



**CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006**

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**SECTION A. General description of project activity****A.1 Title of the project activity:**

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- (1) Title: Landfill Gas Management Project Puerto Vallarta Landfill site, México.
(2) Version: Version 2.
(3) Date: April, 2007.

A.2. Description of the project activity:

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The purpose of the project activity is to flare the landfill gas emitted from the “El Magisterio” landfill.

Additionally, the thermal energy by-product of this process will be used to evaporate leachate, through a Leachate Forced Evaporation System (LFES), in order to promote ground and water quality, and specially to reduce greenhouse gas (GHG) emissions. It will also have an auxiliary burner to assure the total destruction of the landfill gas.

Leachate is the liquid that is produced from the biological degradation of the waste and/or from rainfall that has percolated through the landfill. The LFES removes the requirement to discharge the leachate off site or to dispose it into the landfill.

The common practice for the handling of the leachate, is to evaporate them in open air lagoons, without any control of the filtrations to the underground and/or to reinject them to the landfill, also having the risk of filtrations to the underground and in both cases, contamination of the underground water sources.

The project activity has been designed in one phase; the construction and operation of a landfill gas (LFG) collection and leached forced evaporation system. This phase is expected to start in 2007. Emission reductions are estimated in 68,521 tonnes of CO₂ for the year 2008 and 44,197 tonnes of CO₂ for the year 2014, in the first period.

With the full-scale LFG collection system in place, monitoring of FG collection and LFES will help determine the quantity and quality of gas available from the site.

The basic considerations in the project are the creation of landfill gas extraction wells and a piping system, assisted by suction and pressure pumps. The LFES will be able of treating a maximum flow of 668 m³/hr of LFG.

The project strongly contributes to a sustainable development within the local area in México. Locally the project will have positive, social and environmental impacts. The municipal waste is controlled in a partial way, however its bad operation, mainly due to lack of technical capacity, has generated recurrent problems, such as fires, existence excessive of noxious vectors (dogs, flies, rats, vultures and other birds, among other), floor and underground contamination by leachate, as well as bad odor, and explosion risks because of the inadequate handling of the landfill gas generated by the decomposition of the deposited municipal waste. All these factors put in risk the health of the inhabitants of the city, affecting in first instance the establishments bordering the landfill site, conformed by the colonies Bosques del Progreso, Copa del Rey, Villas del Real, Magisterio and especially a regional hospital, located 400 m at southeast



of the place. With the CDM project implemented, will exist better conditions of hygiene to operate. The release of landfill gas could directly influence the health of the affected inhabitants negatively. Furthermore, emissions of other harmful gases, such as H₂S, volatile organic compounds and mercaptanes are going to be reduced. The project will have a positive impact on employment in the local area as staff will be needed to maintain the operation of the project. Beside the significant reduction of greenhouse gases, the directly affected neighborhoods will be more livable place.

Focusing on the Host Country, the project contributes towards the sustainable development of México, especially by increasing the employment opportunities in the area due to direct or indirect effects of the project implementation and project operation.

To date, there is a power plant using landfill gas in Mexico. The Plant works through a public-private partnership at a landfill in Salinas Victoria, Nuevo Leon, Mexico. The landfill operator is a government entity, call SIMEPRODESO.

In fact there are only a small number of landfill gas plants in operation in developing nations in the world. Mexico has institutional experience in the identification, design and implementation of landfill gas capture and utilization projects. Regulations targeting landfill gas management at sanitary landfills have already been established.

The implementation of this project will assist México in demonstrating the practice of flaring landfill gas and it is also envisaged that the project will create a better environment for future investments of similar nature.

A.3. Project participants:

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Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Mexico (host)	<ul style="list-style-type: none"> Estudios y Técnicas Especializadas en Ingeniería, S.A. de C.V. ENVIR EAU de México, S.A. de C.V. 	No

Contact information is available in Annex 1.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:



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A.4.1.1. Host Party(ies):

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Mexico

A.4.1.2. Region/State/Province etc.:

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State of Jalisco

A.4.1.3. City/Town/Community etc:

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Municipality of Puerto Vallarta

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

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The “El Magisterio” Puerto Vallarta landfill is located in the central part of the State of Jalisco, at 40 meters above sea level. It limits to the north with the state of Nayarit; to the east with the municipalities of San Sebastián del Oeste and Mascota; to the south with the municipalities of Mascota, Talpa de Allende and Cabo Corrientes, and to the west with the municipality of Cabo Corrientes, the Pacific and the state of Nayarit. The site is located at the following coordinates: 20°40'34.06'' N and 105°12'44.07'' W.

Figure 1.- Physical location





The landfill is located 3 kilometers of the international airport, Gustavo Díaz Ordaz in the north of the municipality of Puerto Vallarta in the limits of the colonies Magisterio and Pitillal.

The property has an extension of 10 hectares with a capacity of 636,999 m³ of waste, equivalent to a quantity of waste of 1,500,000 tons.

The landfill will be totally closed in 2006 and the Municipality will open another landfill, called “El Colorado”.



“El Magisterio” Landfill site

A.4.2. Category(ies) of project activity:

>> The project fits into Sectoral Scope 13: “Waste handling and disposal”.

A.4.3. Technology to be employed by the project activity:

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Landfill gas collection and flare system technology:

The gas collection system will include a network of approximately 19 horizontal gas extraction wells and 1,231 m of HDPE pipelines. The collection system was designed as simple and efficiently as possible for gas extraction. It consists of vertical wells and taglorite seal to reduce air infiltration, sole well head connection to the main collector for easy balancing of the well pressure, blower, and Leachate Forced Evaporation System (LFES) for the methane combustion.

The gas extraction plant will be equipped with blowers that create a suction pressure in the system necessary for extraction of the landfill gas, which will be flared with high temperature flare (>1000 °C) in the LFES.

