Monitoring report form
(Version 05.1)

MONITORING REPORT		
Title of the project activity	Caieiras landfill gas emission reduction	
UNFCCC reference number of the project activity	0171	
Version number of the monitoring report	2.0	
Completion date of the monitoring report	17/05/2016	
Monitoring period number and duration of this monitoring period	Monitoring period: #12 16/05/2015 - 31/12/2015	
Project participant(s)	Essencis Soluções Ambientais S.A. Nordic Environment Finance Corporation	
Host Party	Brazil	
Sectoral scope(s)	13 - Waste handling and disposal	
Selected methodology(ies)	ACM0001 - “Flaring or use of landfill gas” (version 13.0.0)	
Selected standardized baseline(s)	Not applicable	
Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD	692,343 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
	-	374,022 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The CDM project activity "Caieiras landfill gas emission reduction" is implemented at the CTR Caieiras landfill. The project activity promotes real, measureable and permanent abatement of greenhouse gas (GHG) emissions through collection and destruction (combustion in high temperature enclosed flares) of landfill gas (LFG) that is generated at this landfill. LFG is rich in methane (CH_4), a powerful GHG. The construction of the CTR Caieiras landfill was initiated in year 2002 and it has been operated by the project owner and host-country project participant Essencis Soluções Ambientais S.A. since its commissioning date in September 2002. The project's LFG collection and destruction system was completely implemented at the landfill in February 2007.

The construction of the project's LFG capture and destruction system (using high temperature enclosed flares) was initiated in March 2006 and was concluded in December 2006. While related testing and commissioning phases occurred in January 2007, the official starting of the project activity (with monitoring data measurements being recorded) is 01/02/2007.

LFG is generated at the CTR Caieiras landfill as a result of anaerobic decomposition of municipal solid waste (MSW) historically disposed at the landfill. The project activity so far encompasses the following components/infrastructure:

(i) Capturing of LFG through a set of LFG collecting wells that are interconnected through a LFG collection pipeline network
(ii) Destruction of all collected LFG (which is collected by the LFG collecting wells and transported through the LFG collection pipeline network) by combustion (in high temperature enclosed flares installed in the project's LFG destruction facility).

As indicated in the both the currently registered and revised versions of the PDD[1] valid for the 2nd 7-year renewable crediting period of the project activity (hereafter denominated as PDD), the project design under its current configuration does not encompass any utilization of LFG. The project activity was implemented and remains being operated without having any share of collected LFG being sold as gaseous fuel to a local industry (in order to be combusted in boilers) or being used as fuel to power a thermal desorption unit or an electricity generation facility[2]. During the monitoring period from 16/05/2015 to 31/12/2015, no collected LFG was thus utilized as gaseous fuel for electricity generation, as gaseous fuel in boilers or for any purpose other than being destroyed through combustion in the installed high temperature enclosed flares.

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[1] As outlined in Section B.2.2 and B.2.6, the monitoring period encompassed by this Monitoring Report addresses post-registration changes in the categories Corrections (in information that do not affect the project design) and Permanent changes in the project design as reflected in a revised version of the PDD that is validated and submitted for approval by UNFCCC as part of the verification assessment performed for the considered monitoring period under the so-called "Issuance" process track for post-registration changes. Due to that this Monitoring Report includes references to the PDD as "revised version of the PDD".

[2] Regarding the currently not any longer considered potential utilization of collected LFG (as previously indicated in the PDD valid for the currently expired 1st 7-year crediting period), the PDD valid for the 2nd 7-year renewable crediting period includes relevant details in the following two explanative boxes:

- Section A.1 / Box 1 – "*Further clarifications about the earlier expected (and currently not any longer expected) potential utilization of collected LFG as (a) gaseous fuel for electricity generation and/or (b) gaseous fuel in industrial boiler(s) (at industrial facility located outside the limits of the CTR Caieiras landfill) and/or (c) as gaseous fuel for a previously existing thermal desorption unit (TDU) under both the baseline and project scenarios."*
- Section A.3 / Box 2 – *"Occurred pilot tests/evaluation of a portable electricity generation facility fuelled by collected LFG at CTR Caieiras Landfill (using LFG collected by the project activity "Caieiras landfill gas emission reduction)" during a no longer than 3-month period within the 1st crediting period"*

By the end of the considered monitoring period, the implemented project's LFG collection system encompassed about 390 vertical LFG collection wells[3]. No horizontal LFG collection trenches have so far been utilized for collecting LFG at the CTR Caieiras landfill. During the considered monitoring period, LFG was collected at the CTR Caieiras landfill with the utilization of centrifugal blowers which are connected to the project's LFG collecting pipeline network.

As part of the operation of the project activity, all collected LFG is conducted within the LFG collecting pipeline network to 3 main pipelines that are interconnected in a main pipeline in the LFG destruction facility. This main pipeline is split into 4 pipelines (1 pipeline for each one of the 4 existing enclosed high temperature flares). LFG sent to the flares is combusted under high temperature and controlled conditions.

The amount and quality of collected LFG which is sent to each individual flare have been continuously measured, recorded and reported along the considered monitoring period. Monitoring activities encompass LFG flow sent to the each individual flare, CH_4 content of collected LFG sent to the flares, LFG temperature and LFG pressure. As also established in the project's monitoring procedure valid for the 2nd 7-year crediting period, the status/conditions of the high temperature enclosed flares and their compliance with operational requirements (as established by the flare equipment manufacturer) are also monitored[4].

All LFG related monitoring instruments/equipment (incl. LFG flow meters[5], LFG pressure sensor, LFG temperature sensor, LFG CH_4 content gas analyzer) are installed in the main LFG pipeline. Thermocouples for measuring temperature of the exhaust gas of the flares are installed in the upper section of each flare. The installed four high temperature enclosed flares are also equipped with Ultra-violet (UV) flame detectors (of which status (flare "*on*" or flare "*off*") is also continuously monitored). The set of LFG and flaring related continuous measurements are recorded and reported with an every minute frequency. Data is stored/archived in a computerized database located in the project's control room.

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[3] It is important to note that, as outlined in the Section B.6.1 of both the currently registered and revised versions of the PDD valid for the 2nd 7-year renewable crediting period, besides of having LFG being effectively collected and destroyed by the active (forced suction) LFG collection and destruction system that is implemented and has operated as part of the project activity (which currently comprises more than 390 LFG collection wells), there are still existing a set of conventional passive LFG venting/combustion drains spread around the landfill (about 50 units in December 2015). In these conventional and passive LFG venting/combustion drains, very small share of generated LFG has been sometimes combusted and sometimes just directly vented into the atmosphere. These remaining conventional LFG venting/combustion infrastructure are not connected to the project activity's LFG collection pipeline network. Unfortunately, venting of LFG has been a practice before and even after the implementation of the project. Although appropriately addressing safety and odor concerns are operational requirements for the CTR Caieiras landfill, the very large area/size of this landfill makes it difficult to keep every single existing conventional drains alight or even convert such drains into appropriate LFG collection wells (and get them connected to the project activity). Moreover, prior of the decision to implement the project activity, sporadic combustion under uncontrolled conditions of minor and not defined share of generated LFG by non-defined fraction of the existing LFG venting/combustion drains (that are not part of the project activity) has been assumed as per applicable design, construction and operational requirements for the CTR Caieiras landfill as a deemed sufficient practice to address safety and odour concerns. A relevant related explanative disclaimer titled "*Challenging/difficulties in converting all conventional and passive LFG venting/combustion drains into appropriated active LFG collecting well connected to the project activity*" is included under Footnote 63 in Section B.6.1 of both the currently registered and revised versions of the PDD. Footnote 79 (included in Section B.6.2) and "*Step A.2: Determination of $F_{CH4,BL,y}$* " under Section B.6.1 of both versions of the PDD also include further related explanations.

[4] As further explained in Section C.1 and D.2 of both the currently registered and revised versions of PDD valid for the 2nd 7-year crediting period of the project activity, the project's monitoring procedures were revised (when compared to the practice and procedures applied during the 1st 7-year crediting period) in order to have the project activity meeting monitoring requirements as per the registered PDD valid for the 2nd crediting period (that applies the CDM baseline and monitoring methodology ACM0001 (version 13.0.0) + applicable methodological tools).

[5] The flow meters are installed in the 4 pipelines which send collected LFG to the flares (1 flow meter to measure flow of LFG sent to each individual flare).

During the considered monitoring period, the project activity was implemented and has operated under the following configuration:

- 3 centrifugal blowers with LFG collection capacity of up to 4,000 Nm^3/h each and 2 centrifugal blowers with LFG collection capacity of up to 7,000 Nm^3/h each (period from 16/05/2015 to 17/12/2015)[6].
- 3 centrifugal blowers with LFG collection capacity of up to 7,000 Nm^3/h each (period from 18/12/2015 to 31/12/2015).
- 4 enclosed high temperature flares (of which specifications are presented in the PDD).
- All monitoring instruments/equipment which are required for measuring LFG related parameters, temperature of the exhaust gas of the flares, status of the flares and grid-sourced electricity consumption (of which specifications are presented in Section D.2).

The MSW disposal area at the CTR Caieiras landfill that is currently covered by the project's LFG collection well has about 567,000 square meters. About 29,900,000 ton of MSW are disposed in such area. During the considered monitoring period, about 54% of the project's existing LFG collecting wells were connected to the project's LFG collecting pipeline (in the average)[7].

Further details about installed GHG abatement equipment are included in Section B.1. Details about all installed monitoring equipment/instruments are made available in Section D.2.

Essencis Soluções Ambientais S.A. (one of the project participants for the project activity and the owner and operator of the CTR Caieiras landfill) has implemented a quality assurance and control (QA/QC) and environmental management system (EMS) for all activities undertaken at the CTR Caieiras landfill. The company's ISO 9001 and ISO 14001 certified QA/QC/EMS system was previously implemented in year 2006. The boundary/scope of this QA/QC/EMS system currently also encompasses applicable work procedures for the operation and monitoring of the project activity.

GHG emission reductions achieved by the project activity during the considered monitoring period from 16/05/2015 to 31/12/2015: 374,022 tCO_2e.

A.2. Location of project activity

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The CTR Caieiras landfill is located at Bandeirantes highway, km 33 in the municipality of Caieiras, São Paulo State, in Brazil. The project site is located in the extreme Northeast region of Caieiras municipality. Caieiras is one of the municipalities encompassing the Metropolitan Region of São Paulo (RMSP).

The project site has the following geographical coordinates:

[6] The replacement of the centrifugal blowers installed at the project site up to 17/12/2015 by new equipment was made as part of the ooccurred gradual moving of the whole installed project's LFG destruction infrastructure (project's LFG flaring facility) to other area/region within the CTR Caieiras landfill during the period from mid-June 2015 to 12 April 2016. Further details are made available in Section B.1 under "*Box 1: Occurred gradual moving of the whole installed project's LFG destruction infrastructure (project's LFG flaring facility) to other area/region within the CTR Caieiras landfill during the period from mid-June 2015 to 12 April 2016 (with the project activity operating under reduced activity level during the period)".*

[7] As part of the normal operation of the CTR Caieiras landfill (and also as part of the normal operation of the project activity), some of the project's LFG collecting wells are often temporarily disconnected from the project's LFG collection pipeline in order to facilitate continuous activities of MSW disposal and compacting, thus allowing transit of machinery (wheel loaders and excavators) and trucks as part of the normal operations of the CTR Caieiras landfill. Furthermore, sometimes some of the project's LFG extracting wells are also often temporarily disconnected from the LFG collection pipeline due to repair, operational and/or maintenance reasons. (welding and other repair services at the wells and/or pipeline, repositioning of the LFG pipeline, maintenance in the head of the LFG wells, etc.).

- 23°20'40" S (-23.3444)
- 46°46'20" W (-46.7722)

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)
Brazil (host)	Essencis Soluções Ambientais S.A.	No
Norway	Nordic Environment Finance Corporation	No

A.4. Reference of applied methodology and standardized baseline

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The project activity applies the following large-scale CDM baseline and monitoring methodology:

- ACM0001 - "Flaring or use of landfill gas" (version 13.0.0). (http://cdm.unfccc.int/filestorage/E/Y/F/EYFHCV3K4J5P06DTQSG9WLMOBNUX2I/EB67_repan12_ACM0001_ver13.0.0.pdf?t=aWV8bmVmZHlhfDAbkn62RDZuyjHVzDOMoxMx)

For the considered monitoring period, as also established in the PDD, the following methodological tools are also applied[8]:

- "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01) (http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf).

  The application of this tool refers to the ex-post application of the latest version of the "Tool to calculate the emission factor for an electricity system" (version 04.0) (http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.pdf)

- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 02) (http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf)

- "Project emissions from flaring" (version 02.0.0, EB 68) (http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v2.0.pdf);

- "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0, EB 61) (http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v2.0.0.pdf);

[8] Both the currently registered and revised versions of the PDD also refer to the methodological tool "Emissions from solid waste disposal sites" (version 06.0.1, EB66). However, it is crucial to note that, as outlined in both versions of the PDD, applicable guidance of this methodological tools is only applied in the context of ex-ante estimation of emission reductions to be achieved by the project activity during the 2nd 7-year crediting period. This methodological tool is not applied for the ex-post determination of emission reductions achieved by the project activity.

A.5. Crediting period of project activity

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From 13/12/2013 to 30/03/2020 (2nd 7-year renewable crediting period).

A.6. Contact information of responsible persons/entities

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Completion date for the application of the CDM-MR-FORM: 09/02/2016 (date of the initial version of this Monitoring Report).

Responsible entity / person:

Mr. Nuno Barbosa
nuno@unicarbo.com.br
UniCarbo Energia e Biogás Ltda.
São Paulo, Brazil

UniCarbo Energia e Biogás Ltda. is a CDM consulting and advisory services company hired by the project participant Essencis Soluções Ambientais S.A. UniCarbo Energia e Biogás Ltda. is not a project participant.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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The total technical Municipal Solid Waste (MSW) disposal capacity for the CTR Caieiras landfill is defined as about 60,000,000 ton of MSW. By the end of the considered monitoring period, an accumulated amount of about 29,900,000 ton of MSW was disposed in this landfill. During the considered monitoring period, MSW has been disposed with an average rate of about 3,023,000 ton of MSW per year[9]. The CTR Caieiras landfill is currently not expected to close prior to year 2030.

At the end of the considered monitoring period, the implemented project's LFG collection system consisted of about 210 operational LFG collecting wells interconnected through a high density polyethylene pipeline network. The LFG collecting wells are used to extract LFG from inner section of the landfill. Collected LFG is transported to the project's LFG destruction facility (enclosed high temperature flares) through the high density polyethylene pipeline network passing through condensation pots (where most of the humidity in collected LFG is removed through condensation).

