at renewal of each credit period. Changes to regulation should be converted to the amount of methane that would have been destroyed/combusted during the year in the absence of the project activity ($MD_{BL,y}$). Project participants should explain how regulations are translated into that amount of gas.

Data/parameter:	**AF**
Unit	-
Description	Adjustment Factor
Source of data	Local information on existing facilities at landfills in the Host Country and information regarding existing regulations in the Host Country.
Value(s) applied)	0

Choice of data or measurement methods and procedures	No methane is captured and destroyed/combusted at the Chiltepeque landfill in the absence of the project activity. According to applicable mandatory laws and regulations there is no obligation to capture and destroy/combust methane generated through the deposition of waste in landfills. This has been explained in more detail in section B.4. of the registered PDD.
Purpose of data	Baseline emissions
Additional comments	-

Data/parameter:	**CE**
Unit	-
Description	Collection efficiency of the degassing system which will be installed in the project activity
Source of data	U.S. EPA Landfill Methane Outreach Program (2007). Users Manual, Central America Landfill Gas Model, page 2-6. (www.epa.gov/lmop/index.html)
Value(s) applied)	65%
Choice of data or measurement methods and procedures	The collection efficiency has been estimated according to the guidelines provided in the Users Manual for the Central America Landfill Gas Model, Table 6, page 2-6.
Purpose of data	Baseline emissions
Additional comments	Used for ex ante estimation of baseline emissions.

Data/parameter:	**Φ**
Unit	-
Description	Model correction factor to account for model uncertainties
Source of data	See below
Value(s) applied)	0.9
Choice of data or measurement methods and procedures	Default value as proposed by the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”.
Purpose of data	Baseline emissions
Additional comments	Oonk et el. (1994) have validated several LFG models based on 17 realized LFG projects. The mean relative error of multi-phase models was assessed to be 18%. Given the uncertainties associated with the model and in order to estimate emission reductions in a conservative manner, a discount of 10% is applied to the model results.

Data/parameter:	**OX**
Unit	-
Description	Oxidation Factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste.)
Source of data	See below
Value(s) applied)	0.1
Choice of data or measurement methods and procedures	0.1 is to be used for managed solid waste disposal sites that are covered with oxidizing material such as soil or compost. For other solid waste disposal sites a value of 0 can be used. The Chiltepeque landfill where the waste would be disposed of in the absence of the project activity is covered with oxidizing material (clay); hence a value of 0.1 is applied.
Purpose of data	Baseline emissions
Additional comments	-

Data/parameter:	F
Unit	-
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas inventories
Value(s) applied)	0.5
Choice of data or measurement methods and procedures	Default value as proposed by the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”.
Purpose of data	Baseline emissions
Additional comments	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the SWDS. A default value of 0.5 is recommended by IPCC.

Data/parameter:	DOC_f
Unit	-
Description	Fraction of degradable organic carbon that can decompose.
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied)	0.5
Choice of data or measurement methods and procedures	Default value as proposed by the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”.
Purpose of data	Baseline emissions
Additional comments	-

Data/parameter:	MCF
Unit	-
Description	Methane correction factor
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value(s) applied)	1
Choice of data or measurement methods and procedures	The landfill site at Puebla where the waste would have been disposed of in the absence of the project activity is a managed landfill site with controlled placement of waste, with compaction and leveling and thus meets the criteria of a managed SWDS in the absence of the project activity. Hence a value of 1 is applied.
Purpose of data	Baseline emissions
Additional comments	The methane correction factor (MCF) accounts for the fact that unmanaged SWDS produce less methane from a given amount of waste than managed SWDS, because a larger fraction of waste decomposes aerobically in the top layers of unmanaged SWDS.

Data/parameter:	DOC_j
Unit	-
Description	Fraction of degradable organic carbon (by weight) in the waste type j
Source of data	IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Tables 2.4 and 2.5)

<table>
<tr><td>Value(s) applied)</td><td>
<table>
<tr><th>Type of Waste</th><th>DOCj
(% wet waste)</th></tr>
<tr><td>Wood and wood products</td><td>43</td></tr>
<tr><td>Pulp, paper and cardboard (other than sludge)</td><td>40</td></tr>
<tr><td>Food, food waste, beverages and tobacco (other than sludge)</td><td>15</td></tr>
<tr><td>Textiles</td><td>24</td></tr>
<tr><td>Garden, yard and park waste</td><td>20</td></tr>
<tr><td>Glass, plastic, metal, other inert waste</td><td>0</td></tr>
</table>
</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>Default value for wet waste has been used as proposed by the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”.</td></tr>
<tr><td>Purpose of data</td><td>Baseline emissions</td></tr>
<tr><td>Additional comments</td><td>-</td></tr>
</table>

<table>
<tr><td>Data/parameter:</td><td>K_j</td></tr>
<tr><td>Unit</td><td>-</td></tr>
<tr><td>Description</td><td>Decay rate for the waste type j</td></tr>
<tr><td>Source of data</td><td>IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3)</td></tr>
<tr><td>Value(s) applied)</td><td>
<table>
<tr><th colspan="2">Waste type</th><th>k</th></tr>
<tr><td>slowly degrading</td><td>Pulp, paper and cardboard, (other than sludge), textiles</td><td>0.06</td></tr>
<tr><td>slowly degrading</td><td>Wood, wood products and straw</td><td>0.03</td></tr>
<tr><td>moderately degrading</td><td>other (non food) organic putrescible garden and park waste</td><td>0.1</td></tr>
<tr><td>rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.185</td></tr>
</table>
</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>Puebla is located in a temperate region of Mexico with a mean annual temperature (MAT) of 16.2 °C (Source: www.worldclimate.com -> Puebla), i.e.< 20 °C. The mean annual precipitation (MAP) is 844 mm (Source: www.worldclimate.com -> Puebla). The annual potential evapotranspiration (PET) is 749.7 mm
(Source: Recursos hidrológicos del centro de México ante un cambio climático global (Hydrologic resources of the central part of Mexico in the view of a global climate change), page 44, Table 2. (Puebla is situated in the Balsas river basin)
http://www.atmosfera.unam.mx/editorial/libros/cambio_climatico/hidrologicos.pdf)
Thus, MAP>PET, which means a wet climate.</td></tr>
<tr><td>Purpose of data</td><td>Baseline emissions</td></tr>
<tr><td>Additional comments</td><td>-</td></tr>
</table>

Combined margin emission factor

Data/parameter:	**$FC_{i,m,y}$**
Unit	TJ/yr
Description	Amount of fossil fuel type i consumed in the project electricity system in year y (2005-2007)

Source of data	Official statistics from the Secretary of Energy, SENER (Prospectiva del Sector Eléctrico (Electricity Sector Outlook), 2006-2015, 2007-2016,2008-2017. (http://www.sener.gob.mx/webSener/portal/Default.aspx?id=1433)
Value(s) applied)	Values applied are provided in Annex 3 of the registered PDD.
Choice of data or measurement methods and procedures	Total fuel consumption is indicated by SENER in TJ/day per fuel type. This value is multiplied by 365 days to obtain the fuel consumption in TJ per year.
Purpose of data	Baseline emissions
Additional comments	No monitoring is needed as the total fuel consumption in the electricity system is used for the calculation of the operating margin emission factor which is determined ex ante.