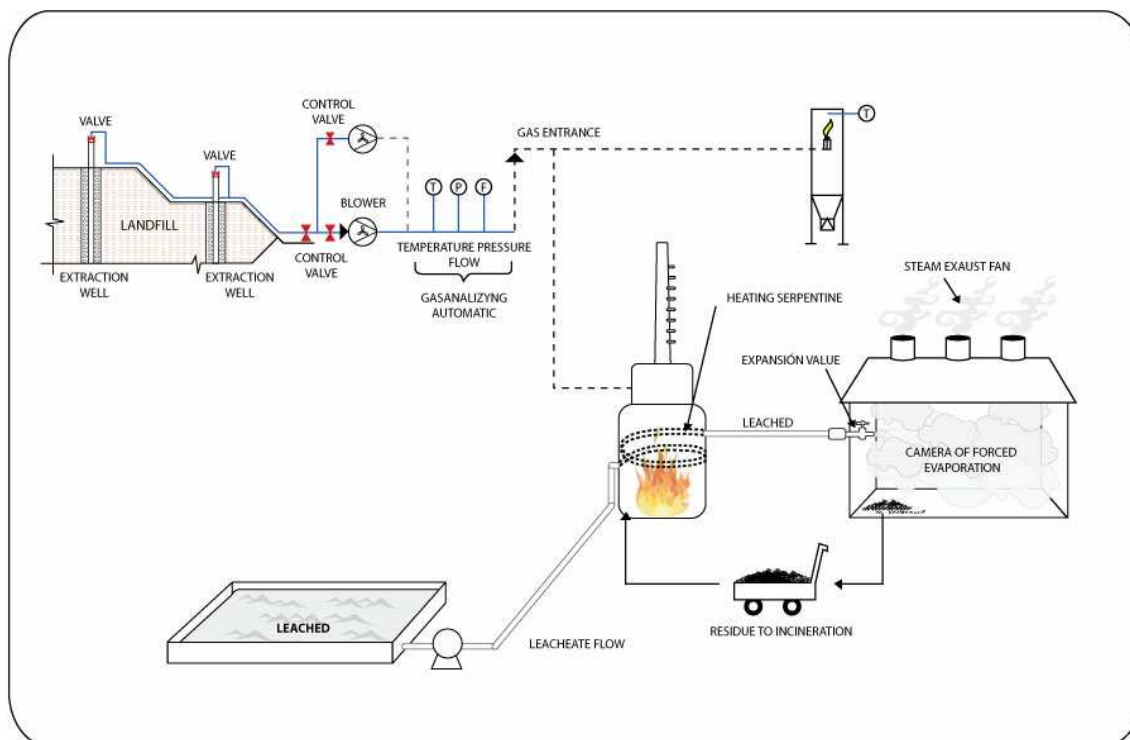
The process in the Leachate Forced Evaporation System begins with the supply from the landfill gas to the burners of the LFES. The operation temperature (between 900 °C and 1200 °C) is reached in a maximum period of 10 minutes, in which the leachate is passed through the serpentine inside the LFES, which will act as heat exchanger, increasing the leachate temperature from 25 °C to 140 °C. The evaporation temperature will always stay below the 143 °C to avoid the evaporation of leachate in the serpentine.

The leachate flow is subjected to a pressure of 4 bars before being heated, because of its later expansion in the camera of forced evaporation. With this, it is possible to evaporate the liquid phase which will be free of pollutants. The solids that were dissolved, will be throw to the floor of the camera, these will be treated later and thermally oxidized at a temperature of 1000 C or greater in the LFES.

The time of residence of the leachate inside the serpentine of the evaporator will be given as a function of the necessary minimum temperature to guarantee the required temperature.

The figure below provides a flowchart of the principal parts and components of the project.

Figure 2.- Principal parts and components of the project



Flaring technology

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:



1) Mechanism of anthropogenic greenhouse gas reduction

Landfill gas is mainly composed of methane and carbon dioxide. The carbon dioxide is not considered an anthropogenic GHG, but rather of bioorganic origin by the Intergovernmental Panel on Climate Change (IPCC) and therefore part of the natural carbon cycle. Methane, however, is considered an anthropogenic GHG since it will not enter the carbon cycle unless flared. Anthropogenic emissions of GHG at the “El Magisterio” Landfill, in Puerto Vallarta occurs when methane produced at the landfill is not destroyed.

Emission reductions will arise from the combustion of methane contained within the collected landfill gas. Combustion is an oxidation process by which methane will be transformed into less potent carbon dioxide (GWP 1) resulting in one mole of carbon dioxide produced for each mole of methane combusted. Since global warming potential of methane is 21 times that of carbon dioxide, this process will reduce the net anthropogenic emissions of CO₂e significantly (894,757 tonnes of CO₂ over the next 21 years).

The baseline scenario corresponds to the emissions resulting from the uncontrolled release of methane gas to the atmosphere and those that would have occurred from the flare of landfill gas. The associated (baseline) emissions for the project is the amount of methane that would have been emitted to the atmosphere during the crediting period in the absence of this project activity.

(2) Why the emission reductions would not occur in the absence of the proposed project activity?

This can be explained in terms of the following criteria:

a) Modalities and procedures for the definition of the baseline

According to the Modalities and Procedures of the CDM (paragraph 48), the methodology of the baseline for a certain project will be based on one of the three following approaches:

- a) The effective emissions of the moment or of the past, as it is applied.
- b) The emissions with a technology that represents a line of economically attractive action.
- c) The average rates of emissions of similar project activities, carried out in the five previous years.

For the project of use of the landfill gas of the “El Magisterio” landfill in Puerto Vallarta approach c), will be used, according to which the baseline is determined in function of the average rates of emissions of similar project activities, carried out in the five previous years. With this approach the following elements were identified:

- 1.- 23.9 % of methane emissions in Mexico, corresponds to sanitary landfills¹.
- 2.- In most the places of final disposition in the country, the landfill gas is released to the atmosphere without any control. Only are sanitary landfills, already closed, has a net of landfill gas reception where it is incinerated, but without energy use.
- 3.- They don't have practical experience in the use of landfill gas of sanitary landfills in the country, except in the case of the project in Monterrey developed in the year 2002.

¹ National Inventory of Emissions of Green Houses Gasses. - 1990-2002, Executive Summarize, 2006



4.- The Monterrey landfill gas project was pioneer with the use of landfill gas for electric generation. It was economically possible through international funds coming from the World Bank.

b) Legal issue

According to the national environmental legislation (NOM-083-SEMARNAT-2003), relative to specifications of environmental protection for the selection of the place, design, construction, operation, monitoring, closure and complementary works of a place of final disposition of urban solid waste and of special handling.

Chapter 7 (point 7.2) indicates that:

The extraction, reception, conduction and control of the landfill gas generated in the place of final disposition should be guaranteed. Once the volume and the age of the residuals propitiate the landfill gas generation without systems for its convenient use, will proceed to their burn through individual wells or by means of the establishment of a central burners network."

The Article 137 of the General Law for the Ecological Balance and the Protection of the Atmosphere (LGEEPA), establishes that, the arrangement to the ecological technical norms that are sent to the Secretary, the operation of the gathering systems, storage for such an effect, transport, lodging, reuse, treatment and final disposition of municipal solid residuals, are subject to the authorization of the governments of the states or in their case, of the municipalities

As we can see, the Mexican regulations require that the landfill gas should be flaring in the case of not having the systems for its convenient use, nevertheless that to the date, the conventional practice is limited to the disposition of waste, without the forecasts for the collecting, control and use of land fill gas

According to data of 1998, Mexico didn't have places in operation with facilities for the reception and burn of methane; in all the cases, the landfill gas was emitted to the atmosphere."

This situation hasn't changed significantly. In this context, it is observed that in similar project activities carried out in Mexico from the year 2000 to date, landfill gas has been sent entirety to the atmosphere.



A.4.4 Estimated amount of emission reductions over the chosen crediting period:

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The GHG emissions by sources are estimated at 389, 352 tonnes de CO₂eq in years 2008-2014. The first crediting period. For the calculations see section B

Please indicate the chosen crediting period and provide the total estimation of emission reductions as well as annual estimates for the chosen crediting period. Information on the emission reductions shall be indicated using the following tabular format.