[9] It is relevant to note that from year 2007, a significant increase in daily MSW disposal at the CTR Caieiras landfill occurred. Such occurred increase and its impact over baseline emissions for the project activity are explained in Section A.3 of both the currently registered and revised versions of the PDD valid for the 2nd 7-year renewable crediting period.

Box 1: Occurred gradual moving of the whole installed project's LFG destruction infrastructure (project's LFG flaring facility) to other area/region within the CTR Caieiras landfill during the period from mid-June 2015 to 12 April 2016 (with the project activity operating under reduced activity level during the period)

As per a previously taken decision by Essencis Soluções Ambientais S.A., the project's LFG destruction infrastructure (project's LFG flaring facility incl. high temperature enclosed flares, centrifugal blowers, valves, safety system/equipment and other ancillary and monitoring equipment/instruments) has moved to other area/region within the CTR Caieiras landfill in (with moving of two of the flares + ancillary equipment starting in mid-June 2015 and with the whole moving process (incl. all related phased testing and commissioning events) being later concluded on 12/04/2016 (thus after the end of the considered monitoring period). During this about 8-month length period, the project's LFG flaring facility operated under reduced activity level in 2 different locations within the CTR Caieiras landfill limits:
- until 17/12/2015: the project's LFG flaring facility operated from its former location with two flares under operation.
- from 18/12/2015 onwards: the project's LFG flaring facility has operated from its new and current location (on the basis of operation of only 2 flares during the period from 18/12/2015 to 12/04/2016 and later with the 4 flares in place since 12/04/2016).

The reason for such occurred change in the location of the project's LFG flaring infrastructure within the limits of the CTR Caieiras landfill is a previously made decision by Essencis Soluções Ambientais S.A. (the host-country project participant, project owner and operator of the CTR Caieiras landfill) to use the area/region within the landfill where the project's LFG flaring facility was previously implemented (and has operated since year 2007) as an additional area for disposal of MSW at the CTR Caieiras landfill. This decision was in line with the previously conceived and approved operational plan for the landfill[10].

In accordance with previously made planning, the whole moving process of the project's LFG destruction facility was gradually performed in order not to have the operation of the project activity being interrupted for a long time. As part of related performed moving activities, 2 of the 4 installed high temperature enclosed flares (flares referred as "Flare 3" and "Flare 2") were initially disconnected (disassembled and removed) from the former location of the LFG destruction facility in mid-June 2015 and were positioned in the new permanent location for the project's LFG flaring facility (using 2 heavy duty truck cranes and ancillary equipment). While not assembled and not connected to the project activity since mid-June 2015, these flares thus became under interrupted operation until 18/12/2015 (date when the project's LFG destruction facility started to operate from its new location (also operating under reduced activity level)).

[10] The following references a previously planned change in the location of project's infrastructure within the limits of the CTR Caieiras landfill was previously made available in Section A.3. of the currently registered version of the PDD for the 2nd 7-year crediting period of the project activity (PDD version 5.9, dated 05/09/2013):

> *"(…) as per the current plan/forecasts of Essencis Soluções Ambientais S.A. for MSW disposal at the CTR Caieiras landfill, the area where the project's LFG destruction facility is currently located may be used in the future for disposal of MSW. Whenever that occurs, the whole project's LFG destruction facility (incl. flares, centrifugal blowers, safety system/equipment and monitoring equipment/instruments) will thus be moved to another area/region within the CTR Caieiras landfill which is yet to be defined. If required, any relevant change in the project's configuration will be addressed as per applicable procedure/rules for addressing permanent post registration changes (e.g. correction in information that does not affect the project design)."*

As outlined in Sections B.2.2 and B.2.6 due to occurred permanent post-registration design changes for the project activity (incl. the occurred gradual moving of the whole installed project's LFG destruction infrastructure (project's LFG flaring facility) to other area/region within the CTR Caieiras landfill), a revised version of the PDD was completed for addressing such changes. Such revised version of the PDD is expected to be validated and submitted for approval by UNFCCC as part of the verification assessment performed for the considered monitoring period under the so-called "Issuance" process track for post-registration changes.

Figure 1 –Views of removal and transferring work of the project's high temperature enclosed flares and ancillary equipment from the former location of the project's LFG flaring facility to its new location (by use of heavy duty truck cranes)

After the disassembly and moving of two the project's flares (flares referred as "Flare 3" and "Flare 2"), all required construction and implementation of infrastructure for having the project's LFG flaring facility operating in its new location (initially also on the basis of 2 operating flares) took place: required civil constructions, electrical installations, changes in the LFG pipeline, implementation of new programmable logic controlling (PLC) unit and electrical controls, etc.

The flaring infrastructure location moving process was partially thus concluded on 17/12/2015 after conclusion of transferring of equipment from the former location of the project's LFG destruction facility to its new location and starting of operation of flares referred as "Flare 3" and "Flare 2" from their new and current location on 18/12//2015

During the largest 216-day share of the considered monitoring period from 16/05/2015 to 17/12/2015, the project activity thus operated with collected LFG being flared in the former location of the flaring facility (on the basis of operation of the 2 flares referred as "Flare 1" and "Flare 4"[11]).

On 18/12/2015, after conclusion of partial installation and configuration of equipment and instruments (+ conclusion of related testing & commissioning work), the project's LFG flaring

[11] It is relevant to note that, within such largest 216-day share of the considered monitoring period, as part of the testing and commissioning work in the context of the performed service intervention in each one of the flares on 08/06/2015, the project activity operated on the basis of the flares referred as "Flare 2" and "Flare 3" during a short period of about 5 hours (from about 09:00 AM to about 02:00 PM on 08/06/2015) instead of the flares referred as "Flare 1" and "Flare 4". Further details about such performed service intervention in the flares are included in Section B.2.6 (under "*2 - Performed service intervention in each one of the installed 4 high temperature enclosed flares on 08/06/2015 for addressing detected undesirable and abnormal intermittent/sporadic vibration + noise problems in the flares (resulting in higher nameplate LFG flaring capacity for each flare"*)

facility started to operate from its new and permanent location (on the basis of operation of 2 flares only, however with 4 flares now available (where "Flare 1" and "Flare 4" were not yet under operation)). During the shortest 14-day share of the considered monitoring period from 18/12/2015 to 31/12/2015 the project activity thus operated with collected LFG being flared in its new and current location of the flaring facility. While 2 of the flares became under operational conditions only on 12/04/2016 (thus after the end of the considered monitoring period), during the entire considered monitoring period, the project activity has operated continuously on the basis of operation of only 2 of 4 flares that are part of the project activity ("Flare 3" and "Flare 2"). Limited interruptions in operation of the whole project activity indeed occurred during the considered monitoring period (e.g. for addressing safety and operational requirements in the context of the moving work and other reasons) with the largest period under full interruption of operations reaching about 24 hours (from 17/12/2015 to 18/12/2015)[12].

As a result of the occurred change in the location of the project's LFG flaring facility, the disposition lay-out for main equipment (flares, valves, pipes, etc.) slightly changed in its new location. Moreover, under its new location, the project's LFG facility uses 3 new 4-stage and more efficient centrifugal blowers that were installed and started operating on 18/12/2015 (thus replacing 4 old 3-stage centrifugal blowers and promoting increase in the total combined LFG suction/collection capacity). Furthermore, as an additional improvement in the project activity, a new programmable logic controller (PLC) unit and new electronic database for monitoring records were also installed for the project activity and also started to operate on 18/12/2015 (with the old database being kept available for sake of historical monitoring data archiving).

It is crucial to note that, as a result of all performed internal testing and commissioning work for the project's LFG flaring facility under its new location, it was confirmed that occurred slight change in the disposition lay-out for main equipment/instruments for the project's LFG destruction facility (when compared to the disposition lay-out for such equipment/instruments under the former location of the flaring facility) does not negatively affect the functioning and operational requirements for the installed flares, valves and/or ancillary equipment. Thus, all operational requirements for the installed high temperature flares will be potentially remain being met along the remaining share of 2nd 7-year crediting period for the project activity and/or along its expected remaining lifetime. Moreover, the lay-out of the project's main LFG transportation pipelines across the landfill was also partially modified (by taking into account the new location of the LFG destruction facility)[13].

[12] While the starting date of the considered monitoring period is 16/05/2015 and the occurred gradual moving process for the project's LFG flaring facility started a bit later in mid-June 2015, it is also relevant to note that due to the also occurred performance of a service intervention in each one of the installed 4 high temperature enclosed flares on 08/06/2015 (for addressing detected undesirable and abnormal intermittent/sporadic vibration + noise problems in the flares) (as further described in Section B.2.6), the flares were also with operations interrupted in the beginning of June 2016. Furthermore, due to operational reasons involving MSW disposal at the CTR Caieiras landfill during May/2015 and June/2015, several project's LFG collection wells had to be partially disconnected from the project activity, thus promoting relative reduction/decrease in the typical flow of collected LFG. Due to these operational aspects/reasons, during the initial share of the considered monitoring period (from 16/05/2015 to mid-June 2015 (when the gradual moving process for the flaring facility was in fact initiated)), the project activity also operated only on the basis of two flares.

[13] As further explained in Section B.2.6, prior of the starting the of the gradual moving process for the project's LFG destruction facility, a service intervention was performed in each one of the installed 4 high temperature enclosed flares on 08/06/2015. The service intervention work was fully performed by technical service representatives authorized by the flares' designer and manufacturer BTS - Termodinâmica de Sistemas Ltda. The performed intervention aimed primarily to address previously detected undesirable and abnormal intermittent/sporadic vibration + noise problems in the flares and included redesign of the LFG burner unit in each flare (through the replacement of the previously assembled 5 LFG injectors in the burner unit by 5 new and larger injectors (with slightly higher LFG firing capacity)) + related inspection/testing/commissioning services. While the performed service intervention resulted in slight increase in the maximum nameplate LFG flaring capacity of all flares (max. flow of LFG to be sent to the flare), it is addressed as permanent post-registration change in the project design. The revised version of the PDD also addresses this post-registration change.

Operation of the project activity during the considered monitoring period in the former location of the LFG flaring facility:
During the 216-day share of the considered monitoring period encompassing the period from 16/05/2015 to 17/12/2015, the flares referred as “Flare 1” and “Flare 4” regularly operated (with minor interruptions) from the former location of the project’s LFG flaring facility.

Operation of the project activity during the considered monitoring period in the new location of the LFG flaring facility:
Within the considered monitoring period, during the 14-day share of the considered monitoring period encompassing the period from 18/12/2015 to 31/12/2015, as a result of the starting of the operation of the project’s LFG flaring infrastructure from its new permanent location, the flares referred as “Flare 2” and “Flare 3” have operated from their new location.

Figure 2 – Indication of the previous (until 17/12/2015) and current (since 18/12/2015) locations of the project’s LFG destruction facility within the limits of the CTR Caieiras landfill

During the largest 216-day share of the considered monitoring period encompassing the period from 16/05/2015 to 17/12/2015 (time within the considered monitoring period that the project

activity operated with LFG being combusted in the LFG flaring facility in its former location), collected LFG has been sucked and pressurized by the previously installed 5 centrifugal blowers powered by electricity motors.

During the shortest 14-day share of the considering monitoring period encompassing the period from 18/12/2015 to 31/12/2015 (time within the considered monitoring period that the project activity operated with LFG being combusted in the LFG flaring facility in its new location), collected LFG has been sucked and pressurized by the installed 3 new centrifugal blowers powered by electricity motors[14].

Under both locations of the project's LFG flaring facility, after passing through the centrifugal blowers, temperature of collected LFG is significantly increased (typical temperature increment of about 30°C or more). The quantity and quality of collected LFG that is sent to each one of the high temperature enclosed flares under operation are measured by following applicable guidance of ACM0001 (version 13.0.0) and the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0) (with Option C being applied). Thus, the determination of the absolute humidity of the gaseous stream is not required. Fraction of CH_4 in collected LFG stream as well as LFG flow for each individual flare (monitoring parameters "Volumetric flow of LFG stream in time interval *t* on a wet basis" ($V_{t,wb}$) and "Volumetric fraction of CH_4 in the collected LFG in time interval *t* on a wet basis" ($v_{CH4,t,wb}$) respectively) are thus both assumed as monitored on the same basis.

As per construction and operational design of the CTR Caieiras landfill, a geo-membrane of PVC or similar material is expected to be eventually installed to cover disposed MSW by the time of the closure of the cells of the landfill. While no cell of the CTR landfill has so far achieved its final configuration, no geo-membrane has been installed to cover disposed MSW so far[15].

During the largest 216-day share of the considered monitoring period encompassing the period from 16/05/2015 to 17/12/2015, the project's LFG destruction facility operated under the following equipment/instrument configuration (while having collected LFG combusted in the former location of the LFG flaring facility):

- 3 condensation trap to separate liquids in the collected LFG (leachate and condensate);
- 1 centrifugal blower manufactured by Anton Blaselbauer Artécnica Ltda. powered by electric motor with nameplate power of 125 HP (93.2 kW).
- 2 centrifugal blower manufactured by Anton Blaselbauer Artécnica Ltda. powered by electric motors with nameplate power of 100 HP (74.5 kW).
- 2 centrifugal blower manufactured by Anton Blaselbauer Artécnica Ltda. powered by electric motors with nameplate power of 200 HP (149.1 kW).
- LFG monitoring equipment/instruments:
    - LFG mass flow meters (1 flow meter for each one of the 2 operational high temperature enclosed flares during the period)
    - LFG temperature sensor,
    - LFG pressure sensor,
    - $CH_4/O_2/CO_2$ content gas analyzer,
    - Thermocouples (1 thermocouple for each enclosed flare under operation during the period (to measure temperature in the exhaust gases of the flare))
    - UV flame detectors (1 flame detector in each enclosed flare (to monitor the operational and flame status of each one of the installed flares))s

[14] A 4th blower manufactured by Anton Blaselbauer Artécnica Ltda. powered by electric motors with nameplate power of 100 HP (74.5 kW) was partially installed/positioned at the new/current location of the LFG flaring facility in December 2015. However, until the end of the considered monitoring period, this particular blower was neither completely assembled (electrical installation was yet to be concluded), nor under operation.

[15] It is important to note that as per the design of the CTR Caieiras landfill, geo-membrane is actually placed in the bottom and sides of the cells of the landfill (prior of disposing MSW in the cell area) for sealing purposes.