Data/parameter:	**$EF_{CO2,i,y}$ and $EF_{CO2,m\ i,y}$**
Unit	tCO_2 /GJ
Description	CO_2 emission factor of fossil fuel type i in year y
Source of data	IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Value(s) applied)	**Fuel type i** / **Value** / **Unit**: Fuel oil: 0.0755 tCO_2/GJ Natural gas: 0.0543 tCO_2/GJ Diesel: 0.0726 tCO_2/GJ Coal: 0.0895 tCO_2/GJ
Choice of data or measurement methods and procedures	According to the “Tool to calculate the emission factor for an electricity system”, IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Purpose of data	Baseline emissions
Additional comments	No monitoring is needed as the emission factors for the fuel types indicated above are used for the calculation of the operating margin and the build margin, which are determined ex ante.

Data/parameter:	**EG_y and $EG_{m,y}$**
Unit	MWh
Description	Net electricity generated and delivered to the Interconnected National System (SIN) by power unit m in year y
Source of data	Official statistics from the Secretary of Energy, SENER (Prospectiva del Sector Eléctrico (Electricity Sector Outlook) 2008-2017. (http://www.sener.gob.mx/webSener/portal/Default.aspx?id=1433)
Value(s) applied)	Values applied are provided in Annex 3 in the registered PDD.
Choice of data or measurement methods and procedures	For EG_y (for the calculation of the operating margin emission factor) data for 2005-2007 is used. For $EG_{m,y}$ (for the calculation of the build margin emission factor) data for the year 2007 is used.
Purpose of data	Baseline emissions
Additional comments	No monitoring is needed as these values are used for the calculation of the operating margin and the build margin which are determined ex ante.

Data/parameter:	**$\eta_{m,y}$**
Unit	-
Description	Average net energy conversion efficiency of power unit m in year y

<table>
<tr><td>Source of data</td><td>Official statistics from the Secretary of Energy, SENER (Prospectiva del Sector Eléctrico (Electricity Sector Outlook) 2008-2017. (http://www.sener.gob.mx/webSener/portal/Default.aspx?id=1433)</td></tr>
<tr><td>Value(s) applied)</td><td><table><tr><th></th><th>Efficiency (%)</th></tr><tr><td>Natural gas (single cycle)</td><td>35.19%</td></tr><tr><td>Natural gas (combined cycle)</td><td>52.18%</td></tr><tr><td>Internal combustion</td><td>42.36%</td></tr></table></td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>The values applied are average values of a set of different values indicated by SENER for the year 2007 (Prospectiva del Sector Eléctrico (Electricity Sector Outlook) 2008-2017, page 168)</td></tr>
<tr><td>Purpose of data</td><td>Baseline emissions</td></tr>
<tr><td>Additional comments</td><td>No monitoring is needed as these values are used for the calculation of the build margin emission factor, which is determined ex-ante.</td></tr>
</table>

Data/parameter:	**$EF_{grid,CM,y}$.= $CEF_{elec,BL,y}$ = $EF_{EL,j,,y}$**
Unit	tCO_2/MWh
Description	Combined margin CO_2 emission factor for the project electricity system in year y
Source of data	Calculated ex-ante using the “Tool to calculate the emission factor for an electricity system”. The calculation is based on official data from the Secretary of Energy, SENER (Prospectiva del Sector Eléctrico (Electricity Sector Outlook) 2004-2013, 2005-2014, 2006-2015, 2007-2016, 2008-2017 (http://www.sener.gob.mx/webSener/portal/Default.aspx?id=1433)
Value(s) applied)	0.4864
Choice of data or measurement methods and procedures	Calculated according to the “Tool to calculate the emission factor for an electricity system”
Purpose of data	Baseline emissions
Additional comments	No monitoring is needed as the $EF_{grid,CM,y}$ is determined ex-ante

Project emissions from electricity consumption

Data/parameter:	**$TDL_{j,y}$**
Unit	-
Description	Average technical transmission and distribution losses for providing electricity to the project in year y
Source of data	Default value as per the “Tool to calculate baseline, project and/or leakage emission from electricity consumption”
Value(s) applied)	20%
Choice of data or measurement methods and procedures	Default value as per the “Tool to calculate baseline, project and/or leakage emission from electricity consumption”
Purpose of data	Project emissions
Additional comments	-

D.2. Data and parameters monitored

Data/parameter:	GWP_{CH4}
Unit	tCO_2e/tCH_4

Description	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
Measured/calculated/default	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
Source of data	IPCC Default value
Value(s) of monitored parameter	25
Monitoring equipment	N/A
Measuring/reading/recording frequency:	IPCC Default Value of Global Warming potential of Methane
Calculation method (if applicable):	N/A
QA/QC procedures:	N/A
Purpose of data:	Baseline emissions
Additional comments:	-

Data/parameter:	$\mathbf{LFG_{total,y}}$
Unit	m^3/h
Description	Total amount of LFG captured at Normal Temperature and Pressure
Measured/calculated/default	Measured
Source of data	On site measurements
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	Measured continuously by a flow meter.
Measuring/reading/recording frequency:	Measured values are averaged in a time interval not greater than hour and afterwards.
Calculation method (if applicable):	N/A
QA/QC procedures:	The flow meter will be subject to regular maintenance and will be calibrated periodically according to the manufacturer's recommendation.
Purpose of data:	Baseline emissions
Additional comments:	-

Data/parameter:	$\mathbf{LFG_{flare,y}}$
Unit	m^3/h
Description	Total amount of LFG flared at Normal Temperature and Pressure
Measured/calculated/default	Measured
Source of data	On site measurements
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	Measured continuously by a flow meter.
Measuring/reading/recording frequency:	Measured values are averaged in a time interval not greater than hour and afterwards.
Calculation method (if applicable):	N/A
QA/QC procedures:	The flow meter will be subject to regular maintenance and will be calibrated periodically according to the manufacturer's recommendation.
Purpose of data:	Baseline emissions

Additional comments:	-

Data/parameter:	**$LFG_{electricity,y}$**
Unit	m^3/h
Description	Amount of LFG combusted in power plant at Normal Temperature and Pressure
Measured/calculated/default	Measured
Source of data	On site measurements
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	Measured continuously by a flow meter.
Measuring/reading/recording frequency:	Measured values are averaged in a time interval not greater than hour and afterwards.
Calculation method (if applicable):	N/A
QA/QC procedures:	The flow meter will be subject to regular maintenance and will be calibrated periodically according to the manufacturer's recommendation.
Purpose of data:	Baseline emissions
Additional comments:	-

Data/parameter:	**$w_{CH4,y}$**
Unit	M^3CH_4/m^3LFG
Description	Methane fraction in the LFG
Measured/calculated/default	Measured
Source of data	Measured continuously by project participants using certified equipment
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	Certified gas analyzer.
Measuring/reading/recording frequency:	Measured values are averaged hourly.
Calculation method (if applicable):	Measured continuously with a gas quality analyzer.
QA/QC procedures:	The gas analyzer will be calibrated periodically according to the manufacturer's recommendation. A zero check and a typical value check will be performed by comparison with a standard certified gas.
Purpose of data:	Baseline emissions
Additional comments:	-

Data/parameter:	**T**
Unit	ºC
Description	Temperature of the landfill gas
Measured/calculated/default	Measured
Source of data	Measurements by the project participants
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls

Monitoring equipment	Measured to determine the density of methane. No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing the LFG volumes in normalized cubic meters.
Measuring/reading/recording frequency:	Continuous measurement.
Calculation method (if applicable):	N/A
QA/QC procedures:	Measuring instruments should be subject to a regular maintenance and testing regime in accordance to the appropriate national/international standards.
Purpose of data:	Baseline emissions
Additional comments:	-

Data/parameter:	**P**
Unit	Pa
Description	Pressure of the landfill gas
Measured/calculated/default	Measured
Source of data	Measurements by the project participants
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	Measured to determine the density of methane. No separate monitoring of pressure is necessary when using flow meters that automatically measure temperature and pressure, expressing the LFG volumes in normalized cubic meters.
Measuring/reading/recording frequency:	Continuous measurement.
Calculation method (if applicable):	N/A
QA/QC procedures:	Measuring instruments should be subject to a regular maintenance and testing regime in accordance to the appropriate national/international standards.
Purpose of data:	Baseline emissions
Additional comments:	-

Data/parameter:	$\mathbf{EL_{LFG,y}}$
Unit	MWh
Description	Net amount of electricity generated from LFG in year y
Measured/calculated/default	Measured
Source of data	Measurements by the project participant
Value(s) of monitored parameter	0
Monitoring equipment	Electricity meter
Measuring/reading/recording frequency:	Continuous measurement with an electricity meter.
Calculation method (if applicable):	N/A
QA/QC procedures:	The electricity meter will be subject to regular maintenance and testing as recommended by the manufacturer to ensure accuracy.
Purpose of data:	Baseline emissions
Additional comments:	-

Data/parameter:	Operation of the energy plant
Unit	Hours
Description	Operation of the energy plant
Measured/calculated/default	Measured
Source of data	Project participants measurements
Value(s) of monitored parameter	0
Monitoring equipment	Generators data
Measuring/reading/recording frequency:	Annually
Calculation method (if applicable):	N/A
QA/QC procedures:	Software verification
Purpose of data:	Baseline emissions
Additional comments:	This is monitored to ensure methane destruction is claimed for methane used in electricity plant when it is operational.

Project emissions from electricity consumption

Data/parameter:	$PE_{EC,y}$
Unit	tCO_2e
Description	Project emissions from electricity consumption by the project activity during the year y
Measured/calculated/default	Calculated
Source of data	Electricity meters readings
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	Electricity meters
Measuring/reading/recording frequency:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Calculation method (if applicable):	Calculated as per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
QA/QC procedures:	As per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”
Purpose of data:	Project emissions
Additional comments:	-

Data/parameter:	$EC_{PJ,j,y}$
Unit	MWh
Description	Total quantity of electricity consumed by the project activity during year y
Measured/calculated/default	Measured
Source of data	Measurements by the electricity supplier
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	Electricity meters
Measuring/reading/recording frequency:	Continuous measurement with an electricity meter.
Calculation method (if applicable):	N/A

QA/QC procedures:	As recommended by the manufacturer
Purpose of data:	Project emissions
Additional comments:	Once electricity is generated onsite with LFG, $EC_{PJ,j,y}$ is already considered in the net amount of electricity generated using LFG ($EL_{LFG,y}$). Prior to any electricity generation on-site from LFG, electricity demand on-site is assumed to be covered by a diesel generator. These emissions are included in the project emissions as emissions from fossil fuel consumption. In case, electricity needed to be purchased from the Interconnected National System (SIN) for any reason, the electricity consumption would be measured by the electricity supplier, and the electricity consumption values indicated in the invoices from the electricity provider would be used to calculate the emission from electricity consumption.

Project emissions from fuel consumption

Data/parameter:	**$PE_{FC,j,y}$**
Unit	tCO_2e
Description	Project emissions from fossil fuel combustion in process j during the year y
Measured/calculated/default	Calculated
Source of data	Calculated as per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	Refer to below parameters
Measuring/reading/recording frequency:	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Calculation method (if applicable):	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
QA/QC procedures:	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Purpose of data:	Project emissions
Additional comments:	-

Data/parameter:	**$FC_{i,j,y}$**
Unit	m^3/yr
Description	Quantity of fuel type i combusted in process j during the year y.
Measured/calculated/default	Measured
Source of data	On site measurements
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	- Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift) - Accessories such as transducers, sonar and piezoelectronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; - In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions.
Measuring/reading/recording frequency:	Continuously

Calculation method (if applicable):	N/A
QA/QC procedures:	The consistency of metered fuel consumption quantities should be crosschecked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross checked with available purchase invoices from the financial records.
Purpose of data:	Project emissions
Additional comments:	-

Data/parameter:	**$EF_{CO2,i,y} = EF_{CO2,diesel,y}$**
Unit	tCO_2/Gj
Description	CO_2 emission factor of fuel type I (diesel) in year y
Measured/calculated/default	Default
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol. 2, Chapter 1, Table 1.4, upper value
Value(s) of monitored parameter	0.0748 Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	N/A
Measuring/reading/recording frequency:	Any future revisions of the IPCC Guidelines will be taken into account.
Calculation method (if applicable):	N/A
QA/QC procedures:	The IPCC default value is used since no data from the fuel provider is available.
Purpose of data:	Project emissions
Additional comments:	-

Data/parameter:	**$NCV_{i,y} = NCV_{diesel,y}$**
Unit	GJ/t
Description	Net Calorific Value of fossil fuel type i (diesel) in year y
Measured/calculated/default	Default
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol. 2, Chapter 1, Table 1.4, upper value
Value(s) of monitored parameter	43.3 Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	N/A
Measuring/reading/recording frequency:	Any future revisions of the IPCC Guidelines will be taken into account.
Calculation method (if applicable):	N/A
QA/QC procedures:	The IPCC default value is used since no data from the fuel provider is available.
Purpose of data:	Project emissions
Additional comments:	-

Data/parameter:	**$\rho_{i,y} = \rho_{diesel,y}$**
Unit	t/m^3

Description	Density of fuel type i (diesel) in year y
Measured/calculated/default	Default
Source of data	Density of diesel in Mexico as indicated by the National Commission for an Efficient Use of Energy
Value(s) of monitored parameter	0.865 Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	N/A
Measuring/reading/recording frequency:	
Calculation method (if applicable):	N/A
QA/QC procedures:	The density of diesel in Mexico as indicated by the National Commission for an Efficient Use of Energy as density values from the diesel provider are not available. http://www.conae.gob.mx/wb/CONAE/CONA_694_a2_tablas_y_figura?page=2
Purpose of data:	Project emissions
Additional comments:	-

Project emissions from flaring

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	As per the "Tool to determine project emissions from flaring gases containing methane"
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	Refer to parameters below
Measuring/reading/recording frequency:	As per the "Tool to determine project emissions from flaring gases containing methane"
Calculation method (if applicable):	As per the "Tool to determine project emissions from flaring gases containing methane"
QA/QC procedures:	As per the "Tool to determine project emissions from flaring gases containing methane"
Purpose of data:	Project emissions
Additional comments:	.

Data/parameter:	**$Fv_{i,h}$**
Unit	-
Description	Volumetric fraction of component i in the residual gas in the hour h where i = CH4
Measured/calculated/default	Measured
Source of data	Measurements by project participants using a continuous gas analyzer
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	Gas Analyzer
Measuring/reading/recording frequency:	Measured continuously with a gas analyzer. Measured values are averaged hourly.