Years	Estimation of annual emission reductions in tonnes of CO ₂ e
2008	68,521
2009	63,693
2010	59,205
2011	55,033
2012	51,154
2013	47,549
2014	44,197
Total estimated reductions (tonnes of CO₂ e)	389, 352
Total number of crediting years (first period)	7
Annual average over the crediting period estimated reductions (tonnes of CO₂ e)	55,621

A.4.5. Public funding of the project activity:

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Public funds will not be requested or utilized in the development of the project.



**SECTION B. Application of a baseline and monitoring methodology****B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:**

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The baseline and monitoring methodologies are already approved methodologies taken from ACM0001 /Version 5 Approved consolidated baseline methodology for landfill gas project activities. To determine the additionality of the project, and emissions, were used: "Tool for the demonstration and assessment of additionality" and "Tool to determine project emissions from flaring gases containing methane".

These methodologies are applicable to landfill gas capture project activities where the baseline scenario is the partial or total atmospheric release of the gas, and the project activities consist of the collected gas that is flared.

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

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This project fulfills the required applicability conditions of the baseline methodology. As stated in ACM0001, "This methodology is applicable to landfill gas capture project activities, where the baseline is the partial or total atmospheric release of the gas and the project activities include situations as such as

- a) The captured gas is flared; or
- b) The captured gas is used to produce energy (e.g. electricity/thermal energy), but no emission reductions are claimed for displacing or avoiding energy from other sources
- c) The captured gas is used to produce energy (e.g. electricity/thermal energy), and emission reductions are claimed for displacing or avoiding energy generation from other sources. In this case a baseline methodology for electricity and/or thermal energy displaced shall be provided or an approved one used, including the ACM0002 "Consolidated Methodology for Grid-Connected Power Generation from Renewable". If capacity of electricity generated is less than 15MW, and/or thermal energy displaced is less than 54 TJ (15GWh), small-scale methodologies can be used.

The gas in this project will be flared

This methodology will be used in conjunction with the respective monitoring methodology.

**B.3. Description of the sources and gases included in the project boundary**

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	Source	Gas	Included	Justification/Explanation
Baseline	Landfill Gas Emissions	CO2	Yes	Although some of the LFG is made up of CO2, this is not included in the baseline as this emission would take place with or without the project activity.
		CH4	Yes	The baseline emissions will be the amount of methane collected each project year.
		N2O	No	Not relevant
Project Activity	Project Emissions	CO2	Yes	CO2 emissions will result from fossil fuel for electricity power plant, required to operate the project.
		CH4	No	As part of the emissions from the <i>project activity itself</i> , methane does not need to be considered, as the project will be destroying the methane.
		N2O	No]Not relevant

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

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An analytical methodology has been used to support the condition of additionality of the “El Magisterio” Puerto Vallarta Landfill gas recovery project.

Preliminary screening based on the starting date of the project activity is not applicable, since the project’s participants do not wish to have the crediting period start prior to the registration of their project activity. The project is only expected to start operation after registration with the UNFCCC. In any case, as it will be demonstrated in the following steps, CDM revenue has been considered from the early stages of development of the project, and it is an integral part of the financial package of the project.

The alternatives to the Project activity are the following:

- Business as usual or baseline: In the business-as-usual scenario, the landfill operator continues to maintain the existing equipment and takes all necessary action to ensure local safety in accordance with the Closure Plan.



- Gas collection as a CDM project activity: the only feasible alternative that goes beyond legal requirements and that would make an investment attractive is a landfill gas collection and flaring project that earns revenue thanks to the CDM.

As the above analysis shows, there are no reasonable alternatives unless CERs could be generated in some of the alternatives.

An analysis of the entrance in vigor of applicable laws and valuation of the regulations indicates that:

Mexican law regulating landfills only establishes general conditions for operation, including closure. In general terms, it establishes requirements for all operational aspects of the landfill, including landfill gas and leachate treatment. The conditions for later stages are general to prevent hazardous situations, like the installation of wells to release landfill gas. However, it does not establish specific characteristics for the wells, which is left to the operator of the landfill under previous authorization of the health authorities. Therefore, estimating the rate of efficiency of landfill gas collection is difficult, although according to those standards, it should be low.

Each alternative identified, complies with all Mexican legal and regulatory requirements.

Hence, the only likely alternative without the CDM benefits is the continuation of the current practice.

The current practice at the landfill of venting of the landfill gas to atmosphere is the baseline scenario, based on the analysis above.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality): >>

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations.

As described above, the only realistic and credible alternatives are the following:

- The current practice at the landfill of venting of the landfill gas to atmosphere
- Gas collection as a CDM project activity: the only feasible alternative that goes beyond legal requirements and that would make an investment attractive is a landfill gas collection and flaring project that earns revenue thanks to the CDM.

There are not other alternatives that deliver outputs and services (e.g. methane destruction, with the methane being used to generate electricity or useful heat to a process) with comparable quality, properties and application.



Step 1b: Each of the alternatives is in compliance with Mexican law. This step would indicate that the most likely scenarios would be the project without CDM and the continuation of the current venting of landfill gas.

Steps 2-5 will demonstrate that the project without CDM is extremely unlikely, and the baseline scenario is thus the current venting of LFG.

Step 2: Financial Analysis: The first sub-step of the Financial Analysis test is to determine the appropriate method – the simple cost analysis, investment comparison analysis or benchmark analysis.

Step 2. Investment analysis

Sub-step 2a: Determine appropriate analysis method

According to the tool for the demonstration and assessment of additionality, one of three options must be applied for this step: (1) simple cost analysis (where no benefits other than CDM income exist for the project), (2) investment comparison analysis (where comparable alternatives to the project exist), or (3) benchmark analysis.

The project activity involves collection and flaring of the LFG as a fuel to evaporate leachate in Leachate Forced Evaporation System, and the only income of the project would come from the carbon revenues; therefore, option (1) simple cost analysis, will be applied.

The costs of the project activity for the “El Magisterio”, Puerto Vallarta landfill, are documented in the table below. Since the only revenues are from CDM, the project is demonstrably additional.

Table: Costs related to project activity in the “El Magisterio”, Puerto Vallarta Landfill Site

Cost Amount	(US \$)	Frequency
Capital costs	655,557	Once
Operational costs	141,482	Annually

The investment in a landfill gas collection and flaring system would not generate any economic benefit in absence of the CDM. Therefore, the project activity is not economically attractive and not a realistic baseline scenario.

A copy of the financial analysis will be provided to the DOE upon project validation. This analysis will include analysis of capital costs, project risk and other factors.

Common Practice Test

Because there is not specific regulation that establishes certain parameters for landfill gas treatment in Mexico, the landfill operator will continue to maintain the existing equipment and will takes all necessary action to ensure local safety in accordance with the Closure Plan.