- 2 high temperature enclosed flares manufactured by BTS - Termodinâmica de Sistemas Ltda. (with 2 of the 4 existent flares ("Flare 3" and "Flare 2") not connected to the project activity during the period)
- 2 electricity meters (one of the electricity meters is used for measuring electricity consumption of the fourth blower only). Installed electricity meters are manufactured by Kron Medidores Ltda. These electricity meters are used to measure the consumption of grid-sourced electricity by the project's related equipment.

During the shortest 14-day share of the considered monitoring period encompassing the period from 18/05/2015 to 31/12/2015, the project's LFG destruction facility operated under the following equipment/instrument configuration (while having collected LFG combusted in the new location of the LFG flaring facility (of which had the disposition lay-out for main equipment (flares, valves, pipes, etc.) slightly changed when compared to its former location):

- 1 new condensation trap to separate liquids in the collected LFG (leachate and condensate);
- 3 7,000 Nm^3/h 4 stage centrifugal blower manufactured by Houston Service Industries - HSI) powered by electric motor with nameplate power of 200 HP (149 kW).
- 1 centrifugal blower manufactured by Anton Blaselbauer Artécnica Ltda. powered by electric motors with nameplate power of 100 HP (74.5 kW), currently not under operation, and still being assembled.
- LFG monitoring equipment/instruments:
    - LFG mass flow meters (1 flow meter for each one of the 2 operational high temperature enclosed flares during the period)
    - LFG temperature sensor,
    - LFG pressure sensor,
    - $CH_4/O_2/CO_2$ content gas analyzer,
    - Thermocouples (1 thermocouple for each enclosed flare under operation during the period (to measure temperature in the exhaust gases of the flare))
    - UV flame detectors (1 flame detector in each enclosed flare (to monitor the operational and flame status of each one of the installed flares))s

- 2 high temperature enclosed flares manufactured by BTS - Termodinâmica de Sistemas Ltda. Ltda. (with 2 of the 4 existent flares ("Flare 1" and "Flare 4") not connected to the project activity during the period)
- 2 electricity meters (one of the electricity meters is used for measuring electricity consumption of the fourth blower only). Installed electricity meters are manufactured by Kron Medidores Ltda. These electricity meters are used to measure the consumption of grid-sourced electricity by the project's related equipment.

Further details about monitoring instruments/equipment are included in Section D.2.

Since the 2nd semester of year 2013 the project's monitoring system and procedures is upgraded in order to meet all additional monitoring requirements established by the CDM baseline and monitoring methodology ACM0001 (version 13.0.0) + applicable methodological tools (as described and predicted in the PDD). As outlined in the revised PDD, Essencis Soluções Ambientais S.A. worked on the required changes in terms of monitoring equipment/instruments and related monitoring procedures (e.g. procurement for new equipment/instruments (e.g. additional LFG flow meters, flame detectors in the flares, etc.), review of monitoring and working procedures, etc.) in order to have the project activity meeting applicable monitoring requirements of ACM0001 (version 13.0.0) + applicable methodological tools.

The following pictures provide overview of the project activity's infrastructure as per the configuration of the LFG flaring facility in its former location (valid for the largest 216-day fraction of the considered monitoring period encompassed by the period from 16/05/2015 to 17/12/2015):

Figure 3 – Partial view of the LFG destruction station (LFG pipeline, blowers and condensation traps) (valid for the project equipment displacement/configuration in place during the largest 216-day share of the considered monitoring period encompassing the period from 16/05/2015 to 17/12/2015[16] when the project's LFG flaring facility operated from its former location) Picture dated year 2013.

[16] The changes in the location and displacement of equipment that is part of the project's LFG destruction facility (incl. high temperature enclosed flares, centrifugal blowers, monitoring instruments/equipment, etc.) were performed in the context of the occurred gradual moving of the whole installed project's LFG destruction infrastructure (project's LFG flaring facility) to other area/region within the CTR Caieiras landfill during the period from mid-June 2015 to 12 April 2016. Further details are made available in Section B.1 under "*Box 1: Occurred gradual moving of the whole installed project's LFG destruction infrastructure (project's LFG flaring facility) to other area/region within the CTR Caieiras landfill during the period from mid-June 2015 to 12 April 2016 (with the project activity operating under reduced activity level during the period).*"

Figure 4 – Partial view of the project's LFG destruction plant (valid for the project equipment displacement/configuration in place in place during the largest 216-day share of the considered monitoring period encompassing the period from 16/05/2015 to 17/12/2015 when the project's LFG flaring facility operated from its former location and with "Flare 2" and "Flare 3" not under operational status) Picture dated year 2013.

Figure 5 – Aerial view of the project's LFG destruction plant valid for the project equipment displacement/configuration in place (valid for the largest 216-day share of the considered monitoring period encompassing the period from 16/05/2015 to 17/12/2015 when the project's LFG flaring facility operated from its former location and with "Flare 2" and "Flare 3" not under operational status). Picture dated year 2013.

The following pictures provide overview of the project activity's infrastructure as per the configuration of the LFG flaring facility in its new location (valid for the shortest 14-day fraction of the considered monitoring period encompassed by the period from 18/12/2015 to 31/12/2015):

Figure 6 – Partial view of the LFG destruction station (LFG pipeline, blowers and condensation traps) (valid for the project equipment displacement/configuration in place during the shortest 14-day share of the considered monitoring period encompassing the period from 18/12/2015 to 31/12/2015 when the project's LFG flaring facility operated from its current location and with "Flare 1" and "Flare 4" not under operational status). Picture dated April 2016.

In general, the project activity was implemented and has operated under full conformance with the previously conceived project design (as described in the revised version of the PDD)[17].

During the considered monitoring period, the project activity faced events when it became temporarily out of operation due to different reasons (work related to the occurred gradual moving of the whole installed project's LFG destruction infrastructure (project's LFG flaring facility) to other area/region within the CTR Caieiras landfill during the period from mid-June 2015 to 12 April 2016 (as further described in Section B.1), performance of the service intervention in the flares (as further described in Section B.2.6), occurred temporarily interruption in the supply of grid-sourced electricity, occurred previously planned and unplanned equipment maintenance/repair events, occurred performance of regular calibration events, events of drainage of condensate from the project's LFG pipeline, identification of unexpected problems in the PLC panel, data communication problems, etc.).
Furthermore, it is also crucial to note that due to both the occurred gradual moving of the whole installed project's LFG destruction infrastructure (project's LFG flaring facility) to other area/region within the CTR Caieiras landfill during the period from mid-June 2015 to 12 April 2016 and lack of operational LFG collection infrastructure covering all the whole area of the landfill, the project

[17] As outlined in Section B.6.2, the occurred change in the location of the project's LFG destruction facility (with slightly changes in the disposition lay-out of main equipment) (that is addressed in Box 1) and the occurred change in the nameplate flaring capacity of the installed high temperature enclosed flares (as a result of the occurred rebuild of the flares' burner units (incl. replacement of LFG injectors)) are acknowledge as representing permanent post-registration changes in the project design that does not promote potential adverse impacts over the previously demonstrated additionality of the project activity and/or its determination of the baseline scenario. These assumed post-registration changes (PRCs) are addressed as per applicable procedure for post-registration changes under the so-called "issuance" process track for PRCs and resulted in a revised version of the PDD.

activity operated under reduced activity level during the whole considered monitoring period. That is reflected in a significant relative reduction in the amount of LFG sent to the flares for combustion when compared to related estimates as per the provisions of both the currently registered and revised versions of the PDD valid for the 2nd 7-year crediting period of the project activity. During the whole considered monitoring period, the project activity operated with only 2 of the 4 project's high temperature enclosed flares under operation.

The CTR Caieiras landfill is regarded as a very well-designed and well-managed landfill. It applies the best practice in Brazil in terms of landfill design and operation. As established by the valid environmental and operational permits, disposed MSW is constantly covered and levelled with the use of heavy equipment (excavators, compacting equipment, etc.). Furthermore, safety requirements are defined and addressed as part of the operation of the landfill by using a preventative approach. No practice to increase the amount of methane generated at the CTR Caieiras landfill has ever been applied. While the project activity represents real improvement in terms of LFG management at the landfill when compared to the situation prior to the implementation of the project activity (baseline scenario), no change in terms of MSW disposal practice at the CTR Caieiras landfill was ever promoted or influenced by the project activity. Further details are included in Section D.2 (under details for the monitoring parameter "Management of SWDS").

Since the project's operation start in February 2007, no backup captive off-grid electricity generator has ever been used to meet the project's electricity demand during eventual interruptions of the supply of grid-sourced electricity to the project activity. While the local electricity grid is reliable (without regular interruptions in the supply of grid-sourced electricity), in the occasions there is interruption in supply of grid-sourced electricity, the operation of the project activity is temporarily interrupted. Currently it is not planned the installation of any backup captive off-grid electricity generator during the 2nd 7-year crediting period.

B.2. Post-registration changes

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

>>
Not applicable.

B.2.2. Corrections

>>

The following correction in information (that do not affect the project design) was performed in the currently registered version of the PDD (as reflected in the revised version of the PDD):

- Duplicated table with details for the monitoring parameter "Temperature in the exhaust gas of the enclosed flare in minute *m*" ($T_{EG,m}$) was deleted from Section B.7.1 of the PDD.
-

B.2.3. Changes to start date of crediting period

>>
Not applicable.

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

>>

Not applicable.

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

>>
Not applicable.

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

>>
The considered verification period encompasses 2 (two) occurred modifications in the project activity that are both considered and addressed as permanent post-registration changes in its design. The following permanent post-registration changes in the project design are considered:

1) *Occurred gradual moving of the whole installed project's LFG destruction infrastructure (project's LFG flaring facility) to other area/region within the CTR Caieiras landfill during the period from mid-June 2015 to 12 April 2016 (with the project activity operating under reduced activity level during the period):*
   As further detailed in Section B.1 (under Box 1), as result of a previously taken decision of Essencis Soluções Ambientais S.A. to utilize the area/region where the project's LFG destruction infrastructure (project's LFG flaring facility) was previously implemented and has operated since year 2007 within the CTR Caieiras landfill as a new MSW disposal area, such project's facility (incl. the installed 4 flares, 5 centrifugal blowers, 3 condensation traps, monitoring equipment/instruments, etc.) was thus required to be moved to other area/region of the landfill. The project activity's facility moving process was initiated in June 2015 and it was concluded on 12 April 2016 (thus after the end of the considered monitoring period).
   As also explained in Section B.1, during such transitional facility moving period the project activity operated under reduced LFG destruction activity level (with only 2 of the 4 existent flares under operation: during the considered monitoring period, the project's LFG flaring facility operated both from its former location (period until 17/12/2015, with two flares under operation: "Flare 1" and "Flare 4") and from its new location (period from 18/12/2015 onwards, also on the basis of operation of only 2 flares: "Flare 3" and "Flare 2").
   As an outcome of the conclusion of the gradual moving of the project's LFG destruction facility, the two other flares finally became under operational status in the new location of the project's LFG destruction facility later on 12/04/2016). Thus, since 12/04/2016 (thus after the end of the considered monitoring period), the project was once again able to operate by combusting collected LFG in 4 high temperature enclosed flares.
   Section B.1 includes relevant details about the occurred moving process within the considered monitoring period and its impact over the operation of the project activity within the period. In the context of the occurred gradual moving process of the LFG destruction facility, 3 new 4-stage and more efficient centrifugal blowers were purchased and were installed in the new location of the facility together transferred equipment/instruments (thus replacing the 4 old 3-stage centrifugal blowers that have operated since the start of operations of the project activity in year 2007). Furthermore, a new programmable logic controller (PLC) unit and new database for monitoring records were also installed for the project activity's LFG destruction facility under its new location and, like the new centrifugal blowers, also started to operate on 18/12/2015 (with the old database being kept available for sake of historical monitoring data archiving).
   The changed disposition lay-out for project's equipment under the new location of the project's LFG destruction facility (when compared to the equipment disposition lay-out as per the previously existent project's LFG destruction facility) does not negatively affect the functioning and operational requirements for the installed flares, valves and/or ancillary equipment. Thus, all operational requirements for the installed high temperature flares and all other relevant equipment will be potentially met along the remaining 2nd 7-year crediting period for the project activity.

While being assumed as an occurred permanent change in the project design, the occurred gradual moving of the whole installed project's LFG destruction infrastructure (project's LFG flaring facility) to other area/region within the CTR Caieiras landfill is acknowledged as not promoting any adverse impact over the previously assessed and demonstrated additionality of the project activity. The change does not adversely affects the application of the CDM baseline and monitoring methodology ACM0001 (version 13.0.0) + applicable methodological tools either. Finally, the previously defined scale of the project activity (registered as large-scale project activity) is not adversely impacted either. In accordance with applicable rules as per the latest version of the CDM Project Standard, the change is thus to be addressed as a PRC under the so-called "*issuance*" process track. For sake of completeness and transparency related details about the occurred gradual moving of the whole installed project's LFG flaring facility to other area/region within the CTR Caieiras landfill (and its new equipment disposition lay-out) are included a revised version of the PDD[18].

2) *Performed service intervention in each one of the installed 4 high temperature enclosed flares on 08/06/2015 for addressing detected undesirable and abnormal intermittent/sporadic vibration + noise problems in the flares (resulting in higher nameplate LFG flaring capacity for each flare):*
Prior of the starting the occurred moving process for the whole project's LFG destruction facility, a service intervention was performed in each one of the installed 4 high temperature enclosed flares on 08/06/2015: the service intervention was performed on 08/06/0215 for all the installed 4 high temperature enclosed flares. The performed service intervention was performed by technical service representatives authorized by the flares' designer and manufacturer BTS - Termodinâmica de Sistemas Ltda. and aimed primarily to address previously detected undesirable and abnormal intermittent/sporadic vibration + noise problems in the flares. The performed service intervention included redesign of the LFG burner unit in each flare (through the replacement of the previously existent 5 LFG injectors in the burner unit by 5 new and larger injectors (with higher firing capacity)) + related inspection + testing services. The performed service intervention successfully addressed the previously detected vibration + noise problems in the flares. By making use of slightly larger LFG injectors in the burner unit of the flares, the performed service intervention also resulted in slightly increase of the nameplate LFG flaring capacity for each one of the installed flares as confirmed by the flares' designer and manufacturer BTS - Termodinâmica de Sistemas Ltda. While for each installed flare, the recommended minimum LFG flaring capacity (for continuous operation) remains being 650 Nm^3/h, the technical maximum recommended LFG flaring capacity (for continuous operation) after the performed service intervention was confirmed by BTS - Termodinâmica de Sistemas Ltda. as being 7,500 Nm^3/h (and not any longer 6,500 Nm^3/h). Such flare specification change requires update in the previously defined value of maximum Operational LFG flow (for continuous operation) (in the context of the ex-ante defined parameter "Manufacturer's flare specifications for temperature, flow rate and maintenance schedule interval" ($SPEC_{flare}$)) as per the currently registered version of the PDD. Thus, the revised version of the PDD also includes updated value for maximum operational LFG flow (for continuous operation) (in the context of the ex-ante determined parameter $SPEC_{flare.}$).
While also being also assumed as an occurred permanent change in the project design, the flare specification change resulted from the performed service intervention is acknowledged as not promoting any adverse impact over the previously assessed and demonstrated additionality of the project activity either. The change does not adversely affects the application of the CDM baseline and monitoring methodology ACM0001 (version 13.0.0) + applicable methodological tools either. Finally, the previously defined scale of the project

[18] The revised version of the PDD addressing post-registration changes in the project design summarized in this section is made available to the Designated Operational Entity (DOE) responsible for the verification assessment encompassed by this Monitoring Report and it is expected to be assessed/validated accordingly.

activity (registered as large-scale project activity) is not adversely impacted either. Thus, in accordance with applicable rules as per the latest version of the CDM Project Standard, the change is thus also to be addressed as a PRC under the so-called "*issuance*" process track.