Calculation method (if applicable):	N/A
QA/QC procedures:	The gas analyzer will be calibrated periodically according to the manufacturer's recommendation. A zero check and a typical value check will be performed by comparison with a standard certified gas.
Purpose of data:	Project emissions
Additional comments:	Only the methane content of the residual gas is measured and the remaining part is considered as N_2. The same basis (dry or wet) has to be considered for this measurement and the measurement of the volumetric flow rate of the residual gas ($FV_{RG,h}$) when the residual gas temperature exceeds 60 °C.

Data/parameter:	**$FV_{RG,h}$**
Unit	m^3/h
Description	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h
Measured/calculated/default	Measured
Source of data	Measurements by project participants using a continuous flow meter
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	Measured continuously with a flow meter.
Measuring/reading/recording frequency:	Measured values are averaged hourly or at a shorter time interval.
Calculation method (if applicable):	N/A
QA/QC procedures:	The flow meter will be calibrated periodically according to the manufacturer's recommendation. .
Purpose of data:	Project emissions
Additional comments:	The same basis (dry or wet) has to be considered for this measurement and the measurement of the volumetric flow rate of the residual gas ($fv_{i,h}$) when the residual gas temperature exceeds 60 °C.

Data/parameter:	**$t_{O2,h}$**
Unit	-
Description	Volumetric fraction of O_2 in the exhaust gas of the flare in the hour h
Measured/calculated/default	Measured
Source of data	Measurements by project participants using a continuous gas analyzer
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	Gas analyzer
Measuring/reading/recording frequency:	Measured continuously with a gas analyzer. Measured values are averaged hourly.
Calculation method (if applicable):	Measurement procedure: Extractive-sampling analyzers with water and particulates removal devices or in situ analyzers for wet basis determination. The point of measurement shall be in the upper section of the flare (80% of total flare height). Sampling shall be conducted with appropriate sampling probes adequate to high temperature levels. An excessively high temperature at the sampling point (above 700 °C) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow.

QA/QC procedures:	The gas analyzer will be calibrated periodically according to the manufacturer's recommendation. A zero check and a typical value check will be performed by comparison with a standard certified gas.
Purpose of data:	Project emissions
Additional comments:	-

Data/parameter:	$fv_{CH4,FG,h}$
Unit	mg/m^3
Description	Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour h
Measured/calculated/default	Measured
Source of data	Measurements by project participants using a continuous gas analyzer
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	Measured continuously with a gas analyzer.
Measuring/reading/recording frequency:	Measured values are averaged hourly.
Calculation method (if applicable):	Measurement method: Extractive-sampling analyzers with water and particulates removal devices or in situ analyzers for wet basis determination. The point of measurement shall be in the upper section of the flare (80% of total flare height). Sampling shall be conducted with appropriate sampling probes adequate to high temperature levels. An excessively high temperature at the sampling point (above 700 °C) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow.
QA/QC procedures:	The gas analyzer will be calibrated periodically according to the manufacturer's recommendation. A zero check and a typical value check will be performed by comparison with a standard certified gas.
Purpose of data:	Project emissions
Additional comments:	Measurement instruments may read ppmv or % values. To convert from ppmv to mg/m^3 simply multiply by 0.716. 1% equals 10 000 ppmv.

Data/parameter:	T_{flare}
Unit	ºC
Description	Temperature in the exhaust gas of the flare
Measured/calculated/default	Measured
Source of data	Measurements by project participants
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	Thermocouple.
Measuring/reading/recording frequency:	Measured continuously by a thermocouple.
Calculation method (if applicable):	Measurement method: A temperature above 500 °C indicates that a significant amount of gases are still being burnt and that the flare is operating.
QA/QC procedures:	Thermocouples will be replaced or calibrated as per the manufacturer's recommendations every year.
Purpose of data:	Project emissions
Additional comments:	An excessively high temperature at the sampling point (above 700 ºC) may be an indication that the flare is not being adequately operated or that its capacity is not adequate to the actual flow.

Data/parameter:	$\eta_{flare,h}$
Unit	-
Description	Flare efficiency in hour h
Measured/calculated/default	Calculated
Source of data	Calculation
Value(s) of monitored parameter	Refer to ERs Ver. 1 15_06_15 Puebla Landfill Gas to Energy project.xls
Monitoring equipment	N/A
Measuring/reading/recording frequency:	Continuously
Calculation method (if applicable):	In case of enclosed flares and continuous monitoring of the flare efficiency, the flare efficiency in the hour h ($\eta_{flare,h}$) is: • 0% if the temperature of the exhaust gas of the flare (T_{flare}) is below 500 °C during more than 20 minutes during the hour h. • Determined according to equation 31 in cases where the temperature of the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour h.
QA/QC procedures:	N/A
Purpose of data:	Project emissions
Additional comments:	-

D.3. Implementation of sampling plan

>>

Not applicable.

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

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

>>

$$BE_y = (MD_{project,y} - MD_{BL,y}) * GWP_{CH4} + EL_{LFG,y} * CEF_{elec,BL,y} + ET_{LFG,y} * CEF_{ther,BL,y} \quad (1)$$

Where,

BE_y	=	Baseline emissions in year y (tCO_2e)
$MD_{project,y}$	=	The amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (tCH_4) in project scenario
$MD_{BL,y}$	=	The amount of methane that would have been destroyed/combusted during the year in the absence of the project due to regulatory and/or contractual requirement, in tonnes of methane (tCH_4)
GWP_{CH4}	=	Global Warming Potential value for methane for the first commitment period is 25 tCO_2e/tCH_4
$EL_{LFG,y}$	=	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, in megawatt hours (MWh).
$CEF_{elec,BL,y}$	=	CO_2 emissions intensity of the baseline source of electricity displaced, in tCO_2e/MWh.

$ET_{LFG,y}$	=	The quantity of thermal energy produced utilizing the LFG, which in the absence of the project activity would have been produced from onsite/offsite fossil fuel fired boiler, during the year y in TJ.
$CEF_{ther,BL,y}$	=	CO_2 emissions intensity of the fuel used by boiler/air heater to generate thermal energy, which is displaced by LFG based thermal energy generation, in tCO_2e/TJ.

Since the project activity does not include any thermal energy production, $ET_{LFG,y}$ is 0. The formula for the calculation of the baseline emissions is therefore reduced to the following equation:

$$BE_y = (MD_{project,y} - MD_{BL,y}) * GWP_{CH4} + EL_{LFG,y} * CEF_{elec,BL,y} \quad (2)$$

$$\mathbf{MD_{BL,y} = MD_{project,y} * AF} \quad (3)$$

Since in the baseline scenario no landfill gas is destroyed/combusted, the adjustment factor, AF, is 0 in this project.

$MD_{project,y}$ will be determined ex post by monitoring the actual quantity of methane captured and destroyed once the project activity is operational.

The methane destroyed by the project activity ($MD_{project,y}$) during a year is determined by monitoring the quantity of methane actually flared and gas used to generate electricity and/or produce thermal energy and/or supply to end users via natural gas distribution pipeline, if applicable, and the total quantity of methane captured.

The sum of the quantities fed to the flare(s), to the power plant(s), to the boiler(s) and to the natural gas distribution network must be compared annually with the total quantity of methane generated. The lowest value of the two must be adopted as $MD_{project,y}$."