**B.6. Emission reductions:****B.6.1. Explanation of methodological choices:**

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Baseline Emissions: The baseline is the atmospheric release of the gas and the baseline methodology considers that some of the methane generated by the landfill may be captured and destroyed to comply with regulations or contractual requirements, or to address safety and odor concerns.

Leakage: No leakage is required to be determined under ACM001.

Emission Reductions: The greenhouse gas emission reduction achieved by the project activity during a given year “y” (ER_y) are estimated as follows:

$$ER_y = (MD_{project,y} - MD_{reg,y}) * GWP_{CH4} + El_y * CEF_{electricity,y} - Et_y * CEF_{thermal,y}$$

Where:

ER_y	is emissions reduction, in tonnes of CO2 equivalents (tCO2e).
$MD_{project,y}$	the amount of methane that would have been destroyed/combusted during the year, in, tonnes of methane (tCH4)
$MD_{reg,y}$	the amount of methane that would have been destroyed/combusted during the year in the absence of the project, in, tonnes of methane (tCH4)
GWP_{CH4}	Global Warming Potential value for methane for the first commitment period is 21 tCO2e/tCH4
El_y	net quantity of electricity exported during year y, in megawatt hours (MWh)
$CEF_{electricity,y}$	CO2 emissions intensity of the electricity displaced, in tCO2e/MWh. This can be estimated using either ACM0002 or AMSI.D, if the capacity is within the small scale threshold values, when grid electricity is used or displaced.
ET_y	incremental quantity of fossil fuel, defined as difference of fossil fuel used in the baseline and fossil use during project, for energy requirement on site under project activity during the year y, in TJ
$CEF_{thermal,y}$	CO2 emissions intensity of the fuel used to generate thermal/mechanical energy, in tCO2e/TJ.

$$El_y = El_{EX,LFG} - El_{IMP}$$

Where:

$El_{EX,LFG}$	net quantity of electricity exported during year y, produced using landfill gas, in megawatt hours (MWh).
El_{IMP}	Net incremental electricity imported, defined as difference of project imports less any imports of electricity in the baseline, to meet the project requirements, in MWh



The amount of methane that would have been destroyed during the year in the absence of the project ($MD_{reg,y}$), is considered 0 because the baseline is the business-as-usual scenario, where the landfill operator continues to maintain the existing equipment and takes all necessary action to ensure local safety in accordance with the Closure Plan.

Since the project does not involve the generation of electricity and calorific energy for the time being, the parameters EG_y , $CEF_{electricity,y}$, $CEF_{thermal,y}$, and ET_y will not be used.

The emission reductions are determined by:

The amount of methane that would have been destroyed during the year, in, tonnes of methane (tCH₄), is:

$$MD_{project,y} = MD_{flare,y} + MD_{electricity,y} + MD_{thermal,y}$$

Like we told above, since the project does not involve the generation of electricity and calorific energy for the time being, the parameters: $MD_{electricity,y}$ and $MD_{thermal,y}$, will be 0.

$$MD_{flare,y} = (LFG_{flare} * W_{CH_4,y} * D_{CH_4}) - (PE_{flare,y} / GWP_{CH_4})$$

Were the $PE_{flare,y}$ (the project emissions from flaring of the residual gas stream in year y (tCO_{2e})), will be determined following the procedure described in the “*Tool to determine project emissions from flaring gases containing Methane*”.

In this tool is indicated that for enclosed flares, either of the following two options can be used to determine the flare efficiency:

- a) To use a 90% default value. Continuous monitoring of compliance with 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 for this specific hour.
- b) Continuous monitoring of the methane destruction efficiency of the flare (flare efficiency).

In this case, we will use the option a).

$$MD_{project,y} = MD_{flare,y} * (0.9)$$

**B.6.2. Data and parameters that are available at validation:**

Data / Parameter:	Eqc
Data unit:	%
Description:	Landfill gas collection efficiency
Source of data used:	Feasibility Study on the Utilization of Landfill gas of Municipality of Puerto Vallarta, Jalisco. P2, 2.4.
Value applied:	60
Justification of the choice of data or description of measurement methods and procedures actually applied :	The selected data is appropriate due to the general conditions of the site, (type and quantity of cover material and each that time is carried out the covering of the residuals).
Any comment:	The amount of gas taking into account EqC shall be measured in monitoring

Data / Parameter:	k
Data unit:	1/year
Description:	Methane generation rate
Source of data used:	“ Pump test for the landfill gas in the site” EPA Method 2E. Feasibility Study on the Utilization of Landfill gas of Municipality of Puerto Vallarta, Jalisco P2, 2.4.
Value applied:	0.08
Justification of the choice of data or description of measurement methods and procedures actually applied :	Since the value is based in a pump test (Method 2E-EPA) the selected data is appropriate.
Any comment:	

Data / Parameter:	Lo
Data unit:	Nm ³ /ton
Description:	Methane generation potential
Source of data used:	Laboratory analysis of the waste locates in the site, obtaining the information of degradable organic Carbon.
Value applied:	112
Justification of the choice of data or description of measurement methods and procedures actually applied :	Since the value is based in a laboratory test (degradable organic carbon percentage in the sample of waste) the selected data is appropriate
Any comment:	



Data / Parameter:	R_i
Data unit:	ton/year
Description:	Amount of waste in the year i
Source of data used:	Puerto Vallarta Municipality.
Value applied:	See table in annex 3 (Municipal Solid Waste of Puerto Vallarta)
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on amounts provided by the Municipality.
Any comment:	-

Data / Parameter:	GWP_{CH4}
Data unit:	-
Description:	Global Warming Potential of Methane
Source of data used:	IPCC Second Assessment Report: Climate Change 1995
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	Since the selected data are based on the IPCC report, it is considered to be appropriate.
Any comment:	-

Data / Parameter:	ρ_{CH4}
Data unit:	tCH ₄ /Nm ³ CH ₄
Description:	Methane density at standard temperature and pressure
Source of data used:	Revision to the approved consolidated monitoring methodology ACM0001 “Consolidated monitoring methodology for landfill gas project activities”.
Value applied:	0.0007168
Justification of the choice of data or description of measurement methods and procedures actually applied :	Since the value adopted in the approved consolidated methodology is used, the selected data is considered to be appropriate.
Any comment:	Changes in the approved methodology shall be checked in monitoring