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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As part of the application of the designed monitoring plan valid for the 2nd 7-year crediting period, as reported in the PDD, LFG and flaring related monitoring data is automatically measured, processed and recorded with the use of related monitoring instruments/equipment, a Programmable Logic Controller (PLC) unit, and a database (with customized design and configuration) that are all integrated to a data supervisory system (SCADA) of which design and configuration customized to the project activity.

Until 17/12/2015, the previously installed PLC unit was utilized for continuously processing the project's monitoring measurements. From 18/12/2015 onwards, a new PLC unit was utilized for processing the project's monitoring measurements.

Until 17/12/2015, a SQL based was utilized for recording and archiving monitoring data. From 18/12/2015 onwards, a MS-Access based database has been used for recording and archiving monitoring data.

The project's data supervisor system that handle LFG and flaring related monitoring data is sourced by Elipse Software Ltda. (model: e3). In the second half of 2013, both the project's data supervisor system and the SQL based database were upgraded in order to have the project's monitoring system under full compliance with ACM0001 (version 13.0.0) + applicable methodological tools[19]. In December 2015, the main screen lay-out of the project's data supervisor system was upgraded in line with the new displacement of the project's LFG destruction facility as a result of its gradual moving to new area/region within the CTR Caieiras landfill (with the project's LFG flaring infrastructure starting to operate from this new location on 18/12/2015).
During the considered monitoring period, continuous measurements of LFG flow to each individual flare, LFG pressure, LFG temperature, LFG CH_4 content, LFG O_2 content, LFG CO_2 content[20], temperature of the exhaust gas (for each installed flare) and status of the flame detector (for each installed flare) were processed by the project's PLC unit and recorded within an every-minute frequency by the project's SQL format database.

As part of the implemented data reporting and emission reduction calculation procedures that are applicable for the 2nd 7-year crediting period of the project activity, two sets of data files (with set of LFG and flaring related monitoring records) are generated for each month of considered monitoring period as follows:

- One MS-Excel format spreadsheet file

[19] During the whole 1st 7-year crediting period for the project activity, both the project's data supervisor system and the SQL based database were configured in order to have the project's monitoring system under compliance with the applied previous version of ACM0001 (version 2).

[20] Continuous monitoring of LFG O_2 and CO_2 contents is not required as per ACM0001 (version 13.0.0) + applicable methodological tool. Moreover, the monitoring plan of the registered PDD does not refer to monitoring of LFG O_2 and CO_2 contents either. However, LFG O_2 and CO_2 contents are measured due to safety and operational requirements.

- One PDF format data file

Both data files contain LFG and flaring related monitoring records for every 1-month period encompassed by the considered monitoring period. While data in MS-Excel format is handled as a primary data input for the performance of emission reduction calculations (data is used as input data for the compilation of monthly emission reduction calculation spreadsheets that are enclosed to this Monitoring Report), the PDF format files (which also lists/reports all LFG and flaring related monitoring records in table format within an every-minute frequency for each month of the considered monitoring period) are kept in storage and are considered as proof of authenticity of data retrieved from the SQL/MS-Access databases and exported to MS-Excel format data.

The project's data supervisory system (which was linked to the previously available project's SQL database and that is currently linked to the currently available project's MS-Access database) includes in its user interface functionalities for regularly generating both MS-Excel format data as well as PDF format data files upon request of the system user (functions "*Exporta Excel*" and "*Exporta PDF*" respectively).

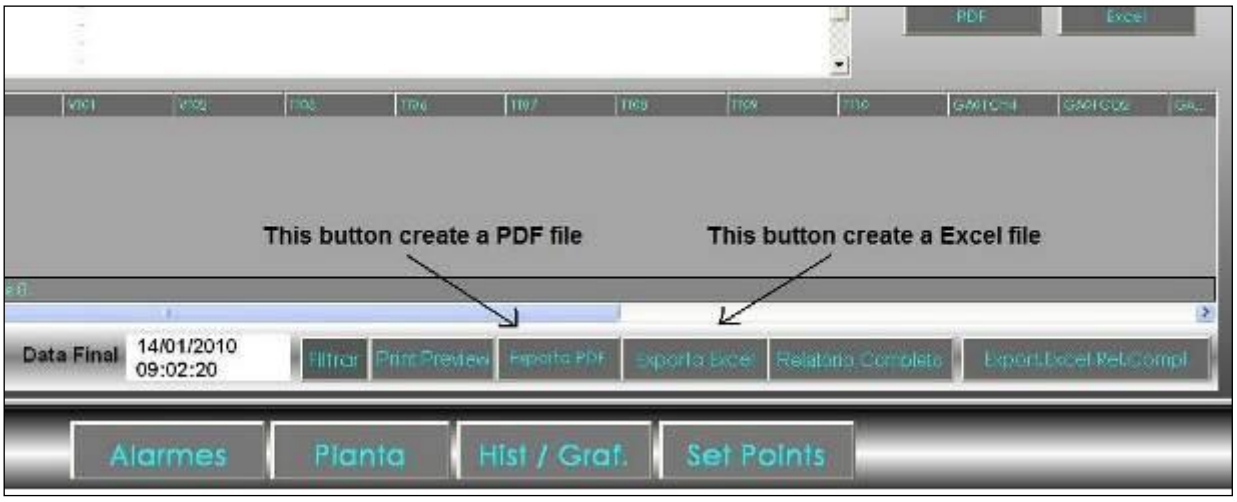


Figure 7 – Zoom view of the buttons (controls) in the user interface of the project's supervisory system that are used to generate MS-Excel format and PDF format files with every minute monitoring data

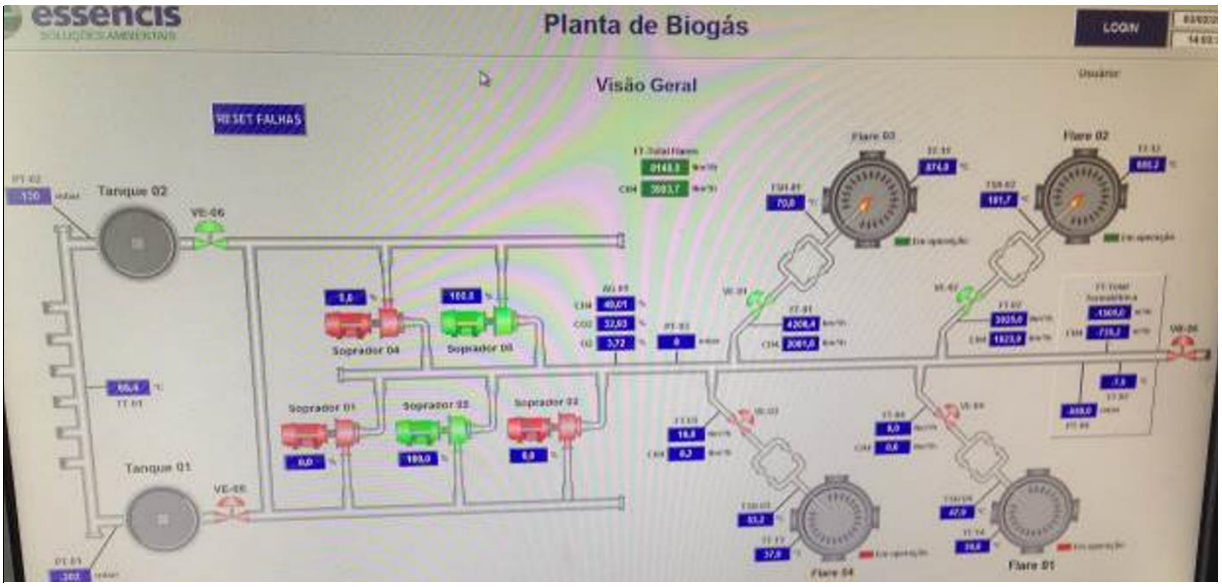


Figure 8 - General view of the screen lay-out of the project's data supervisor system (valid since 18/12/2015)

As per the project's operational procedure valid for the 2nd 7-year crediting period, the following routine (steps) is monthly performed by the project operational staff in order to appropriately report LFG and flaring (temperature of exhaust gas of the flares and flare status) related monitoring records:

1) Every month, a MS-Excel format spreadsheet data file with LFG and flaring related monitoring records (raw data files) is generated by using the functionality "*Exporta Excel*" of the project's supervisory system. Each generated file includes monitoring data reported for a full month. A PDF format data file with the same LFG and flaring related monitoring records is also generated for the month in question by using the functionality "*Exporta PDF*" of the project's supervisory system.

2) The content of every monthly raw data file (in MS-Excel format) is used as input data in customized and pre-formatted monthly MS-Excel format emission reduction calculation spreadsheet template/model (designed by the project participant Essencis Soluções Ambientais S.A.). This MS-Excel based template is internally denominated as "*MMYYYY*", where "*MM*" is the number of the month and "*YYYY*" is the year of the input data.

As per applicable documented working procedures, the project activity is managed by the CDM Project Superintendent at Essencis Soluções Ambientais S.A. The CDM Project Superintendent supervises the CDM Project supervisor who is the one in charge of all monitoring related activities (handling of data, preparation of the Monitoring Report and emission reduction calculation spreadsheet). Both the CDM Project Superintendent and the CDM Project supervisor are fully supported by CDM specialists (consultants) from the CDM consultancy company UniCarbo Energia e Biogás Ltda. The operation of the project activity and the application of the monitoring plan is responsibility of the CDM Project Supervisor, who reports all relevant project related issues to the CDM Project Superintendent (operation status of the project activity, results and events, collection and storage of monitoring data, calibration events, and maintenance of equipment). The CDM specialists (consultants) also support the project team in operational and monitoring related issues.

The diagram bellow shows the hierarchy for the project management.

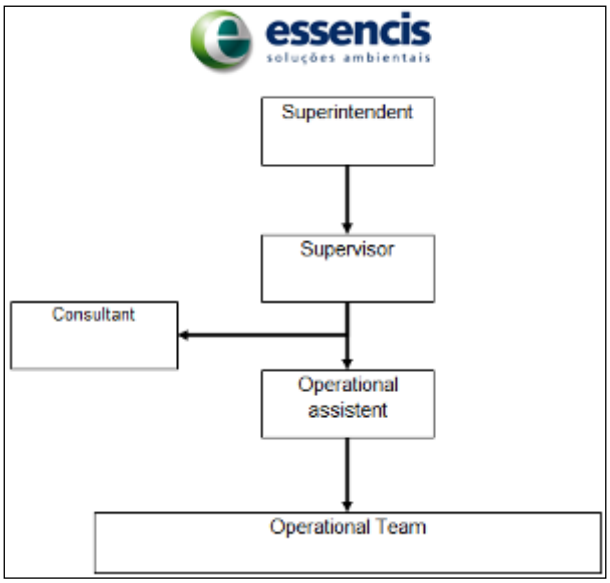


Figure 9 - Hierarchy for the project management of the project activity

The project's operational and management structure relies on trained staff with responsibilities clearly defined. All collaborators and employees involved with operation of project and/or monitoring are trained internally and/or externally. Training efforts includes *inter alia*:

a) General competence development about LFG generation and collection;
b) Review of equipment operational principles and captors;

c) Maintenance and calibration requirements for project's related equipment;
d) Procedures for monitoring data gathering and data handling[21];
e) Emergency and safety procedures.

The schematic diagram below illustrates the monitoring system of the project activity and summarizes the monitoring points for measuring instruments/equipment:

[21] While the PDD valid for the 2nd 7-year crediting period (that applies ACM0001 (version 13.0.0) + applicable methodological tools) includes somehow differentiated monitoring requirements (when compared to the PDD valid for the 1st 7-year crediting period (that applies ACM0001 (version 2), of which monitoring requirements were followed by the project's operational staff during the 1st crediting period from year 2007 to 2013); additional training were thus provided to the project's operational and monitoring staff in order to have such differentiated monitoring requirements being met. The project activity's monitoring infrastructure was also upgraded at the time of its renewal of the crediting period in order to fulfil such additional monitoring and methodological requirements.