In case the total amount of methane generated is the highest value, $MD_{project,y}$ is given by:

$$\mathbf{MD_{project,y} = MD_{flared,y} + MD_{electricity,y} + MD_{thermal,y} + MD_{PL,y}} \quad (4)$$

Where,

$MD_{flared,y}$	=	Quantity of methane destroyed by flaring (tCH_4)
$MD_{electricity,y}$	=	Quantity of methane destroyed by generation of electricity (tCH_4)
$MD_{thermal,y}$	=	Quantity of methane destroyed for the generation of thermal energy (tCH_4)
$MD_{PL,y}$	=	Quantity of methane sent to the pipeline for feeding to the natural gas distribution network (tCH_4)

Since the project activity does not include thermal energy generation and feeding of methane to a natural gas distribution network, the components, $MD_{thermal,y}$ and $MD_{PL,y}$ in equation 4 become 0. Equation 4 is thus reduced to:

$$\mathbf{MD_{project,y} = MD_{flared,y} + MD_{electricity,y}} \quad (5)$$

As per the methodology, the quantity of methane destroyed by flaring is calculated as follows:

$$MD_{flared,y} = \{LFG_{flare,y} * w_{CH4,y} * D_{CH4}) - (PE_{flare,y}/GWP_{CH4}) \quad (6)$$

Where:

$LFG_{flare,y}$	=	Quantity of LFG fed to the flare(s) during the year measured in cubic meters (m^3)
$w_{CH4,y}$	=	Average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m^3 CH_4 / m^3 LFG)
D_{CH4}	=	Methane density expressed in tonnes of methane per cubic meter of methane (t CH_4/m^3CH_4)
$PE_{flare,y}$	=	Project emissions from flaring of the residual gas stream in year y (t CO_2e) determined following the procedure described in the "Tool to determine project emissions from flaring gases containing methane". If methane is flared through more than one flare, the $PE_{flare,y}$ shall be determined for each flare using the tool. The project will use an enclosed flaring system and monitoring will be done continuously.

$$MD_{electricity,y} = LFG_{electricity,y} * w_{CH4,y} * D_{CH4} \quad (7)$$

Where,

$MD_{electricity,y}$	=	Quantity of methane destroyed by generation of electricity
$LFG_{electricity,y}$	=	Quantity of LFG fed into electricity generator.

Ex-ante estimation of the amount of methane that would have been destroyed/combusted during the year, in tonnes of methane ($MD_{project,y)}$

The ex-ante estimation of the amount of methane that would have been destroyed/combusted during the year, in tonnes of methane ($MD_{project,y}$) will be done with the latest version of the approved "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site", considering the following additional equation:

$$MD_{project,y} = BE_{CH4,SWDS,y}/GWP_{CH4} \quad (8)$$

Where,

$BE_{CH4,SWDS,y}$	=	Methane generation from the landfill in the absence of the project activity at year y (tCO_2e), calculated as per the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site". The tool estimates methane generation adjusted for, using adjustment factor (f), any LFG in the baseline that would have been captured and destroyed to comply with relevant regulations or contractual requirements, or to address safety and odor concerns. As this is already accounted for in equation 3, "f" in the tool shall be assigned a value 0.

Furthermore, according to the methodology ACM0001, the following guidance should be taken into account:

- In the tool x will refer to the year since the landfill started receiving wastes (x runs from the first year of landfill operation (x=1) to the year for which the emission are calculated (x=y);
- Sampling to determine the different waste types is not necessary, the waste composition can be obtained from previous studies.

The methodology ACM0001 also indicates that the efficiency of the degassing system, which will be installed in the project activity should be taken into consideration while estimating the ex ante estimation. This is taken into consideration by the application of a LFG collection efficiency (CE) of 65% to the methane generation in year y ($BE_{CH4,SWDS,y}$).

Note: the same term $MD_{project,y}$ is used for the ex-post measurement of methane destruction as in Equations (4) and (5) as well as for the ex-ante estimation of methane destruction using Equation (8). In fact, Equation (8) refers to the ex-ante estimation of methane captured without taking into account the methane destruction efficiency of the flare. Since the amount of methane flared depends on other uses of methane, the ex-ante estimation for this project activity starts from an estimate of methane captured using Equation (8) and considering the collection efficiency (CE), then estimates how much of the methane is used for power generation, with the remainder going to the flare. Finally, the methane destruction efficiency of the flare is taken into consideration in determining the methane destruction in the project scenario.

As per the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site”, the amount of methane generated in the year y ($BE_{CH4,SWDS,y}$) is calculated as follows:

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX)\frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y}\sum_{j} W_{j,x} \cdot DOC_j \cdot (1-e^{-k_j}) \cdot e^{-k_j \cdot (y-x)} \qquad \textbf{(9)}$$

Where:

$BE_{CH4,SWDS,y}$	=	Methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site (SWDS) during the period from the start of the project activity to the end of the year y (tCO_2e)[9]
φ	=	Model correction factor to account for model uncertainties (0.9)
f	=	Fraction of methane captured at the SWDS and flared, combusted or used in another manner (0)
GWP_{CH4}	=	Global Warming Potential value for methane for the first commitment period is 25 tCO_2e/tCH_4
OX	=	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
F	=	Fraction of methane in the SWDS gas (volume fraction) (0.5)
DOC_f	=	Fraction of degradable organic carbon (DOC) that can decompose
MCF	=	Methane correction factor
$W_{j,x}$	=	Amount of organic waste type j prevented from disposal in the SWDS in the year x (tons).
DOC_j	=	Fraction of degradable organic carbon (by weight) in the waste type j
k_j	=	Decay rate for the waste type j
J	=	Waste type category (index)
		Year since the landfill started receiving wastes (x runs from the first year of

[9] Note: Methane emissions avoided during the year y from preventing waste disposal at the solid waste disposal site (SWDS) means in this case, as explained above, methane generated from the landfill in the absence of the Project activity.

x	=	landfill operation (x=1) to the year for which the emission are calculated (x=y)
y	=	Year for which methane emissions are calculated

Determination of $CEF_{elec,BL,y}$

In the baseline, electricity is generated by plants connected to the Interconnected National System (SIN). The emission factor is therefore calculated by using the "Tool to calculate the emission factor for an electricity system"

According to the "Tool to calculate the emission factor for an electricity system", CEF is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and built margin (BM) factor by applying the following steps:

STEP 1. Identify the relevant electricity systems.
STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional).
STEP 3. Select a method to determine the operating margin (OM).
STEP 4. Calculate the operating margin emission factor according to the selected method.
STEP 5. Calculate the build margin (BM) emission factor.
STEP 6. Calculate the combined margin (CM) emissions factor.

$CEF_{elec,BL,y}$ corresponds to $EF_{grid,CM,y}$ in the "Tool to calculate the emission factor for an electricity system".

Step 1: Identify the relevant electricity systems

The grid emission factor is calculated based on the last version of the "Electricity Sector Outlook" developed by the Mexican Secretary of Energy (SENER) (2008-2017).

The relevant power system is the one where the landfill is located, and comprises the Interconnected National System (SIN), which covers all of Mexico, except Baja California and Baja California South, each of which has an isolated system, not connected to the Interconnected National System (SIN), or to each other.

For imports from a connected electricity system, the emission factor is 0 tCO_2/MWh.

Electricity exports are not subtracted from the electricity generation data used for calculating and monitoring the electricity emission factors.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

Option I is chosen: only grid power plants are included in the calculation.

Step 3: Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor (EFgrid,OM,y) is based on one of the following methods:

(a) Simple OM; or
(b) Simple adjusted OM; or
(c) Dispatch data analysis OM; or
(d) Average OM.