**B.6.3 Ex-ante calculation of emission reductions:**

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For the full period of 2008 - 2027

$$ER_y = (MD_{project,y} - MD_{reg,y}) \times GWPC_{CH_4}$$

If $GWPC_{CH_4} = 21$, then

$$ER_y = (35,559 \text{ ton } CH_4 - 0 \text{ ton } CH_4) \times 21 \text{ tCO}_2$$

$$ER_y = 746,735 \text{ tCO}_2e$$

For the first crediting period of 2008-2014

$$ER_y = (MD_{project,y} - MD_{reg,y}) \times GWPC_{CH_4}$$

If $GWPC_{CH_4} = 21$, then

$$ER_y = (18,540 \text{ CH}_4 - 0 \text{ CH}_4) \times 21 \text{ tCO}_2$$

$$ER_y = 389,352 \text{ tCO}_2e$$

For the second crediting period of 2015-2021

$$ER_y = (MD_{project,y} - MD_{reg,y}) \times GWPC_{CH_4}$$

If $GWPC_{CH_4} = 21$, then

$$ER_y = (11,114 \text{ CH}_4 - 0 \text{ CH}_4) \times 21 \text{ tCO}_2$$

$$ER_y = 233,402 \text{ tCO}_2e$$

For the third crediting period of 2022-2027

$$ER_y = (MD_{project,y} - MD_{reg,y}) \times GWPC_{CH_4}$$

If $GWPC_{CH_4} = 21$, then

$$ER_y = (5,904 \text{ CH}_4 - 0 \text{ CH}_4) \times 21 \text{ tCO}_2$$

$$ER_y = 123,981 \text{ tCO}_2e$$

**B.6.4 Summary of the ex-ante estimation of emission reductions:**

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Year	Estimation of project activity emissions. (tonnes of CO ₂ e)	Estimation of baseline emissions (tonnes of CO ₂ e)	Estimation of leakage (tonnes of CO ₂ e)	Estimation of overall emission reductions (tonnes of CO ₂ e)
2008	7,680	76,202	0	68,521
2009	7,144	70,837	0	63,693
2010	6,645	65,850	0	59,205
2011	6,182	61,214	0	55,033
2012	5,751	56,905	0	51,154
2013	5,350	52,899	0	47,549
2014	4,978	49,175	0	44,197
Total (tonnes of CO _{2e} For 1 st crediting period)				389,352
				389,000 (rounded to nearest 1,000)

B.7 Application of the monitoring methodology and description of the monitoring plan:**B.7.1 Data and parameters monitored:***(Copy this table for each data and parameter)*

Data / Parameter:	1. LFG _{total,y}
Data unit:	Cubic meters
Description:	Total amount of landfill gas captured
Source of data to be used:	Landfill Operator
Value of data applied for the purpose of calculating expected emission reductions in section B.5	This is the key figure to determine overall baseline emissions (and emission reductions), since the amount of LFG captured would have otherwise been emitted to the atmosphere.
Description of measurement methods and procedures to be applied:	Measured by a flow meter. Data to be aggregated monthly and yearly.
QA/QC procedures to be applied:	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment:	



Data / Parameter:	2. LFG _{flare,y}
Data unit:	Cubic meter
Description:	Amount of landfill gas flared
Source of data to be used:	Landfill Operator
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Whatever landfill gas is flared is therefore destroyed, reducing the emissions of a potent greenhouse gas. For this reason, this figure is important in the calculation of total emissions reductions from this project.
Description of measurement methods and procedures to be applied:	Measured by a flow meter. Data to be aggregated monthly and yearly.
QA/QC procedures to be applied:	Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment:	

Data / Parameter:	3 FE (Flare Efficiency)
Data unit:	Percentage
Description:	Flare/combustion efficiency, determined by the operation hours (1) and the methane content in the exhaust gas (2)
Source of data to be used:	Landfill Operator
Value of data applied for the purpose of calculating expected emission reductions in section B.5	FE represents the flare efficiency, which determines the fraction of the methane destroyed. Since methane is the source of calculating baseline emissions, the percentage that is destroyed in the flare is important for calculating overall emission reductions.
Description of measurement methods and procedures to be applied:	(1) Continuous measurement of operation time of flare (e.g. with temperature). (2) Periodic measurement of methane content of flare exhaust gas.
QA/QC procedures to be applied:	Regular maintenance will ensure optimal operation of flares. Flare efficiency should be checked quarterly, with monthly checks if the efficiency shows significant deviations from previous values.
Any comment:	



Data / Parameter:	4 $w_{CH_4,y}$
Data unit:	$m^3 CH_4/m^3 LFG$
Description:	Methane fraction in the landfill gas
Source of data to be used:	Landfill Operator
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not all landfill gas is methane, the greenhouse gas in this project. In order to get an accurate reflection of the GHG reducing impact on this project, it is necessary to know the percentage of LFG that is methane.
Description of measurement methods and procedures to be applied:	Continuous gas quality analyzer.
QA/QC procedures to be applied:	The gas analyser will be subject to a regular maintenance and testing regime to ensure accuracy.
Any comment:	

Data / Parameter:	5 T
Data unit:	Degrees Celsius
Description:	Temperature of the landfill gas
Source of data to be used:	Landfill Operator
Value of data applied for the purpose of calculating expected emission reductions in section B.5	It is necessary to convert the volume of gas (m^3 of LFG recovered) into mass (tonnes of LFG captured) in order to convert to TCO_2eq and CERs. To convert from volume to mass, it is necessary to know the temperature and pressure of the gas collected.
Description of measurement methods and procedures to be applied:	Measured to determine the density of methane D_{CH_4} . No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters.
QA/QC procedures to be applied:	The gas flow meter to be used will be subject to a regular maintenance and testing regime to ensure accuracy
Any comment:	



Data / Parameter:	6 P
Data unit:	Pa
Description:	Pressure of landfill gas
Source of data to be used:	Landfill operator
Value of data applied for the purpose of calculating expected emission reductions in section B.5	It is necessary to convert the volume of gas (m ³ of LFG recovered) into mass (tonnes of LFG captured) in order to convert to TCO ₂ eq and CERs. To convert from volume to mass, it is necessary to know the temperature and pressure of the gas collected.
Description of measurement methods and procedures to be applied:	Measured to determine the density of methane D _{CH₄} . No separate monitoring of temperature is necessary when using flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters.
QA/QC procedures to be applied:	The gas flow meter to be used will be subject to a regular maintenance and testing regime to ensure accuracy
Any comment:	

Data / Parameter:	7 EL _{IMP}
Data unit:	MWH
Description:	Total amount of electricity imported to meet project requirement
Source of data to be used:	Landfill operator
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Required to determine CO ₂ emissions from use of electricity or other energy carriers to operate the project activity. If grid electricity is imported from the grid to operate the project, then the project may cause emissions of CO ₂ , which need to be deducted from baseline emissions to get an accurate reflection of emission reductions.
Description of measurement methods and procedures to be applied:	Metering of MWH from the grid to the project site.
QA/QC procedures to be applied:	Meter calibration will be frequent
Any comment:	



Data / Parameter:	8 ET _y and CO ₂ intensity of that thermal energy
Data unit:	TJ
Description:	Thermal Energy used in LFG project
Source of data to be used:	Landfill operator
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The quantity of fossil fuel used to meet the energy requirements. If electricity is produced on site using fossil fuel, it is covered under this category. This would be considered project emissions and would have to be deducted from the total baseline emissions in order to get an accurate reflection of emission reductions.
Description of measurement methods and procedures to be applied:	Metering of MWH from the local power plant, and consider the efficiency of the engine.
QA/QC procedures to be applied:	Meter will need to be checked for accuracy, as is required for any electricity sector project.
Any comment:	

B.7.2 Description of the monitoring plan:
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>>

The monitoring plan is included as an appendix to the PDD document.