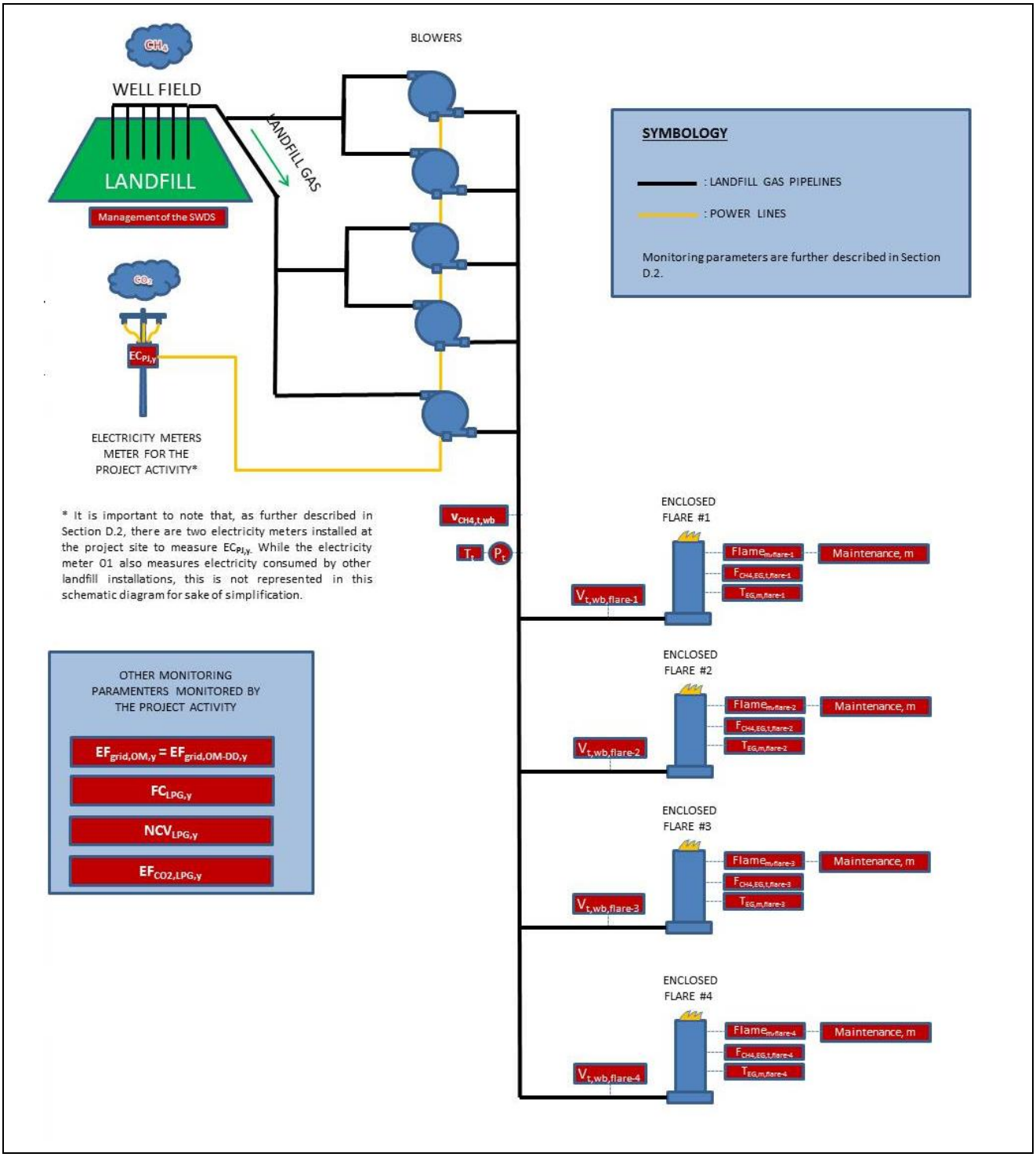


Figure 10 - Schematic diagram for the monitoring system of the project activity (monitoring points for measuring instruments/equipment) valid until 17/12/2015

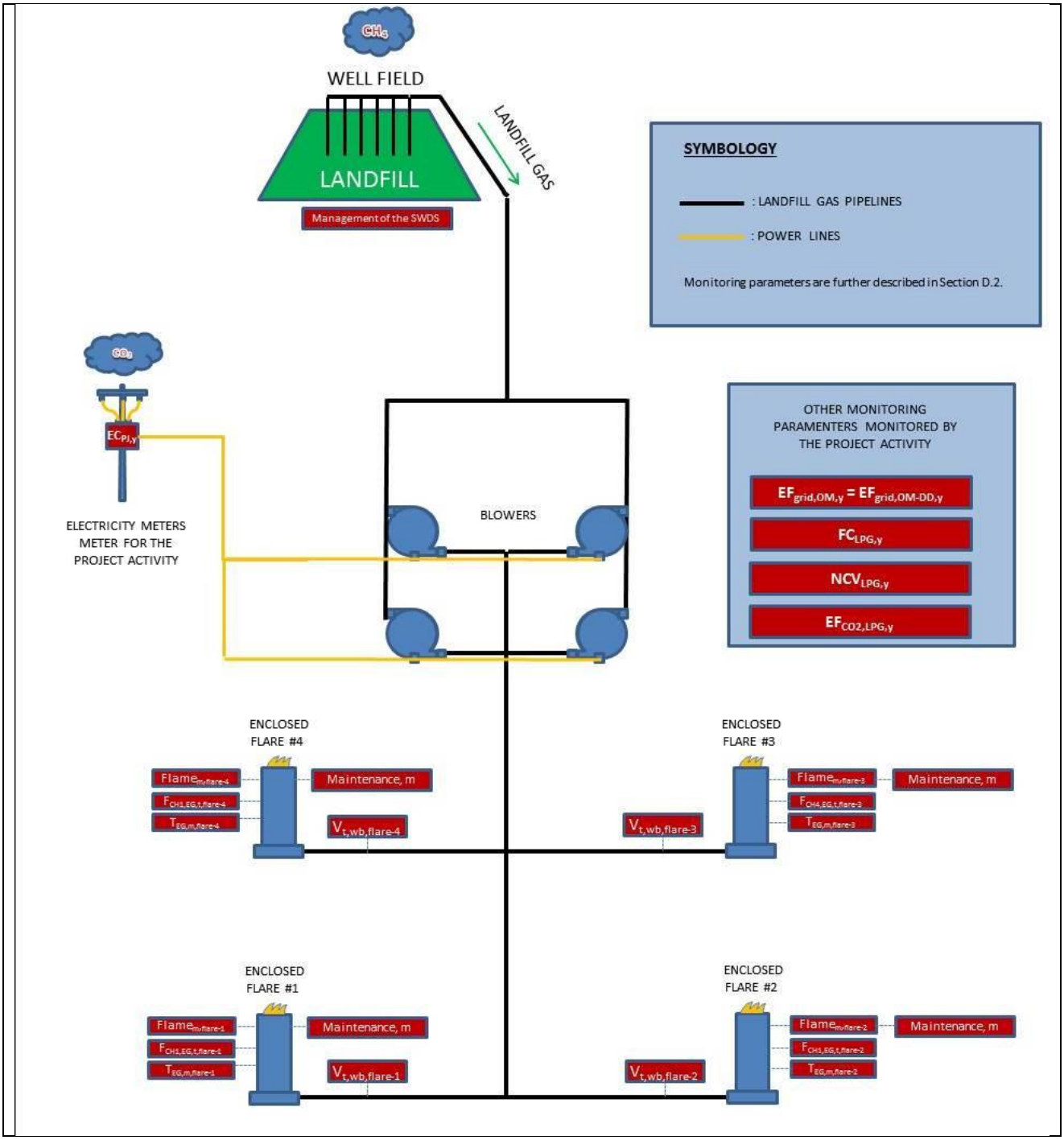


Figure 11 - Schematic diagram for the monitoring system of the project activity (monitoring points for measuring instruments/equipment) valid from 18/12/2015 onwards

SECTION D. Data and parameters

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

Data/parameter:	**OX_{top_layer}**
Unit	Dimensionless
Description	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline.
Source of data	The PDD refers to the default value as per the CDM baseline and monitoring methodology ACM0001 (version 13.0.0). The value is consistent with how oxidation is accounted for in the methodological tool “Emissions from solid waste disposal sites” (version 06.0.1).
Value(s) applied)	0.1
Choice of data or measurement methods and procedures	Default value as per the applied CDM baseline and monitoring methodology ACM0001 “Flaring or use of landfill gas” (version 13.0.0)
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data/parameter:	GWP_{CH4}
Unit	tCO_2/tCH_4
Description	Global Warming Potential of CH_4
Source of data	The PDD refers to the "Global Warming Potential for Given Time Horizon" in table 2.14 of the errata to the contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, based on the effects of greenhouse gases over a 100-year time horizon. Available at: www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14 The applied value is also in accordance with the "Standard for application of the global warming potential to clean development mechanism project activities and programmes of activities for the second commitment period of the Kyoto Protocol".
Value(s) applied)	25
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	**-**

Data/parameter:	R_u
Unit	$Pa.m^3/kmol.K$
Description	Universal ideal gases constant
Source of data	The PDD refers to the default value as per the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0).
Value(s) applied)	8,314
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	**-**

Data/parameter:	**MM_k**
Unit	kg/kmol
Description	Molecular mass of gas *k*
Source of data	The PDD refers to the default value as per the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0).
Value(s) applied)	As outlined in the PDD, for considered gases *k* that are greenhouse gases (GHGs), the values in the table below are applied for MM_i. As per the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream": "*The determination of the molecular mass of the gaseous stream ($MM_{t,db}$) requires measuring the volumetric fraction of all gases (k) in the considered gaseous stream. However as a simplification, only the volumetric fraction of gases k that are greenhouse gases and are considered in the emission reduction calculation in the underlying methodology must be monitored and the difference to 100% may be considered as pure nitrogen. The simplification is not acceptable if it is differently specified in the underlying methodology.*" ACM0001 (version 13.0.0) does not include any restriction to such simplification. Thus, only the volumetric fraction of gases that are greenhouse gases and are considered in related calculations (CH_4 in the particular case of the project activity) should be considered and the difference to 100% is just considered as pure nitrogen. Compound: Nitrogen; Structure: N_2; Molecular mass (kg/mol): 28.01
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	**-**

Data/parameter:	**MM_i**
Unit	kg/kmol
Description	Molecular mass of greenhouse gas *i*
Source of data	The PDD refers to the default value as per the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0).
Value(s) applied)	As outlined in the PDD, the following value of molecular mass is applicable for CH_4 (the only GHG which is considered): Compound: Methane; Structure: CH_4; Molecular mass (kg/mol): 16.04
Choice of data or measurement methods and procedures	-

Purpose of data	Calculation of baseline emissions
Additional comments	-

Data/parameter:	**P_n**
Unit	Pa
Description	Total pressure at normal conditions
Source of data	The PDD refers to the default value as per the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0).
Value(s) applied)	101,325
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	In accordance with the PDD, since measurements of LFG flow are automatically converted and recorded in normalized cubic meters (by considering standard temperature and pressure (STP) conditions), the ex-ante determined parameters Temperature at normal conditions (T_n) and Total pressure at normal conditions (P_n) are not considered.

Data/parameter:	**MM_{H2O}**
Unit	kg/kmol
Description	Molecular mass of water
Source of data	The PDD refers to the default value as per the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0).
Value(s) applied)	18.0152
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	-

Data/parameter:	**T_n**
Unit	K
Description	Temperature at normal conditions
Source of data	The PDD refers to the default value as per the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0).
Value(s) applied)	273.15
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comments	In accordance with the PDD, since measurements of LFG flow are automatically converted and recorded in normalized cubic meters (by considering standard temperature and pressure (STP) conditions), the ex-ante determined parameters Temperature at normal conditions (T_n) and Total pressure at normal conditions (P_n) are not considered.

Data/parameter:	**$TDL_{grid,y}$**
Unit	Dimensionless
Description	Average technical transmission and distribution losses for grid sourced electricity consumed by the project activity.
Source of data	The PDD refers to the applicable default as per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01).
Value(s) applied)	20%
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of project emissions (due to consumption of grid-sourced electricity by the project activity).
Additional comments	**-**

Data/parameter:	**w_{BM}**
Unit	%
Description	Weighting of build margin emissions factor
Source of data	The PDD refers to the applicable default value as per the "Tool to calculate the emission factor for an electricity system" (version 03.0.0). The selected value is valid for the whole 2nd 7-year renewable crediting period.
Value(s) applied)	0.75 (75%)
Choice of data or measurement methods and procedures	The applicable value valid for 2nd crediting period as per the "Tool to calculate the emission factor for an electricity system" (Version 3.0.0) is selected.
Purpose of data	Calculation of project emissions (due to consumption of grid-sourced electricity by the project activity).
Additional comments	**-**

Data/parameter:	**w_{OM}**
Unit	%
Description	Weighting of operating margin emissions factor
Source of data	The PDD refers to the applicable default value as per the "Tool to calculate the emission factor for an electricity system" (version 03.0.0). The selected value is valid for the whole 2nd 7-year renewable crediting period.
Value(s) applied)	0.25 (25%)
Choice of data or measurement methods and procedures	The applicable value for the 2nd crediting period as per the "Tool to calculate the emission factor for an electricity system" (version 3.0.0) is selected.
Purpose of data	Calculation of project emissions (due to consumption of grid-sourced electricity by the project activity).
Additional comments	**-**

<table>
<tr><td>Data/parameter:</td><td>$SPEC_{flare}$</td></tr>
<tr><td>Unit</td><td>°C (for temperature values)
Nm^3/h (for LFG flow values)
Number of days (for maintenance schedule interval values)</td></tr>
<tr><td>Description</td><td>Manufacturer's flare specifications for temperature, flow rate and maintenance schedule interval.</td></tr>
<tr><td>Source of data</td><td>The PDD refers to data as per the flares's designer and manufacturer. Data is used as a reference for later ex-post determination of values of flare efficiency ($\eta_{flare,m}$) for each individual high temperature enclosed flare in the context of determination of baseline emissions.</td></tr>
<tr><td>Value(s) applied)</td><td>Flare 1, Flare 2, Flare 3 and Flare 4:
<table>
<tr><td>$SPEC_{flare,\ Flare\ 1}$
$SPEC_{flare,\ Flare\ 2}$
$SPEC_{flare,\ Flare\ 3}$
$SPEC_{flare,\ Flare\ 4}$</td><td>Min.</td><td>Max.</td></tr>
<tr><td>Operational LFG flow for each flare (for continuous operation):</td><td>650 Nm^3/h</td><td>6,500 Nm^3/h (until the occurred performance of service intervention in early June 2015)

7,500 Nm^3/h (after the occurred performance of service intervention in early June 2015)[22]</td></tr>
<tr><td>Required temperature of the exhaust gas of the flare (to ensure LFG destruction (combustion) under high CH_4 destruction efficiency):</td><td>500 °C</td><td>1,200 °C</td></tr>
<tr><td>Required minimum frequency for inspection and maintenance service in each flare (incl. inspection in the conditions of the flare isolation ceramics revetment material):</td><td colspan="2">Min. every 6 months</td></tr>
<tr><td>Required/recommended minimum frequency for replacement of the flare isolation ceramics revetment material in each flare:</td><td colspan="2">after 10 years of regular and appropriate operation</td></tr>
</table></td></tr>
</table>

[22] As further explained in Section B.2.6, a service intervention was performed in each one of the installed 4 high temperature enclosed flares on 08/06/2015 aiming to address/solve previously detected undesirable and abnormal

intermittent/sporadic vibration + noise problems in the flares. The service intervention was performed on 08/06/2015 for all flares.
The performed service intervention included redesign of the LFG burner unit in each flare (through the replacement of the previously existent 5 LFG injectors in the burner unit by 5 new and larger injectors (with higher firing capacity)) + related inspection + testing services. The performed service intervention successfully addressed the previously detected vibration + noise problems in the flares. By making use of slightly larger LFG injectors in the burner unit of the flares, the performed service intervention also resulted in slight increase of the nameplate LFG flaring capacity for each one of the installed flares. These changes in the specification of the flares after the performance of the service intervention was confirmed by the flare manufacturer BTS - Termodinâmica de Sistemas Ltda. as follows: while for each installed flare, the recommended minimum LFG flaring capacity (for continuous operation) remains being 650 Nm^3/h, the technical maximum recommended LFG flaring capacity (for continuous operation) after the performed service intervention was confirmed by BTS - Termodinâmica de Sistemas Ltda. as being 7,500 Nm^3/h (and not any longer 6,500 Nm^3/h).
While also being assumed as an occurred permanent change in the project design, the flare specification change resulted from the performed service intervention is acknowledged as not promoting any adverse impact over the overall function of the flares. The occurred service intervention in the flares is addressed as a permanent post-registration change in the project design (since the specifications of the flares are modified).