Option (a), simple OM is chosen for the calculation of the operating margin emission factor.

The simple OM method (option a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

In Mexico electricity generation is dominated by thermal power plants. Low-cost/must-run resources constitute less than 50% of total grid generation. Table 10 shows the average of the five most recent years:

	2003	2004	2005	2006	2007
Share of low-cost/must-run	18%	20%	21%	21%	19%
Average share of low-cost/must-run					**20%**

Table No. 3 – Share of low cost/must run resources

The tool provides for ex-ante or ex-post calculation of the operating margin. The ex ante option is selected which means that the operating margin emission factor is calculated ex-ante based on a 3-year generation weighted average.

Step 4: Calculate the operating margin emission factor according to the selected method.

(a) Simple OM

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units.

The simple OM may be calculated:

Option A: Based on the net electricity generation and a CO2 emission factor of each power unit; or

Option B: Based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

In this case Option B is chosen given that the necessary data for Option A is not available.

With Option B, the simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, not including low-cost/must-run power plants/units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OMsimple,y} = \frac{\sum_i (FC_{i,y} * NCV_{i,y} * EF_{CO2,i,y})}{EG_y} \quad \textbf{(10)}$$

Where:

$EF_{grid,OMsimple,y}$	=	Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)
$FC_{i,y}$	=	Amount of fossil fuel type i consumed in the project electricity system in year y (mass or volume unit)
$NCV_{i,y}$	=	Net calorific value (energy content) of fossil fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$	=	CO_2 emission factor of fossil fuel type i in year y (tCO_2/GJ)
EG_y	=	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost/must-run power plants/units, in year y (MWh)
i	=	All fossil fuel types combusted in power sources in the project electricity system in year y
y	=	The relevant year as per the data vintage chosen in Step 3

Step 5: Calculate the build margin (BM) emission factor

For the calculation of the build margin (BM) emission factor the tool provides for ex ante and ex post calculation. Option 1 ex ante calculation has been chosen.

The sample group of power units m used to calculate the build margin is determined as follows:

(a) Identify the set of five power units, excluding power units registered as CDM project activities that started to supply electricity to the grid most recently ($SET_{5\text{-units}}$) and determine their annual electricity generation ($AEG_{SET\text{-}5\text{-units}}$, in MWh);

(b) Determine the annual electricity generation of the project electricity system, excluding power units registered as CDM project activities (AEG_{total}, in MWh). Identify the set of power units, excluding power units registered as CDM project activities, that started to supply electricity to the grid most recently and that comprise 20% of AEG_{total} (if 20% falls on part of the generation of a unit, the generation of that unit is fully included in the calculation) ($SET_{\geq 20\%}$) and determine their annual electricity generation ($AEG_{SET\text{-}\geq 20\%}$ in MWh).

(c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger annual electricity generation (SET_{sample})

For Mexico, the set of power capacity addition in the electricity system that comprise 20% of the system generation ($SET_{\geq 20\%}$) comprise a larger annual generation than the set of five power plants that have been built most recently ($SET_{5\text{-units}}$). SET_{sample} thus corresponds to the $SET_{\geq 20\%}$. The oldest power unit included in the $SET_{\geq 20\%}$ started to supply electricity to the grid in the year 2003 (see Annex 3, Table 30).

Therefore, none of the power units in SET_{sample} started to supply electricity to the grid more than 10 years ago SET_{sample} is therefore used to calculate the build margin.

The build margin emission factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} * EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (11)$$

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year y (tCO_2/MWh)
$EG_{m,y}$	=	Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)
$EF_{EL,m,y}$	=	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
m	=	Power units included in the build margin
y	=	Most recent historical year for which power generation data is available.

The CO_2 emission factor of each power unit m ($EF_{EL,BM,y}$) is determined using either option A1, A2 or A3 provided in the tool for the calculation of the simple OM emission factor. Option A2 has been chosen.

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} * 3.6}{\eta_{m,y}} \quad (12)$$

Where:

$EF_{EL,m,y}$	=	CO_2 emission factor of power unit m in year y (tCO_2/MWh)
$EF_{CO2,m,i,y}$	=	Average CO_2 emission factor of fuel type i used in power unit m in year y (tCO_2/GJ)
$\eta_{m,y}$	=	Average net energy conversion efficiency of power unit m in year y (ratio)
m	=	All power units serving the grid in year y except low- cost / must – run power units
i	=	All fossil fuel types combusted in power unit m in year y
y	=	The relevant year as per the vintage chosen in Step 5.

Step 6: Calculate the combined margin emission factor

The tool provides for the following methods for the calculation of the combined margin (CM) emission factor ($EF_{grid,CM,y}$):

(a) Weighted average CM; or
(b) Simplified CM.

Option (a), the weighted average CM, has been chosen.

With Option (a), the combined margin emission factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * w_{OM} + EF_{grid,BM,y} * w_{BM} \quad (13)$$

Where:

$EF_{grid,BM,y}$	=	Build margin CO_2 emission factor in year y ($t\ CO_2/MWh$)
$EF_{grid,OM,y}$	=	Operating margin CO_2 emission factor in year y ($t\ CO_2/MWh$)
w_{OM}	=	Weighting of operating margin emission factor (%)
w_{BM}	=	Weighting of build margin emission factor (%)

The following weightings are applied: $w_{OM} = w_{BM} = 0.5$

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

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Project Emissions:

According to ACM0001, the project emissions PE_y are calculated using the following equation:

$$PE_y = PE_{EC,y} + PE_{FC,j,y} \quad (14)$$

Where:

$PE_{EC,y}$	=	Emissions from consumption of electricity in the project case. The project emissions from electricity consumption ($PE_{EC,y}$) will be calculated following the latest version of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.
$PE_{FC,j,y}$	=	Emissions from consumption of heat in the project case. The project emissions from fossil fuel combustion ($PE_{FC,j,y}$) will be calculated following the latest version of the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”. For this purpose, the process j in the tool corresponds to all fossil fuel combustion in the landfill, as well as any other on-site fuel combustion for the purposes of the project activity.

Project Emissions from electricity consumption ($PE_{EC,y}$)

The electricity consumed by the project activity is bought from the Interconnected National System (SIN). Hence, scenario A: “Electricity consumption from the grid”, as provided in the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”, is used to determine the project emissions from electricity consumption.

$$PE_{EC,y} = \Sigma_j EC_{PJ,j,y} * EF_{EL,j,,y} *(1+TDL_{j,y}) \quad (15)$$

Where:

$PE_{EC,y}$	=	Project emissions from electricity consumption in year y (tCO_2/yr)
$EC_{PJ,j,y}$	=	Quantity of electricity consumed by the project in year y (MWh/yr)
$EF_{EF,j,y}$	=	Emission factor for the grid electricity generation (tCO_2/MWh)
$TDL_{j,y}$	=	Average technical transmission and distribution losses for providing electricity to the project in year y

Emissions from electricity consumption are only calculated in case electricity is bought from the Interconnected National System (SIN) and no electricity is generated onsite from LFG. When electricity is generated from the captured LFG (phase 2), electricity consumption by the project activity is already considered in the net electricity export to the Interconnected National System (SIN) ($EL_{LFG,y}$) which is the electricity generated minus the electricity consumed by the project activity.