B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

>>

Date of completion: 14/08/2006

Company: Estudios y Técnicas Especializadas en Ingeniería, S.A. de C.V.

Address: Tuxpan 77-11, San Jerónimo Aculco Colony, Magdalena Contreras, Delegation.

City: Mexico City

Country: Mexico

Zip Code: 10400

Contact Person: Francisco Marquez

Telephone number: +52 55 55688611, +525555688612

E- mail: energia@eteisa.com



SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>
01/01/ 2008

C.1.2. Expected operational lifetime of the project activity:

>>
21 years

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>
01/01/2008

C.2.1.2. Length of the first crediting period:

>>
7 years

C.2.2. Fixed crediting period:

Option not selected

C.2.2.1. Starting date:

>>
N.A.

C.2.2.2. Length:

>>
N.A.

**SECTION D. Environmental impacts**

>>

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

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The environmental impacts associated with the construction and operation of this project are discussed below.

Vegetation

Landfill gas collection will improve landfill surface and vegetation. To reducing surface emissions on the landfill, we will be creating a more suitable environment for the vegetation grows. Landfill gas in the soil and air tend to prevent vegetation from growing, which is why there is currently no vegetation on the “El Magisterio” Puerto Vallarta landfill.

Water quality

Landfill gas condensate will be collected by condensate traps and returned to a leachate treatment facility to be subjected to forced evaporation. The project will reduce the impact to the underground and the phreatic mantels that are currently impacted by the inadequate disposition of the leached in the place.

Air Quality

The implementation of the LFG collection and flaring system will significantly decrease the environmental impacts that occur under the present operating conditions of the landfill site. Methane and other compounds which are normally released from landfills that do not contain a LFG collection and flaring system will be greatly reduced. As discussed in Section B2, the project activity will generate **404,721 tonnes** of CO₂e emission reductions (not considering the electricity self-consumption), over the first crediting period (2007 – 2012). This represents a significant reduction of GHG emissions from the landfill site. The control of LFG emissions through the employment of the LFG collection and flaring system represents many significant environmental and health benefits to the landfill site and local areas including:

- Reduction of LFG migration throughout the landfill.
- Improvement of landfill surface and vegetation.
- Sustained local wildlife habitats.
- Increased safety of landfill site operations through decreased potential for landfill fires.
- Reduction of GHG emissions to the atmosphere.
- Reduction in pollution from volatile organic compound (VOC) (smog, acid rain ...).
- Reduction ozone depleting compound emissions such as CFC (Montreal Protocol). Landfills often receive waste such as refrigerators and spray cans that contain CFC compounds. These compounds are released when their container rusts or breaks.
- Reduction of nuisance odors.
- Reduction of health problems related to the landfill (respiratory distress, asthma, asphyxia, cancer).



- Enhancement of the quality of life and the public safety for the population living close to the landfill.

Noise

The use of an enclosed system will reduce the emitted noise from the LFES. Acoustic barrier can also be installed if noise needs to be reduce further.

Visual impact

The operation of the LFG collection and LFES will not pose environmental impacts on the surrounding areas of the landfill. The LFG collection system pipe network will be close to the ground and probably covered with soil and vegetation, therefore it will not pose a visual impact to the neighboring properties. Any building installed on-site for this system will be relatively small. The LFES will be elevated above the landfill surface; however, it will be strategically placed in order to have minimum visual impact to the surrounding lands. The use of an enclosed burner will eliminate the visible flame. Visual impacts will be reduced by using building and landscape architectural techniques.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

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No significant environmental impacts (other than the positive ones listed above) are expected from this project.

**SECTION E. Stakeholders' comments**

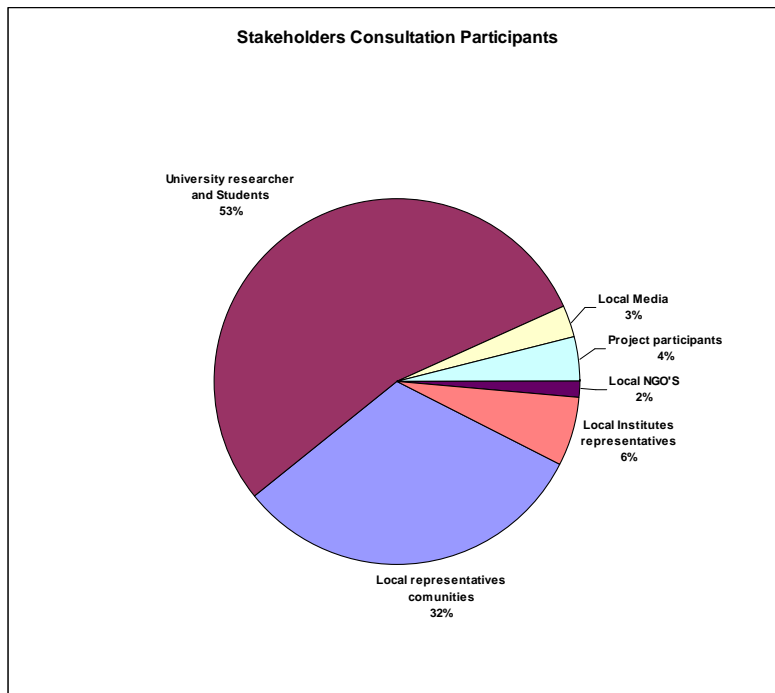
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E.1. Brief description how comments by local stakeholders have been invited and compiled:

The stakeholders consultation for the project, was held on March, 26, 2007 at the University of the Valley of Atemajac, in the city of Puerto Vallarta, Mexico. The objective of the event, was to let to the stakeholders to know the main activities and benefits of the Landfill Gas Management Project Puerto Vallarta Landfill site, to understand the basic concepts related to the climate change, its impacts and consequences, and how this project can help together with other projects around the world, to diminish the effects of this change, under the Kyoto Protocol.

The event was properly announced on March 24th, until March 25th, in the local news paper called "Vallarta Opina" and it was attended by 95 peoples from the academy, local media and members of the community.

The event lasted around 90 minutes, where presentations included the following topics: climate change; how this project is mitigating climate change through the Clean Development Mechanism of the Kyoto Protocol; the technical details of the project; and a session aimed at addressing questions posed by the stakeholders.



As the graph shows, it had a great participation of university students but almost a third of the participants represented local communities.

The pictures below show participants at the stakeholder consultation and the diffusion that was given of the event in the local means





**E.2. Summary of the comments received:**

>>

Were made questions related to the technology applied, the CDM procedures, environmental topics, and how was estimated the landfill generation, among others things and the Envir Eau and ETEISA representatives give them the correctly answers:

First, the representatives of the community were interested in to know how the project is being done to manage such leachate in landfill, and The Envir Eau and ETEISA representatives explained how El Magisterio landfill comply with all environmental regulations (NOM-083), which contemplate the use of a plastic membrane to manage leachate in a waste water treatment facility on site and in this case, the lechate will be evaporate through a Leachate Forced Evaporation System (LFES), in order to promote ground and water quality, and specially to reduce greenhouse gas (GHG) emissions.