By taking into account the performed service intervention in the flares on 08/06/2015 and its impact over the ex-ante determined parameter "Manufacturer's specification for the flare" ($SPEC_{flare}$), the following criteria/conditions are taken into account for the determination of the flare efficiency in the context of determination of project emissions from flaring during the considered monitoring period:

- Until 08/06/0215 at 08:59, for each minute *m,* the flow rate LFG sent to the flares referred as "Flare 2" and "Flare 3" (sub-monitoring parameters $F_{CH4,RG,m,flare-2} = F_{CH4,sent\_flare,y,flare-2}$ and $F_{CH4,RG,m,flare-3} = F_{CH4,sent\_flare,y,flare-3}$) should not be higher than 6,500 Nm^3/h; otherwise flare efficiency is assumed as 0% and no emission reductions are therefore accounted for LFG combusted in these flares in the minute *m* in question.

- Until 08/06/0215 at 13:59, for each minute *m,* the flow rate LFG sent to the flares referred as "Flare 1" and "Flare 4" (sub-monitoring parameters $F_{CH4,RG,m,flare-1} = F_{CH4,sent\_flare,y,flare-1}$ and $F_{CH4,RG,m,flare-4} = F_{CH4,sent\_flare,y,flare-4}$) should not be higher than 6,500 Nm^3/h; otherwise flare efficiency is assumed as 0% and no emission reductions are therefore accounted for LFG combusted in these flares in the minute *m* in question.

- From 09:00 of 08/06/0215 onwards, for each minute *m,* the flow rate LFG sent to the flares referred as "Flare 2" and "Flare 3" (sub-monitoring parameters $F_{CH4,RG,m,flare-2} = F_{CH4,sent\_flare,y,flare-2}$ and $F_{CH4,RG,m,flare-3} = F_{CH4,sent\_flare,y,flare-3}$) should not be higher than 7,500 Nm^3/h; otherwise flare efficiency is assumed as 0% and no emission reductions are therefore accounted for LFG combusted in these flares in the minute *m* in question.

- from 14:00 of 08/06/0215 onwards, for each minute *m,* the flow rate LFG sent to the flares referred as "Flare 1" and "Flare 4" (sub-monitoring parameters $F_{CH4,RG,m,flare-1} = F_{CH4,sent\_flare,y,flare-1}$ and $F_{CH4,RG,m,flare-4} = F_{CH4,sent\_flare,y,flare-4}$) should not be higher than 7,500 Nm^3/h; otherwise flare efficiency is assumed as 0% and no emission reductions therefore are accounted for LFG combusted in these flares in the minute *m* in question.

In the particular case of the considered monitoring period, it is however noteworthy the following:

- During the largest 216-day share of the considered monitoring period from 16/05/2015 to 17/12/2015, the project activity operated mostly with collected LFG being flared on the basis of operation of the 2 flares referred as "Flare 1" and "Flare 4" (Note: an exception for this fact is a short period encompassing about 5 hours in June 2015 (from about 09:00 AM to about 02:00 PM on 08/06/2015) where, as part of the testing and commissioning work in the context of the performed service intervention in the flares, the project activity operated on the basis of the flares referred as "Flare 2" and "Flare 3" during such short period (instead of the flares referred as "Flare 1" and "Flare 4")).
- During the shortest 14-day share of the considered monitoring period from 18/12/2015 to 31/12/2015 the project activity thus operated with collected LFG being flared on the basis of operation of the 2 flares referred as "Flare 2" and "Flare 3".

Further details about such performed service intervention in the flares are included in Section B.2.6 (under "*2 - Performed service intervention in each one of the installed 4 high temperature enclosed flares on 08/06/2015 for addressing detected undesirable and abnormal intermittent/sporadic vibration + noise problems in the flares (resulting in higher nameplate LFG flaring capacity for each flare"*)

Choice of data or measurement methods and procedures	As established by the methodological tool "Project emissions from flaring", the flare specifications and operational + maintenance requirements (as set/recommended by the equipment manufacturer) are documented and considered for the ex-ante determination of applicable values for the parameter $SPEC_{flare}$. During the 2nd 7-year crediting period, ex-ante selected data will be compared against monitored data related to the operation of the flares, including: a) Minimum and maximum monitoring records for data regarding inlet LFG flow rate, (b) Minimum and maximum monitoring records for data of temperature in the exhaust gas of each individual high temperature enclosed flare; and (c) Duration in days of time periods between maintenance events for each individual high temperature enclosed flare.
Purpose of data	Calculation of baseline emissions
Additional comments	All flare specification and operation details/requirements are based on information provided by the equipment manufacturer.

Data/parameter:	**$EF_{grid,BM,y}$**
Unit	tCO_2/MWh
Description	Build margin CO2 emission factor in year *y*
Source of data	As outlined in the PDD, data is ex-ante determined as per applicable guidance of the "Tool to calculate the emission factor for an electricity system" and value is valid for the whole 2nd 7-year crediting period. The selected value is the value calculated by the DNA of Brazil and valid for year 2012 ($EF_{grid,BM,2012}$).
Value(s) applied)	0.2010
Choice of data or measurement methods and procedures	Data is determined as per applicable guidance of the "Tool to calculate the emission factor for an electricity system" valid for 2nd crediting period.
Purpose of data	Calculation of project emissions (due to consumption of grid-sourced electricity by the project activity).
Additional comments	-

Ex-ante determined parameters not used in the context of ex-post determination and calculation of emission reductions achieved by the project activity:

The following ex-ante determined parameters (that are also included in the PDD) are not used for the purpose of ex-post determination of baseline emissions and project emissions achieved by the project activity during the considered monitoring period:

- Efficiency of the LFG capture system that will be installed in the project activity (η_{PJ})
- Default value for model correction factor to account for model uncertainties ($\varphi_{default}$)
- Oxidation factor (reflecting the amount of methane from the considered SWDS that is oxidized in the soil (or other material covering the waste)) (OX)
- Fraction of methane in the SWDS gas (volume fraction) (F)
- Fraction of degradable organic carbon (DOC) in MSW that decomposes in the considered SWDS ($DOC_{f,default}$)
- Methane correction factor (MCF)
- Fraction of degradable organic carbon in the waste type j (weight fraction) (DOC_j)
- Decay rate for the waste type *j* (k_j)
- Weight fraction of the waste type *j* (W_j)

As also outlined in the PDD, data for the above-listed parameters are used only in the context of ex-ante estimation of annual accumulated values for the "Amount of methane in the LFG which is destroyed or utilized by the project activity" ($F_{CH4,PJ,y}$) (in the context of ex-ante estimation of emission reductions to be achieved by the project activity during the 2nd 7-year renewable crediting period). Due to that, details for the above-listed parameters are not included in this Section as they are not relevant in the context of determination of emission reductions achieved by the project activity during the considered monitoring period. Relevant details for such not reported parameters are included in Section B.6.2 of the PDD.

D.2. Data and parameters monitored

Data/parameter:	**Management of SWDS**
Unit	Dimensionless
Description	Management of the SWDS
Measured/calculated/default	As per the adopted monitoring procedure for the project activity, the management of the CTR Caieiras landfill is yearly compared against the previously conceived original construction and operational design of the landfill in order to confirm that the overall management and operation for CTR Caieiras landfill (including relevant aspects related to landfilling practice) were not modified with the unique aim to increase generation of methane on site. By performing the checking annually, it is monitored whether any practice aiming to increase methane generation in the landfill has occurred. As required by ACM0001 (version 13.0.0), any change in the management of the landfill after the implementation of the project activity

	should be justified by referring to applicable technical or regulatory specifications.
Source of data	A technical evaluation was performed by the independent 3rd party engineering company "Cepollina Engenheiros Consultores Ltda.". The findings for the performed evaluations are reported in a declaration document issued by such company that is dated 29/01/2016 (a previous evaluation was also performed by Cepollina Engenheiros Consultores Ltda. on 20/05/2015). As part of the performed technical evaluation, the current configuration and operational conditions of the CTR Caieiras landfill were compared against the previously conceived design and operational conditions of the landfill prior to the implementation of the project activity on the basis of different sources, including inter alia: - Original design documents of the landfill (as described in the documentation required for all phases of the environmental licensing for the CTR Caieiras landfill); - Applicable local or national regulations - Expertise and experience of "Cepollina Engenheiros Consultores Ltda." with the CTR Caieiras landfill. Since January 2007 "Cepollina Engenheiros Consultores Ltda." has performed regular technical inspections at the CTR Caieiras landfill as part of the continuously performed assessment of geotechnical stability monitoring for the landfill cells. Such regular assessments are required by the competent environmental authority from São Paulo State (Companhia de Tecnologia de Saneamento Ambiental - CETESB) for the validity of the environmental and safety permit/licensing for the CTR Caieiras landfill.
Value(s) of monitored parameter	As outlined in the issued internal technical evaluation/declaration report dated 29/01/2016, the previously conceived original design of the landfill (dated prior to the implementation of the project activity) is confirmed not to being modified during the period from 01/02/2007 (date when the project activity started to operate) to 31/12/2015. This report confirms that no practice to increase methane generation at the CTR Caieiras landfill have occurred (when compared to management and MSW landfilling practices prior to implementation of the project activity). Aspects, conditions and circumstances related to management of the landfill (e.g. waste disposal, waste covering, waste compacting, management of leachate, draining of rainwater, etc.) were not changed with an aim to increase methane generation on site. It is relevant to note that MSW management business (collection and disposal of MSW) in Brazil (and in most of the developing countries) has its own economics, dynamics, politics and related regulations. That makes MSW disposal activity for the CTR Caieiras landfill and other similar landfills in Brazil completely independent from the CDM mechanism and/or revenues of commercialization of CERs generated by project based destruction of methane in landfills. In the particular case of the CTR Caieiras landfill, it is important to note that this landfill was designed and it has operated inter alia as per terms and conditions of the public service concession contracts established with the Administration of the Municipality of São Paulo. The design and operation of the landfill is also under conformance with terms and conditions for the environmental licensing that were previously defined and are regularly monitored by the competent environmental authority from São Paulo State (CETESB). While the occurrence of changes in the quantitative condition related to MSW disposal in this landfill (such as the occurred increment in the amount of disposed MSW in the landfill as explained in the PDD) are completely independent from the CDM project activity, the project activity per se does not represent any incentive for promoting a change in the

	management of the landfill in order to increase the amount of methane generated in the site. The registered CDM project activity does not encompass any MSW management related measures. Currently, there is still no climate change of waste management policy in Brazil which would provide an incentive or a mandate to have MSW being disposed in landfills with better/improved LFG collection / destruction systems (such as the project's LFG collection and destruction system currently implemented at the CTR Caieiras landfill). In this context, it is crucial to note that, regarding the amount of methane that is generated at the CTR Caieiras landfill and collected by the project activity, as outlined in the PDD (under Footnote 63 (Section B.6.1) and Footnote 79 (Section B.6.2)), significant amount of methane generated by the project activity has unfortunately not been collected and destroyed due to the lack of LFG collection infrastructure covering all regions of the very large CTR Caieiras landfill.
Monitoring equipment	Not applicable. No measuring equipment is used for monitoring management of the CTR Caieiras landfill.
Measuring/reading/recording frequency:	Annual checking is performed.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the project activity are performed at Essencis Soluções Ambientais S.A. in accordance with detailed working instructions that are included in the company's ISO 9001 and 14001 certified quality management and control (QA/QC) and environmental management system (EMS).
Purpose of data:	Calculation of baseline emissions
Additional comments:	As required by ACM0001 (version 13.0,0), any change in the management of the landfill after the implementation of the project activity will be justified by referring to technical or regulatory specifications and impacts of such changes in the determination of baseline emissions should in this case be taken into account appropriately. Such monitoring requirement will be used for the determination/confirmation of baseline emissions and/or confirmation of the project's implementation as described in the PDD (in terms of operation and management conditions of the landfill from which LFG is combusted).