For the determination of the emission factor ($EF_{EL,j,y}$) for the grid electricity generation, Option A1 has been chosen, where the emission factor is determined by applying the “Tool to calculate the emission factor for an electricity system”. The calculation steps are the same as outlined above for $CEF_{elec,BL,y}$, with $EF_{EL,j,y} = EF_{grid,CM,y}$.

Project Emissions from onsite fuel consumption ($PE_{FC,\ j,y}$)

Project emissions from fossil fuel combustion ($PE_{FC,j,y}$) in the project are determined using the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion", as follows:

$$PE_{FC,\ j,\ y} = \Sigma_i\ FC_{i,\ j,\ y} * COEF_{i,\ y} \qquad (16)$$

Where:

$PE_{FC,\ j,\ y}$	=	CO_2 emissions due to on-site fuel consumption in the year y (tCO_2)
$FC_{i,\ j,\ ,y}$	=	Quantity of fuel type i combusted in process j during the year y (mass or volume unit/yr)
$COEF_{i,\ y}$	=	CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit)
i	=	Fuel type combusted in process j during the year y

The CO_2 emission coefficient COEFi,y is determined using Option B given in *"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"* since the necessary data for Option A is not available.

$$COEF_{i,y} = NCV_{i,y} * EF_{CO2,i,y} \qquad (17)$$

Where:

$COEF_{i,y}$	=	CO_2 emission coefficient of fuel type i in year y (tCO_2/mass or volume unit)
$NCV_{i,y}$	=	Weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$	=	Weighted average CO_2 emission factor of fuel type i in year y (tCO_2/GJ)
I	=	Fuel type combusted in process j during the year y

Project emissions from flaring ($PE_{flare,y}$)

According to ACM0001, the project emissions from flaring are considered as $PE_{flare,y}$ in the calculation of $MD_{Project}$. $PE_{flare,y}$ is calculated following the procedure described in the "Tool to determine project emissions from flaring gases containing methane". If methane is flared through more than one flare, the $PE_{flare,y}$ shall be determined for each flare using the tool.

The project will use an enclosed flaring system. According to the tool, there are two options for determining the efficiency of enclosed flares:

a) To use a 90% default value continuous monitoring of compliance with the manufacturer's specification of flare (temperature, flow rate of residual gas at the inlet of the flare) must be performed. If in a specific hour any of the parameters are out of the limit of manufacturer's specifications, a 50% default value for the flare efficiency should be used for the calculations of this specific hour.

b) Continuous monitoring of the methane destruction efficiency of the flare (flare efficiency).

The second option, "continuous monitoring of the methane destruction efficiency of the flare (flare efficiency)" is used to determine the flare efficiency.

According to the “Tool to determine project emissions from flaring gases containing methane” the temperature in the exhaust gas of enclosed flares is measured to determine whether the flare is operating or not. If there is no record of the temperature of the exhaust gas of the flare or if the recorded temperature is less than 500 °C for any particular hour, it shall be assumed that during that hour the flare efficiency is zero.

For the calculation of the flare efficiency, the seven steps described in the “Tool to determine project emissions from flaring gases containing methane” are followed.

Step 1: Determination of the mass flow rate of the residual gas that is flared

Calculate the residual gas mass flow rate in each hour h, based on the volumetric flow rate and the density of the residual gas. The density of the residual gas is determined based on the volumetric fraction of all components in the gas.

$$FM_{RG,h} = \rho_{RG,n,h} * FV_{RG,h} \quad (18)$$

Where:

Parameter	SI Unit	Description
$FM_{RG,h}$	Kg/h	Mass flow rate of the residual gas in hour h
$\rho_{RG,n,h}$	Kg/m^3	Density of the residual gas at normal conditions in hour h
$FV_{RG,h}$	m^3/h	Volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h

And,

$$\rho_{RG,n,h} = \frac{P_n}{\frac{R_u}{MM_{RG,h}} \times T_n} \quad (19)$$

Where:

Parameter	SI Unit	Description
$\rho_{RG,n,h}$	kg/m^3	Density of the residual gas at normal conditions in hour h
P_n	Pa	Atmospheric pressure at normal conditions (101,325)
R_u	Pa.m^3/kmol.K	Universal ideal gas constant (8,314)
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour h
T_n	K	Temperature at normal conditions (273.15)

And,

$$MM_{RG,h} = \sum_i (fv_{i,h} * MM_i) \quad (20)$$

Where:

Parameter	SI Unit	Description
$MM_{RG,h}$	kg/kmol	Molecular mass of the residual gas in hour h

$fv_{i,h}$	-	Volumetric fraction of component i in the residual gas in the hour h
MM_i	kg/kmol	Molecular mass of residual gas component i
I		The components CH_4, CO, CO_2, O_2, H_2, N_2

According to the tool, project participants may only measure the volumetric fraction of methane and consider the difference to 100% as being nitrogen (N2). This simplified approach will be applied to this project activity.

Step 2: Determination of the mass fraction of carbon, hydrogen, oxygen and nitrogen in the residual gas

Determine the mass fractions of carbon, hydrogen, oxygen, and nitrogen in the residual gas, calculated from the volumetric fraction of each component i in the residual gas, as follows:

$$fm_{j,h} = \frac{\sum_i fv_{i,h} \cdot AM_j \cdot NA_{j,i}}{MM_{RG,h}} \quad (21)$$

Where:

Parameter	SI Unit	Description
$fm_{i,h}$	-	Mass fraction of element j in the residual gas in hour h
$fv_{i,h}$	-	Volumetric fraction of component i in the residual gas in the hour h
AMi	Kg/kmol	Atomic Mass of element j
$NA_{j,i}$	-	Number of atoms of element j in component i
j	-	The elements carbon, hydrogen, oxygen, and nitrogen. With the simplified approach, only methane is measured and the balance assumed to be nitrogen
i	-	The components CH_4 and N_2 (simplified approach)

Step 3: Determination of the volumetric flow rate of the exhaust gas on a dry basis

This step is applicable because the methane combustion efficiency of the flare will be measure continuously. Determine the average volumetric flow rate of the exhaust gas in each hour h based on a stoichiometric calculation of the combustion process, which depends on the chemical composition of the residual gas, the amount of air supplied to combust it and the composition of the exhaust gas, as follows:

$$TV_{n,FG,h} = V_{n,FG,h} * FM_{RG,h} \quad (22)$$

Where:

Variable	SI Unit	Description
$TV_{n,FG,h}$	m^3/h	Volumetric flow rate of the exhaust gas in dry basis at normal conditions in hour *h*
$V_{n,FG,h}$	m^3/kg residual gas	Volume of the exhaust gas of the flare in dry basis at normal conditions per kg of residual gas in hour *h*
$FM_{RG,h}$	kg residual gas/h	Mass flow rate of the residual gas in the hour *h*

$$V_{n,FG,h} = V_{n,CO2,h} + V_{n,O2,h} + V_{n,N2,h} \quad (23)$$

Where:

Variable	SI Unit	Description
$V_{n,FG,h}$	m^3/kg residual gas	Volume of the exhaust gas of the flare in dry basis at normal conditions per kg of residual gas in the hour *h*
$V_{n,CO2,h}$	m^3/kg residual gas	Quantity of CO_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*
$V_{n,O2,h}$	m^3/kg residual gas	Quantity of O_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*
$V_{n,N2,h}$	m^3/kg residual gas	Quantity of N_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*

$$V_{n,O2,h} = n_{O2,h} * MV_n \quad (24)$$

Where:

Variable	SI Unit	Description
$V_{n,O2,h}$	m^3/kg residual gas	Quantity of O_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*
$n_{O2,h}$	kmol/kg residual gas	Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h*
MV_n	m^3/kmol	Volume of one mole of any ideal gas at normal temperature and

$$V_{n,N_2,h} = MV_n * \left\{ \frac{fm_{N,h}}{200 AM_N} + \left(\frac{1 - MF_{O_2}}{MF_{O_2}} \right) * \left[F_h + n_{O_2,h} \right] \right\} \quad (25)$$

Where:

Variable	SI Unit	Description
$V_{n,N2,h}$	m^3/kg residual gas	Quantity of N_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*
MV_n	m^3/kmol	Volume of one mole of any ideal gas at normal temperature and pressure (22.4 L/mol)
$fm_{N,h}$	-	Mass of nitrogen in the residual gas in the hour *h*
AM_n	kg/kmol	Atomic mass of nitrogen
MF_{O2}	-	O_2 volumetric fraction of air
F_h	kmol/kg residual gas	Stoichiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h*
$n_{O2,h}$	kmol/kg residual gas	Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h*

$$V_{n,CO_2,h} = \frac{fm_{C,h}}{AM_C} * MV_n \quad (26)$$

Where:

Variable	SI Unit	Description
$V_{n,CO2,h}$	m^3/kg residual gas	Quantity of CO_2 volume free in the exhaust gas of the flare at normal conditions per kg of residual gas in the hour *h*
$fm_{C,h}$	-	Mass fraction of carbon the residual gas in the hour *h*
AM_c	kg/kmol	Atomic mass of carbon
MV_n	m^3/kmol	Volume of one mole of any ideal gas at normal temperature and pressure (22.4 L/mol)

$$n_{O_2,h} = \frac{t_{O_2,h}}{\left(1-(t_{O_2,h}/MF_{O_2})\right)} \times \left[\frac{fm_{C,h}}{AM_C} + \frac{fm_{N,h}}{2AM_N} + \left(\frac{1-MF_{O_2}}{MF_{O_2}}\right) \times F_h\right] \qquad \textbf{(27)}$$

Where:

Variable	SI Unit	Description
$n_{O2,h}$	kmol/kg residual gas	Quantity of moles O_2 in the exhaust gas of the flare per kg residual gas flared in hour *h*
$t_{O2,h}$	-	Volumetric fraction of O_2 in the exhaust gas in the hour *h*
MF_{O2}	-	Volumetric fraction of O_2 in the air (0.21)
F_h	kmol/kg residual gas	Stoichiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h*
$fm_{j,h}$	-	Mass fraction of element *j* in the residual gas in the hour *h*

$$F_h = \frac{fm_{C,h}}{AM_C} + \frac{fm_{H,h}}{4AM_H} - \frac{fm_{O,h}}{2AM_O} \qquad \textbf{(28)}$$

Where:

Variable	SI Unit	Description
F_h	kmol/kg residual gas	Stoichiometric quantity of moles of O_2 required for a complete oxidation of one kg residual gas in hour *h*
$fm_{j,h}$	-	Mass fraction of element *j* in the residual gas in the hour *h*
AM_i	kg/kmol	Atomic mass of element *j*
j		The elements carbon (index C) and hydrogen (index H) (simplified approach)

<u>Step 4: Determination of methane mass flow rate in the exhaust gas on a dry basis</u>

This step is applicable because the methane combustion efficiency of the flare will be measured continuously. The mass flow of methane in the exhaust gas is based on the volumetric flow of the exhaust gas and the measured concentration of methane in the exhaust gas, as follows:

$$TM_{FG,h} = \frac{TV_{n,FG,h} * fv_{CH4,FG,h}}{1000000} \quad (29)$$

Where:

Variable	SI Unit	Description
$TM_{FG,h}$	kg/h	Mass flow rate of methane in the exhaust gas of the flare in dry basis at normal conditions in the hour *h*
$TV_{n,FG,h}$	m^3/h exhaust gas	Volumetric flow rate of the exhaust gas in dry basis at normal conditions in hour *h*
$fv_{CH4,FG,h}$	mg/m^3	Concentration of methane in the exhaust gas of the flare in dry basis at normal conditions in hour *h*

Step 5: Determination of methane mass flow rate in the residual gas on a dry basis

The quantity of methane in the residual gas flowing into the flare is the product of the volumetric flow rate of the residual gas ($FV_{RG,h}$) the volumetric fraction of methane in the residual gas ($fv_{CH4,RG,h}$) and the density of methane ($r_{CH4,n}$) in the same reference conditions (normal conditions and dry or wet basis).

$$TM_{RG,h} = FV_{RG,h} * fv_{CH4,RG,h} * \rho_{CH4,n} \quad (30)$$

Where,

Variable	SI Unit	Description
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour *h*
$FV_{RG,h}$	m^3/h	Volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h*
$fv_{CH4,RG,h}$	-	Volumetric fraction of methane in the residual gas on dry basis in hour *h*
$\rho_{CH4,n}$	kg/m^3	Density of methane at normal conditions (0.716)

Step 6: Determination of the hourly flare efficiency

In case of enclosed flares and continuous monitoring of the flare efficiency, the flare efficiency in the hour h ($n_{flare,h}$) is:

• 0% if the temperature of the exhaust gas of the flare (T_{flare}) is below 500 °C during more than 20 minutes during the hour h.

• Determined as follows in cases where the temperature of the exhaust gas of the flare (T_{flare}) is above 500 °C for more than 40 minutes during the hour h:

$$\eta_{flare,h} = 1 - \frac{TM_{FG,h}}{TM_{RG,h}} \quad (31)$$

Where:

Variable	SI Unit	Description
$\eta_{flare, h}$	-	Flare efficiency in the hour *h*
$TM_{FG, h}$	kg/h	Methane mass flow rate in exhaust gas averaged in a period of time t (hour, two months, or year)
$TM_{RG, h}$	kg/h	Mass flow rate of methane in the residual gas in the hour *h*

Step 7: Calculation of annual project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions from each hour h, based on the methane flow rate in the residual gas ($TM_{RG,h}$) and the flare efficiency during each hour h ($n_{flare,h}$), as follows:

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} * (1 - \eta_{flare,h}) * \frac{GWP_{CH4}}{1000} \quad (32)$$

Where:

Variable	SI Unit	Description
$PE_{flare, y}$	tCO_2e	Project emissions from flaring of the residual gas stream in year *y*
$TM_{RG,h}$	kg/h	Mass flow rate of methane in the residual gas in the hour *h*
$\eta_{flare,h}$	-	Flare efficiency in hour *h*

E.3. Calculation of leakage

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No leakage is considered for the project activity.

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

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	GHG emission reductions or net GHG removals by sinks (t CO_2e) achieved in the monitoring period		
				Up to 31/12/2012	From 01/01/2013	Total amount
Total	16,800	0	0	3,500	13,300	16,800

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

Item	Values estimated in ex ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	229,131	16,800

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

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Main difference is given due the electricity generation has not started; it is expected to start the electricity generation on 01/11/2015.

Appendix 1. Contact information of project participants and responsible persons/entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Person/entity responsible for completing the CDM-MR-FORM
Organization name	Rellenos Sanitarios RESA
Street/P.O. Box	Av. Revolución No. 528, Col. San Pedro de los Pinos, C.P. 03800
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Document information

Version	*Date*	*Description*
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 (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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