Next, the members of the community asked about the possibility of using the landfill gas like fuel for the houses, and the Envir Eau and ETEISA representatives explained it is usually difficult to compete against natural gas or LPG used in houses now because the cost of the technology for its use doesn't make it profitable. Nevertheless, these alternatives could be explored in the future.

Other question was made by Members of the University, who wanted to know how the generation of biogas was estimated.

The Envir Eau and ETEISA representatives explained that the US EPA model was used, including several variables like amount and type of waste, climate conditions at the site, structure of the site, among others things.

This model allows to know the generation projections and landfill gas recovery, considering the efficiency of the gathering system

The projections of landfill gas recovery are obtained multiplicand the generation projections for the efficiency of the gathering system. With that, we obtain the landfill gas Recovery for every year of projection in cubic meters per minute, cubic meters for hour and trillion joules (GJ) per year.

The Envir Eau and ETEISA representatives explained that the CO₂ from methane combustion will go to the atmosphere but causing 21 times less harm than the methane otherwise would have caused.

The members of the community, wanted to know if with this project the smell of the landfill will decrease.

The Envir Eau and ETEISA representatives explained that the smell is part of the operations due to the waste that is being brought daily. However, with this project, around 60% of the landfill gas will be captured and destroyed, then the smell of this biogas will be reduced in the same proportion.

Some stakeholders wanted to know if the information of the project is available for its consultation to have a better understanding of the project and their involvement of it.

The Envir Eau and ETEISA representatives explained that this project will be published on the internet, and the link will be sent by email to the stakeholders when the project is open for comments.



The Members of the community expressed their satisfaction with the Clean Development Mechanism as a tool for reducing pollution at a local level. Also, members of the University were interested in using this project as an example for Environmental Education for the community.

Stakeholders, including: local representatives communities, University researcher and students, local media, project participants, local NGO'S, local institutes representatives, community, University, local NGO's and The Envir Eau and ETEISA representatives for this project implementation and the public consultation, which helped to inform the community about its operations.

E.3. Report on how due account was taken of any comments received:

>>

All the question and concerns raised about the project, were addressed during the stakeholder consultation and there have not been formal comments submitted by any of the stakeholders regarding this project. Overall, the stakeholder consultation was a very positive event with stakeholders congratulating, for undertaking the project.

**Annex 1****CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

Organization:	Estudios y Técnicas Especializadas en Ingeniería, S. A. de C.V.	Evir Eau de México, S.A. de C.V..
Street/P.O. Box:	Tuxpan 77-11, San Jerónimo Aculco Colony, Magdalena Contreras, Delegation.	Angel Urraza, 224, Independencia Colony, Benito Juarez, Delegation.
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State/Region:	Federal District	Federal District
Postfix/ZIP:	10400	03100
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URL:		
Represented by:		
Title:	Engineer	Lawyer
Salutation:		
Last Name:	De Avila	Nelson
Middle Name:		
First Name:	Luis Eduardo	Marco
Department:	General Director	
Mobile:	52 55 19954706	
Direct FAX:		
Direct tel:		
Personal E-Mail:	Deavilar2000@yahoo.com	envireau@terra.com



Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding will be used for this project.

**Annex 3****BASELINE INFORMATION****Municipal Solid Waste of Puerto Vallarta**

Year	MSW Generate (tonn/day)	MSW Generate (tonn/year)
1980		
1981	33.4	12,199
1982	35.5	12,943
1983	37.6	13,733
1984	39.9	14,571
1985	42.4	15,460
1986	44.9	16,404
1987	47.7	17,405
1988	50.6	18,467
1989	53.7	19,593
1990	68.1	24,857
1991	84.1	30,691
1992	101.8	37,143
1993	121.3	44,269
1994	142.8	52,127
1995	166.5	60,778
1996	190.6	69,561
1997	216.6	79,070
1998	244.8	89,356
1999	275.3	100,474
2000	297.6	108,624
2001	332.5	121,366
2002	370.2	135,139
2003	411.0	150,016
2004	455.0	166,075
2005	523.6	191,129
2006	622.0	227,024



Year	Captured methane (t/y)	Methane destroyed in LFES (CH ₄ T/year) (90%)	tCO _{2e} /year	Emissions due to electrical energy consumed tCO _{2e} /year	E R considering electricity consumption tCO _{2e} /year
2008	3,629	3,266	68,581	60.279	68,521
2009	3,373	3,036	63,753	60.279	63,693
2010	3,136	2,822	59,265	60.279	59,205
2011	2,915	2,623	55,093	60.279	55,033
2012	2,710	2,439	51,215	60.279	51,154
2013	2,519	2,267	47,609	60.279	47,549
2014	2,342	2,107	44,257	60.279	44,197
2015	2,177	1,959	41,142	60.279	41,081
2016	2,024	1,821	38,245	60.279	38,185
2017	1,881	1,693	35,553	60.279	35,493
2018	1,749	1,574	33,050	60.279	32,990
2019	1,626	1,463	30,723	60.279	30,663
2020	1,511	1,360	28,560	60.279	28,500
2021	1,405	1,264	26,550	60.279	26,490
2022	1,306	1,175	24,681	60.279	24,620
2023	1,214	1,093	22,943	60.279	22,883
2024	1,128	1,016	21,328	60.279	21,268
2025	1,049	944	19,827	60.279	19,766
2026	975	878	18,431	60.279	18,371
2027	907	816	17,133	60.279	17,073
Total	39,574	35,616	747,940	1,205.58	746,734.81



Annex 4

MONITORING INFORMATION

The purpose of the project is to destroy methane with a highly efficient LFES with a methane destruction capacity of close to 98%, nevertheless, a default value has been applied like above is indicated based on Tool to determine project emissions from flaring gases containing methane”.

The project includes, to demonstrate the fulfillment of the proposed objectives, a monitoring system that combines the measurement, estimation and calculation of operating variables, the emissions of gases that have a local effect and the emission of greenhouse gases. The system also considers transmission, storage and reporting of the variables monitored.