Data/parameter:	**$V_{t,wb}$**
Unit	m^3 wet gas/h
Description	Volumetric flow of LFG stream in time interval *t* on a wet basis
Measured/calculated/default	Continuously measured by 4 LFG flow meters (one flow meter for each installed high temperature enclosed flare)
Source of data	Measured as part of the operation of the project activity by applying appropriate monitoring instruments (4 flow meters) (with recordable electronic signal).
Value(s) of monitored parameter	The monthly emission reduction calculation spreadsheets (that are enclosed to this Monitoring Report) include all records of measurement data of LFG flow sent to each installed high temperature enclosed flare during the considered monitoring period. Measurement data is recorded and reported with an every-minute frequency. While measurements are performed by installed 4 LFG flow meters (one flow meter for each individual installed flare), the monitoring parameter $V_{t,wb}$ is thus measured, recorded and reported on the basis of the following sub-parameters: - $V_{t,wb,flare-1}$: Volumetric flow of LFG to Flare 1 - $V_{t,wb,flare-2}$: Volumetric flow of LFG to Flare 2 - $V_{t,wb,flare-3}$: Volumetric flow of LFG to Flare 3 - $V_{t,wb,flare-4}$: Volumetric flow of LFG to Flare 4

Monitoring equipment	Measurements are performed by 4 LFG flow meters that are installed in independent sections of the LFG pipeline located between the centrifugal blowers and each one of the installed 4 high temperature enclosed flares, thus ensuring the flow of LFG sent to each one of the flares is continuously measured. *Specifications and calibration details for the installed LFG flow meters:* *Flow meter used for measuring $V_{t,wb,flare-1}$ (Flare 1):* - Manufacturer: Contech Indústria e Comércio de Equipamentos Eletrônicos Ltda - Model: FT-2 - Accuracy: +/-1% - Serial Number: 1412000235 - Instrument internal identification number: FT-01 - Calibration frequency (as specified by the monitoring methodology/tool and/or in the PDD): The registered PDD establishes that "*Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations".* - Calibration frequency (as per the application of the monitoring plan and recommendations from the equipment manufacturer): Calibration events are performed every 2 years - Dates for performed calibration events valid for the considered monitoring period: 04/06/2014 - Validity of the performed calibration events: The calibration event performed on the installed flow meter is valid until 04/06/2016 (2 years) - Entity/company responsible for performing the calibration events: the calibration event was performed by Contech Indústria e Comércio de Equipamentos Eletrônicos Ltda. *Flow meter used for measuring $V_{t,wb,flare-2}$ (Flare 2):* - Manufacturer:Contech Indústria e Comércio de Equipamentos Eletrônicos Ltda - Model: FT-2 - Accuracy: +/-1% - Serial Number: 1412000236 - Instrument internal identification number: FT-02 - Calibration frequency (as specified by the monitoring methodology/tool and/or in the PDD): The registered PDD establishes that "*Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations".* - Calibration frequency (as per the application of the monitoring plan and recommendations from the equipment manufacturer): Calibration events are performed every 2 years - Date for performed calibration event valid for the considered monitoring period: 04/06/2014 - Validity of the performed calibration events: The calibration event performed on the installed flow meter is valid until 04/06/2016 (2 years) - Entity/company responsible for performing the calibration events: the calibration event was performed by Contech Indústria e Comércio de Equipamentos Eletrônicos Ltda. *Flow meter used for measuring $V_{t,wb,flare-3}$ (Flare 3):* - Manufacturer:Contech Indústria e Comércio de Equipamentos Eletrônicos Ltda - Model: FT-2 - Accuracy: +/-1% - Serial Number: 1412000237 - Instrument internal identification number: FT-03 - Calibration frequency (as specified by the monitoring methodology/tool and/or in the PDD): The registered PDD establishes that "*Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations".*

	- Calibration frequency (as per the application of the monitoring plan and recommendations from the equipment manufacturer): Calibration events are performed every 2 years - Date for performed calibration event valid for the considered monitoring period: 04/06/2014 - Validity of the performed calibration events: The calibration event performed on the installed flow meter is valid until 04/06/2016 (2 years) - Entity/company responsible for performing the calibration events: the calibration event was performed by Contech Indústria e Comércio de Equipamentos Eletrônicos Ltda. *Flow meter used for measuring $V_{t,wb,flare-4}$ (Flare 4):* - Manufacturer:Contech Indústria e Comércio de Equipamentos Eletrônicos Ltda - Model: FT-2 - Accuracy: +/-1% - Serial Number: 1412000238 - Instrument internal identification number: FT-04 - Calibration frequency (as specified by the monitoring methodology/tool and/or in the PDD): The registered PDD establishes that "*Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations".* - Calibration frequency (as per the application of the monitoring plan and recommendations from the equipment manufacturer): Calibration events are performed every 2 years - Date for performed calibration event valid for the considered monitoring period: 04/06/2014 - Validity of the performed calibration events: The calibration event performed on the installed flow meter is valid until 04/06/2016 (2 years) - Entity/company responsible for performing the calibration events: the calibration event was performed by Contech Indústria e Comércio de Equipamentos Eletrônicos Ltda.
Measuring/reading/recording frequency:	Continuous measurements are recorded and reported with an every-minute frequency.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Monitoring equipment/instruments are calibrated and maintained as per instrument specifications and/or recommendations of manufacturer. Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the project activity are performed at Essencis Soluções Ambientais S.A. in accordance with detailed working instructions that are included in the company's ISO 9001 and 14001 certified quality management and control (QA/QC) and environmental management system (EMS).
Purpose of data:	Calculation of baseline emissions
Additional comments:	The design of the installed LFG flow meters ensures that measurement data is automatically converted and recorded in normal cubic meters per hour (Nm^3/h). Due to that, measurements of LFG pressure and LFG temperature are not required for performing GHG calculations (see further details in Section E.1). Reported values of $V_{t,wb}$ are used for the determination of the amount of methane in the LFG flared by the project activity ($F_{CH4,flared,y}$) as per Option C of the applicable methodological "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (measurements of volume flow in a wet basis).

Data/parameter:	$v_{CH4,t,wb}$
Unit	m^3 CH_4/m^3 wet gas
Description	Volumetric fraction of CH_4 in the collected LFG in time interval *t* on a wet basis
Measured/calculated/default	Continuously measured by continuous CH_4 content gas analyzer.
Source of data	Measured as part of the operation of the project activity by applying appropriate monitoring instruments (CH_4 content gas analyser) (with recordable electronic signal).
Value(s) of monitored parameter	The monthly emission reduction calculation spreadsheets (that are enclosed to this Monitoring Report) include measurement data for $v_{CH4,t,wb}$ that are recorded and reported with an every-minute frequency.

Monitoring equipment	Measurements are performed by installed continuous CH_4 content gas analyser for which the LFG sample collecting point is located in the main LFG pipeline in a section between the centrifugal blowers and the high temperature enclosed flares. *Specifications and calibration details for the installed continuous CH_4 content gas analyzer:* - Manufacturer: BGM Instrumentação Controle e Automação Ltda. - Model: CENTRUM AG 4000 - Accuracy: ±2.0% - Serial Number: NS 53159 - Instrument internal identification number: GA01 - Calibration frequency (as per the application of the monitoring plan and recommendations from the equipment manufacturer): Calibration events are performed with a maximum interval of 3 months. Although the validity for each performed calibration event is 3 months, as per the applied monitoring practice, equipment has been calibrated within shorter intervals. - Dates and validity for performed calibration events valid for the considered monitoring period: - 15/05/2015 (valid until 15/08/2015) - 22/05/2015 (valid until 22/08/2015) - 29/05/2015 (valid until 29/08/2015) - 05/06/2015 (valid until 05/09/2015) - 12/06/2015 (valid until 12/09/2015) - 19/06/2015 (valid until 19/09/2015) - 26/06/2015 (valid until 26/09/2015) - 03/07/2015 (valid until 03/10/2015) - 10/07/2015 (valid until 10/10/2015) - 17/07/2015 (valid until 17/10/2015) - 24/07/2015 (valid until 24/10/2015) - 31/07/2015 (valid until 31/10/2015) - 07/08/2015 (valid until 07/11/2015) - 14/08/2015 (valid until 14/11/2015) - 21/08/2015 (valid until 21/11/2015) - 28/08/2015 (valid until 28/11/2015) - 11/09/2015 (valid until 11/12/2015) - 18/09/2015 (valid until 18/12/2015) - 24/09/2015 (valid until 24/12/2015) - 01/10/2015 (valid until 01/01/2016) - 08/10/2015 (valid until 08/01/2016) - 15/10/2015 (valid until 15/01/2016) - 22/10/2015 (valid until 22/01/2016) - 29/10/2015 (valid until 29/01/2016) - 05/11/2015 (valid until 05/02/2016) - 13/11/2015 (valid until 13/02/2016) - 19/11/2015 (valid until 19/02/2016) - 27/11/2015 (valid until 27/02/2016) - 04/12/2015 (valid until 04/03/2016) - 10/12/2015 (valid until 10/03/2016) - 17/12/2015 (valid until 17/03/2016) - 14/01/2016 (valid until 14/04/2016) - Entity/company responsible for performing the calibration events: all calibration events were performed by trained responsible staff of the project participant Essencis Soluções Ambientais S.A. by following the applicable internal working procedure titled "*CA.BG.01.05 – Rev 09 Calibração analisador de gases"* (*CA.BG.01.05 – Rev 09* – Calibration of gas analyser). Calibration events valid for the considered monitoring period were performed by using certified span gas cylinders with a known CH_4 composition. Certified span gases utilized for performing

	the calibration events valid for the considered monitoring period: - Gas cylinders with N_2 with a minimum purity of 99.999%: cylinder S/N 395939, certificate number IBG04220814, supplied by IBG – Indústria Brasileira de Gases Ltda. - Gas cylinders with N_2 with a minimum purity of 99.999%: cylinder S/N 1507099 certificate number IBG02390815, supplied by IBG – Indústria Brasileira de Gases Ltda. - Gas cylinders with a calibration mixture of 5.01 cmol/mol of O_2: cylinder n° S/N 3933516, certificate number IBG00590114, supplied by IBG – Indústria Brasileira de Gases Ltda. - Gas cylinders with a calibration mixture of 60.14 cmol/mol of CO_2: cylinder n° S/N 4849752, certificate number IBG04180814 supplied by IBG – Indústria Brasileira de Gases Ltda. - Gas cylinders with a calibration mixture of 60.01 cmol/mol of CH_4: cylinder n° S/N 4849720, certificate number IBG05801014 supplied by IBG – Indústria Brasileira de Gases Ltda. - Gas cylinders with a calibration mixture of 60.14 cmol/mol of CH_4: cylinder n° S/N 35112, certificate number IBG03151015 supplied by IBG – Indústria Brasileira de Gases Ltda.
Measuring/reading/recording frequency:	Continuously measurements are recorded/reported every minute.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Monitoring equipment/instruments are calibrated and maintained as per instrument specifications and/or recommendations of manufacturer. Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the project activity are performed at Essencis Soluções Ambientais S.A. in accordance with detailed working instructions that are included in the company's ISO 9001 and 14001 certified quality management and control (QA/QC) and environmental management system (EMS).
Purpose of data:	Calculation of baseline emissions
Additional comments:	-

Data/parameter:	**T_t**
Unit	K
Description	Temperature of the LFG stream in time interval *t*
Measured/calculated/default	Continuously measured by LFG temperature sensor. Measurements are primarily recorded and reported in ^oC. Recorded/reported data is converted into Kelvin and data is also reported in this unit, thus meeting the related monitoring requirement as per the PDD.
Source of data	Measured as part of the operation of the project activity by applying appropriate monitoring instruments (temperature sensor) (with recordable electronic signal).

Value(s) of monitored parameter	The monthly emission reduction calculation spreadsheet (that is enclosed to this Monitoring Report) includes measurement data for T_t that are recorded and reported with an every-minute frequency.
Monitoring equipment	Measurements are performed by installed LFG temperature sensor that is installed in the main LFG pipeline in a section between the centrifugal blowers and the high temperature enclosed flares. *Specifications and calibration details for the LFG temperature sensor:* - Manufacturer: Pressgage instrumentos de Medição e Controle Ltda. - Model: STP-100 - Accuracy: ±1.0% - Serial Number (S/N): 45519 - Instrument internal identification number: TT02 - Calibration frequency: as specified by the monitoring methodology/tool): Periodically calibrated by an officially accredited entity. - Calibration frequency (as per the application of the monitoring plan): yearly - Date for performed calibration events valid for the considered monitoring period: 27/02/2015 (Calibration Certificate 7765/2015, issued by Pakari Indústria e Serviços LTDA., - Validity of the performed calibration event: The calibration event dated 27/02/2015 is valid until 27/02/2016 (1 year).
Measuring/reading/recording frequency:	Continuously measurements are recorded/reported every minute.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Monitoring equipment/instruments are calibrated and maintained as per instrument specifications and/or recommendations of manufacturer. Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the project activity are performed at Essencis Soluções Ambientais S.A. in accordance with detailed working instructions that are included in the company's ISO 9001 and 14001 certified quality management and control (QA/QC) and environmental management system (EMS).
Purpose of data:	Calculation of baseline emissions
Additional comments:	In accordance with the PDD, since measurements of LFG flow are automatically converted and recorded in normalized cubic meters (by considering standard temperature and pressure (STP) conditions), monitoring of "Pressure of the gaseous stream in time interval t" (P_t) and Temperature of the gaseous stream in time interval *t* (T_t) are not required.

Data/parameter:	**P_t**
Unit	Pa
Description	Pressure of the LFG stream in time interval *t*
Measured/calculated/default	Continuously measured by LFG pressure sensor. Measurements are primarily recorded and reported in mbar. Recorded/reported data is converted into Pascal and data is also reported in this unit, thus meeting the related monitoring requirement as per the PDD.

Source of data	Measured as part of the operation of the project activity by applying appropriate monitoring instruments (pressure sensor) (with recordable electronic signal).
Value(s) of monitored parameter	The monthly emission reduction calculation spreadsheet (that is enclosed to this Monitoring Report) includes measurement data for P_t that are recorded and reported with an every-minute frequency.
Monitoring equipment	Measurements are performed by installed LFG pressure sensor that is installed in the main LFG pipeline in a section between the centrifugal blowers and the high temperature enclosed flares. *Specifications and calibration details for the LFG pressure sensor:* - Manufacturer: Pressgage instrumentos de Medição e Controle Ltda. - Model: TPI-PRESS - Accuracy: ±1.5% - Serial Number: 43608 - Instrument internal identification number: PT002 - Calibration frequency (as specified by the monitoring methodology/tool): Periodically calibrated by an officially accredited entity - Calibration frequency (as per the application of the monitoring plan): yearly - Date for performed calibration events valid for the considered monitoring period: 27/02/2015 (Calibration Certificate: 7759/2015, issued by Pakari Indústria e Serviços LTDA.) - Validity of the performed calibration events: The calibration event dated 27/02/2015 is valid until 27/02/2016 (1 year).
Measuring/reading/recording frequency:	Continuously measurements are recorded/reported every minute.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Monitoring equipment/instruments are calibrated and maintained as per instrument specifications and/or recommendations of manufacturer. Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the project activity are performed at Essencis Soluções Ambientais S.A. in accordance with detailed working instructions that are included in the company's ISO 9001 and 14001 certified quality management and control (QA/QC) and environmental management system (EMS).
Purpose of data:	Calculation of baseline emissions
Additional comments:	In accordance with the PDD, since measurements of LFG flow are automatically converted and recorded in normalized cubic meters (by considering standard temperature and pressure (STP) conditions), monitoring of "Pressure of the gaseous stream in time interval t" (P_t) and Temperature of the gaseous stream in time interval *t* (T_t) are not required.

Data/parameter:	**$EC_{PJ,y}$**
Unit	MWh
Description	Amount of grid electricity consumed by the project activity during the year *y*
Measured/calculated/default	Continuously measured by electricity meter.