Monitoring Variables

The plan to monitor gases for the collection was designed under UNFCCC guidelines for this type of project. The following variables and characteristics are considered:



Data to be collected in order to monitor emissions from the project activity, and how this data will be archived								
ID number	Data variable	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	For how long is archived data kept?	Comment
1. LFGtotal,y	Total amount of landfill gas captured	m ³	m	continuously	100%	electronic	During the crediting period and two years after.	Measured by a flow meter. Data to be aggregated monthly and yearly.
2. LFGflare,y	Total amount of landfill gas flared	m ³	m	continuously	100%	electronic	During the crediting period and two years after	Measured by a flow meter. Data to be aggregated monthly and yearly.
3. FE	LFES/combustion efficiency, determined by the operation hours and the methane content in the exhaust gas	%	m / c	(1) Continuously , (2) quarterly, monthly if unstable.	n/a	electronic	During the crediting period and two years after	Continuous measurement of operation time of LFES (with temperature). Periodic measurement of methane content in the LFES exhaust gas.
4. wCH ₄ ,y	Methane fraction in the landfill gas	m ³ CH ₄ / m ³ LFG	m	continuously	100%	electronic	During the crediting period and two years after	Non Dispersive Infra Red Absorbance Method (NDIR)
5. T	Temperature of the landfill gas	°C	m	continuously	100%	electronic	During the crediting period and two years after	Measured to determine the density of methane DCH ₄



6. p	Pressure of the landfill gas	Pa	m	continuously	100%	electronic	During the crediting period and two years after	Measured to determine the density of methane DCH ₄
7.	Total amount of electricity and/or other energy carriers used in the project for gas pumping and heat transport (not derived from the gas)	Mwh	m	continuously	100%	electronic	During the crediting period and two years after	Required to determine CO ₂ emissions from use of electricity or other energy carriers to operate the project activity
8. EFy	CO ₂ emission intensity of the electricity and/or other energy carriers in ID 8	t CO ₂ / MWh	c	At the validation and baseline renewal	0%	electronic	During the crediting period and two years after	Required to determine CO ₂ emissions from use of electricity or other energy carriers to operate the project activity
9.	Regulatory requirements relating to landfill gas projects	Test	n/a	Annually	100%	electronic	During the crediting period and two years after	Required for any changes to the adjustment factor (AF) or directly MDreg,



Design of the LFES to correctly monitor the LFES gases

The stack has been designed to monitor contaminating gases, including, among other considerations, the distance between the top of the flame and the continuous sampling locations at a ratio of 5 times the flame diameter (to ensure a regular gas profile); a distance of 1.5 additional diameters between the sampling zone and the stack exit. Although it is true that the continuous measurement of emissions is approved “case-by-case” by the EPA, given the complexity of the behavior of the different contaminants, whether measured by temperature and/or pressure of the sample, particle load, interference with other gases, moisture content, vibration of the gas analyzers, type of gas off take system and conditioning, etc., dependent on each emitting source, there are general guidelines, such as the PS (Performance Specification) 1 to 7, found in Appendix B of the Code of Federal Regulations 40, Part 60, and the requirement of a measurement quality assurance program set by the EPA in Appendix F of Code of Federal Regulations 40, Part 60 (40 CFR60 Appendix F).

A flange is projected in the same zone to facilitate specific sampling. That place will be accessible to the operator by ladder to a horizontal platform designed according to the indications in the Proceff Resolution on the subject. (See <http://www.sesma.cl/sitio/download/aire/isoci.PDF>).

A flange will also be included in the system to sample gases specifically according to México standards CH6C, CH7E, CH10 and CH25, plus two flanges based on the CH5 methodology.

Continuous monitoring equipment calibration procedure

The measurement principles and techniques in the EPA guidelines will be used for each measurable component, such as equivalent methods and/or reference methods adopted by the EPA and, in the cases where EPA has no guideline, like for VOCs, world-renowned techniques will be utilized. Contaminating gas analyzers will never use electrolyte cells (except for the oxygen sensor) because of the response to other gases that act as interference and their low resolution.

There are no regulations in México governing calibration procedures and the recommendations being developed for the measurement of air quality are inappropriate for the measurement of emissions.

Since each source of emission is different, the continuous emission monitoring system is required to be governed by an integral information quality assurance program approved by the EPA. The guide to developing this program is found in Appendix F of CFR 40, Part 60, of the EPA; therefore, the calibration procedures are part of a global program to assure the quality of the information provided by the continuous monitoring system that also includes standard operating procedures, a training program, maintenance procedures, report preparation and validation procedures, chains of custody and external and internal auditing procedures, all duly scheduled and documented.

The assurance plan also includes the calibration of other variables, such as flows, pressure, moisture and temperature.

The calibration procedures involve:

- Elements of calibration: EPA 1 protocol gas cylinders with a 1% tolerance for each of the measurable gases, sourced from the United States, and gas cylinders with a 2% tolerance,



sourced domestically, for each of the measurable gases. The choice of the concentration of cylinders involves the ranges and accuracy of each analyzer. There must be one cylinder for each measurable gas where the concentration is approximately 80% of the range (the “span” value). There must be zero air for the zero setting in all analyzers and a nitrogen cylinder for the zero on the oxygen sensor. There must be cylinders for level 1 calibration and for daily review for all gases.

- **Instructions:** A list of step-by-step instructions on how the calibration gases inflow (level 1 gases, 1% tolerance) to the system, taking into account flows and pressures, waiting times, calibration validation standards and the ways in which each of the analyzers to be calibrated is adjusted. Each procedure includes an annex that constitutes a record of the main results and elements that were a factor in the calibration. If the system includes a sample conditioning system, the system will be checked through direct calibration and system calibration. In the system calibration, the gases enter virtually from the same stack, testing the entire measurement system. In the direct calibration, the gases enter the analyzers directly. Dilutors to generate gases of a known concentration are not allowed since they increase the cylinder tolerance from 1% to more than 3% and the dilutor output does not generate any pressure, which is required for calibration. By generating pressure at the output, the dilutor varies the dilution flows, thus losing calibration.
- **Period of calibration:** The period of calibration is determined by the secretion in the analyzer over time. To determine this secretion, level 2 gases lower in certification, with a tolerance of 2%, are entered automatically every day. When a certain percentage is exceeded as specified in the system’s quality manuals, an alarm sounds automatically to make a level 1 calibration using EPA 1 protocol gases. The zero and span secretion percentage will support the level of reliability that has been assumed in the monitoring objective.

The continuous monitors will be calibrated annually using the EPA reference methodologies and/or their national equivalent.

Technical specifications of continuous sensors or monitors

Below are the technical specifications of the continuous monitors or sensors to be used:

CH₄ Monitor

Principle of Operation	Non-Dispersive Infrared Absorption (NDIR)
Range	0 – 5000 ppm
Accuracy	1%
Precision	1 ppm
Zero Drift	+ 1%
Span Drift	+ 2%
Detection Limit	1 ppm

O₂ Monitor

Principle of Operation	Paramagnetic
Range	0 – 25%
<u>Accuracy</u>	<u>0.1%</u>
<u>Precision</u>	<u>0.01%</u>
<u>Zero Drift</u>	<u>+ 1%</u>



<u>Span Drift</u>	<u>+ 2%</u>
<u>Detection Limit</u>	<u>0.01%</u>

Computer result recording procedure

The data from the analyzer will be sent by analog output signals to a data acquisition and storage machine, or data logger, to record results. Each of these signals will be connected to the data logger, which reads the signals and stores them in its memory for 6 months.

The data logger is connected to a computer that downloads the data stored in the data logger's memory from time to time in order to keep a historic backup of the data. This computer will store the data for the entire period of the project and two years after.

Software will be installed on the computer that will allow a graph of each of these signals to be displayed on the screen and the rough and validated data to be uploaded to a web site accessible by password.