<table>
<tr><td>Source of data</td><td>Monitored values are based on measurements performed by Elektro Eletricidade e Serviços S.A. (local electricity distribution company serving the region where the project activity is located) by applying appropriated monitoring instruments (electricity meters).</td></tr>
<tr><td>Value(s) of monitored parameter</td><td>Monthly records of grid-sourced electricity consumption valid for the considered monitoring period:

<table>
<tr><th>Month</th><th>Amount of consumed grid-sourced electricity (MWh)</th></tr>
<tr><td>May 2015
(16/05/2015 to 31/05/2015)</td><td>188.425</td></tr>
<tr><td>Jun. 2015</td><td>265.992</td></tr>
<tr><td>Jul. 2015</td><td>228.391</td></tr>
<tr><td>Aug. 2015</td><td>198.984</td></tr>
<tr><td>Sep. 2015</td><td>208.641</td></tr>
<tr><td>Oct. 2015</td><td>219.713</td></tr>
<tr><td>Nov. 2015</td><td>176.592</td></tr>
<tr><td>Dec. 2015</td><td>178.624</td></tr>
</table>
</td></tr>
</table>

Monitoring equipment	Measurements are performed by installed electricity meters. *Specifications and calibration details for the installed electricity meters:* Electricity meter 01 (Blowers 1, 2, 3, 5 and landfill installations): - Manufacturer: KRON Instrumentos Elétricos Ltda. - Model: MULT-K - Accuracy: ±0.2% - Serial Number: 234215 - Instrument internal identification number: ME Plant Electricity meter 02 (Blower 4) - Manufacturer: Manufacturer: KRON Instrumentos Elétricos Ltda. - Model: MULT-K - Accuracy: ±0.2 % - Serial Number: 465025 - Instrument internal identification number: ME Blower 4 Calibration requirements for Electricity meter 01 and 02: - Calibration frequency (as specified by the monitoring methodology/tool): As per the PDD, all monitoring equipment must be calibrated periodically. The "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" establishes the following regarding maintenance and calibration for electricity meters: "*(...) meters should be installed, maintained and calibrated according to equipment manufacturer instructions and be in line with national standards, or, if these are not available, international standards (e.g. IEC, ISO)*". - Calibration frequency (as per the recommendation of the meter manufacturer): it is important to note that the installed meters are approved/certified by INMETRO (The Brazilian national authority for metrology and standardization issues), and they are thus in conformance with INMETRO's requirements for maintenance and testing of electricity meters. According to the instrument manufacturer, the meters are to be calibrated every 5 years. A calibration frequency of 5 years was adopted. - Date of valid calibration events: Electricity meter 01: 19/03/2012 (Calibration Certificate: R-0701/12, issued by Naka Comércio e Indústria de Instrumentação Industrial Ltda Electricity meter 02: 19/03/2012 (Calibration Certificate:R-0702/12, issued by Naka Comércio e Indústria de Instrumentação Industrial Ltda. - Validity of the performed calibration events: Electricity meter 01: the calibration event dated 19/03/2012 is valid until 19/03/2017 (5 years) Electricity meter 02: the calibration event dated 19/03/2012 is valid until 19/03/2017 (5 years)
Measuring/reading/recording frequency:	Accumulated values for continuous measurements of grid-sourced electricity consumption are recorded once a month.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Monitoring equipment/instruments are calibrated and maintained as per instrument specifications and/or recommendations of manufacturer.

	Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the project activity are performed at Essencis Soluções Ambientais S.A. in accordance with detailed working instructions that are included in the company's ISO 9001 and 14001 certified quality management and control (QA/QC) and environmental management system (EMS).
Purpose of data:	Calculation of project emissions (due to consumption of grid-sourced electricity by the project activity).
Additional comments:	The amount of grid-sourced electricity consumed by the project activity consists in the sum of the values measured by both electricity meters.

Data/parameter:	$\mathbf{EF_{grid,OM,y}}$ = $\mathbf{EF_{grid,OM\text{-}DD,y}}$
Unit	tCO_2/MWh
Description	Operation margin CO_2 emission factor in year *y* = Dispatch data analysis operating margin CO_2 emission factor in year *y*
Measured/calculated/default	Calculated (based on official monthly values as calculated and published by the DNA of Brazil).
Source of data	Value for year 2015 is selected. Selected value is the average of monthly official values as calculated and currently made available (published) by the DNA of Brazil. Monthly official values are made available online: http://www.mct.gov.br/upd_blob/0238/238520.htm
Value(s) of monitored parameter	0.5580 tCO_2/MWh
Monitoring equipment	Not applicable
Measuring/reading/recording frequency:	Values are calculated annually.
Calculation method (if applicable):	Value applicable for year 2015 is calculated by the DNA of Brazil as per applicable guidance of the calculation method "dispatch data analysis operating margin CO_2 emission factor" of the "Tool to calculate the emission factor for an electricity system".
QA/QC procedures:	Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the project activity are performed at Essencis Soluções Ambientais S.A. in accordance with detailed working instructions that are included in the company's ISO 9001 and 14001 certified quality management and control (QA/QC) and environmental management system (EMS).
Purpose of data:	Calculation of project emissions (due to consumption of grid-sourced electricity by the project activity)
Additional comments:	-

Data/parameter:	$F_{CH4,EG,t}$
Unit	kg
Description	Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the time period *t*
Measured/calculated/default	Measurements are performed by a third party accredited entity.
Source of data	Related measurements and calculations were performed by the independent third party inspection services companies "Ecosampling Ambiental Ltda." (measurements performed in June 2015) and "Merieux NutriSciences / Bioagri Ambiental Ltda." (measurements performed on December 2015 and February 2016). Biannual measurements of mass flow of methane in the exhaust gas are performed on the basis of measurements of CH_4 concentration in a collected gas sample + measurements of speed of exhaust gas in the upper section of the flares with one hour of duration each. Measurements were performed as per applicable guidance of the following standards: *Measurements performed on 08/06/2015 (Flares 1, 2, 3 and 4) by Ecosampling Ambiental Ltda.:* US-EPA Method 25A – Determination Of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer (available online: http://www.epa.gov/ttnemc01/promgate/m-25a.pdf); CETESB L9.221 - Stacks and chimneys in stationary emission sources- Sampling points determination procedure) (available online: http://www.cetesb.sp.gov.br/userfiles/file/servicos/normas/vigentes/L9.221_Dutos%20e%20chamin%C3%A9s%20de%20fontes%20estacion%C3%A1rias%20-%20determina%C3%A7%C3%A3o%20dos.pdf) CETESB L9.222 - Stacks and chimneys in stationary emission sources – Determination of speed and outflow of gases (available online: http://www.cetesb.sp.gov.br/userfiles/file/servicos/normas/vigentes/L9.222_Dutos%20e%20chamin%C3%A9s%20de%20fontes%20estacion%C3%A1rias%20-%20determina%C3%A7%C3%A3o%20da.pdf) *Measurements performed on 01/12/2015 (Flare 4), 22/12/2015 (Flares 1 and 2) and 22/02/2016 (Flare 3) by Merieux NutriSciences / Bioagri Ambiental Ltda.:* US-EPA Method 18 – Measurement of Gaseous Organic Compound Emission by Gas Chromatography (available online: https://www3.epa.gov/ttnemc01/promgate/m-18.pdf); CETESB L9.221 - "Pipelines and chimneys in stationary emission sources- Sampling points determination procedure) (available online: http://www.esaat.com.br/docs/met_cetesb/CETESB-L9.221.pdf) CETESB L9.222 - "Pipelines and chimneys in stationary emission sources – Determination of speed and outflow of gases) (available online: http://www.esaat.com.br/docs/met_cetesb/CETESB-L9.222.pdf)

	CETESB L9.223 - "Pipelines and chimneys in stationary emission sources – Determination of dry molecular mass and the excess of the air flow gas" (available online: http://www.esaat.com.br/docs/met_cetesb/CETESB-L9.223.pdf) CETESB L9.224 - "Pipelines and chimneys in stationary emission sources – Determination of humidity of effluents" (available online: http://www.esaat.com.br/docs/met_cetesb/CETESB-L9.224.pdf)
Value(s) of monitored parameter	While biannual related measurements were performed for each one of the installed 4 flares, the monitoring parameter $F_{CH4,EG,t}$ is thus measured, recorded and reported on the basis of the following sub-parameters: - $F_{CH4,EG,t,flare-1}$: Mass flow of methane in the exhaust gas of Flare 1 - $F_{CH4,EG,t,flare-2}$: Mass flow of methane in the exhaust gas of Flare 2 - $F_{CH4,EG,t,flare-3}$: Mass flow of methane in the exhaust gas of Flare 3 - $F_{CH4,EG,t,flare-4}$: Mass flow of methane in the exhaust gas of Flare 4 For the determination of values of $F_{CH4,EG,t}$, average the accumulated mass of methane measured during one hour of continuous measurements are considered (average of every-minute measurements). The table below summarizes the performed biannual determination of $F_{CH4,EG,t}$ for each one of the installed flares valid for the considered monitoring period:

Flare	Dates of performed measurements	Company responsible for the performance of measurements	Identified value of $F_{CH4,EG,t,flare-n}$
Flare 1 ($F_{CH4,EG,t,flare-1}$)	08/06/2015	Ecosampling Ambiental Ltda.	0.0549
	22/12/2015	Merieux NutriSciences / Bioagri Ambiental Ltda.	0.0616
Flare 2 ($F_{CH4,EG,t,flare-2}$)	08/06/2015	Ecosampling Ambiental Ltda.	0.0183
	22/12/2015	Merieux NutriSciences / Bioagri Ambiental Ltda.	4.8020
Flare 3 ($F_{CH4,EG,t,flare-3}$)	08/06/2015	Ecosampling Ambiental Ltda.	0.0183
	22/02/2016	Merieux NutriSciences / Bioagri Ambiental Ltda.	0.0144
Flare 4 ($F_{CH4,EG,t,flare-4}$)	08/06/2015	Ecosampling Ambiental Ltda.	0.1098
	01/12/2015	Merieux NutriSciences / Bioagri Ambiental Ltda.	0.0084

Monitoring equipment	Measurements were performed by the independent 3rd party inspection service companies "Ecosampling Ambiental Ltda." (measurements performed in June 2015) and "Merieux NutriSciences / Bioagri Ambiental Ltda." (measurements performed on December 2015 and February 2016) using appropriated chromatographers and pitot tubes.
Measuring/reading/recording frequency:	Biannual
Calculation method (if applicable):	-
QA/QC procedures:	Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the project activity are performed at Essencis Soluções Ambientais S.A. in accordance with detailed working instructions that are included in the company's ISO 9001 and 14001 certified quality management and control (QA/QC) and environmental management system (EMS). Both independent 3rd party inspection service companies Ecosampling Ambiental Ltda. and Merieux NutriSciences / Bioagri Ambiental Ltda.. are licensed independent third party inspections services companies specialized in inspections and testing of air emissions from stationary sources. In Brazil, operation of inspection entities and labs are regulated by the Instituto Nacional de Metrologia, Qualidade e Tecnologia (INMETRO) (the Brazilian national authority for metrology and certification affairs).
Purpose of data:	Calculation of baseline emissions.
Additional comments:	-

Data/parameter:	**$T_{EG,m}$**
Unit	^{o}C
Description	Temperature in the exhaust gas of the enclosed flare in minute *m*
Measured/calculated/default	Continuously measured by thermocouples installed in the upper section of the 4 flares (one thermocouple for each installed high temperature enclosed flare).
Source of data	Measured as part of the operation of the project activity by applying appropriate monitoring instruments (thermocouples) (with recordable electronic signal).
Value(s) of monitored parameter	Values for each one of the installed 4 high temperature enclosed flares are reported in the monthly emission reduction calculation spreadsheets (that are enclosed to this Monitoring Report). Measurement data is recorded and reported with an every-minute frequency. While measurements are performed by 4 thermocouples (one thermocouple installed in the upper section of each individual installed flare), the monitoring parameter $T_{EG,m}$ is measured, recorded and reported on the basis of the following sub-parameters: - $T_{EG,m,flare-1}$: Temperature in the exhaust gas of Flare 1 - $T_{EG,m,flare-2}$: Temperature in the exhaust gas of Flare 2 - $T_{EG,m,flare-3}$: Temperature in the exhaust gas of Flare 3 - $T_{EG,m,flare-4}$: Temperature in the exhaust gas of Flare 4

Monitoring equipment	*Specifications and calibration details for the installed/utilized thermocouples:* *Thermocouple used for measuring $T_{EG,m,flare-1}$ (Flare 1):* - Manufacturer: Naka Comércio e Indústria de Instrumentação Industrial Ltda. - Model: NKTC-3000, type N - Accuracy: ±0.75% - Serial Number: 099160 - Instrument internal identification number: TT11 - Calibration frequency (as specified by the monitoring methodology/tool): periodically calibrated by an officially accredited entity - Calibration frequency (as per the application of the monitoring plan): yearly - Calibration Dates: 27/02/2015 (Calibration Certificate 7755/2015, issued by Pakari Indústria e Serviços LTDA - Validity of the performed calibration events: The calibration event dated 27/02/2015 is valid until 27/02/2016 (1 year). *Thermocouple used for measuring $T_{EG,m,flare-2}$ (Flare 2):* - Manufacturer: Naka Comércio e Indústria de Instrumentação Industrial Ltda. - Model: NKTC-3000, type N - Accuracy: ±0.75% - Serial Number: 099157 - Instrument internal identification number: TT12 - Calibration frequency (as specified by the monitoring methodology/tool): periodically calibrated by an officially accredited entity - Calibration frequency (as per the application of the monitoring plan): yearly - Calibration Dates: 27/02/2015 (Calibration Certificate 7753/2015, issued by Pakari Indústria e Serviços LTDA.) - Validity of the performed calibration events: The calibration event dated 27/02/2015 is valid until 27/02/2016 (1 year). *Thermocouple used for measuring $T_{EG,m,flare-3}$ (Flare 3):* - Manufacturer: Naka Comércio e Indústria de Instrumentação Industrial Ltda. - Model: NKTC-3000, type N - Accuracy: ±0.75% - Serial Number: 099158 - Instrument internal identification number: TT13 - Calibration frequency (as specified by the monitoring methodology/tool): periodically calibrated by an officially accredited entity - Calibration frequency (as per the application of the monitoring plan): yearly - Calibration Dates: 11/03/2015 (Calibration Certificate 7751/2015, issued by Pakari Indústria e Serviços LTDA.) - Validity of the performed calibration events: The calibration event dated 11/03/2015 is valid until 11/03/2016 (1 year). *Thermocouple used for measuring $T_{EG,m,flare-4}$ (Flare 4):* - Manufacturer: Naka Comércio e Indústria de Instrumentação Industrial Ltda. - Model: NKTC-3000, type N - Accuracy: ±0.75% - Serial Number: 099159 - Instrument internal identification number: TT14 - Calibration frequency (as specified by the monitoring methodology/tool): periodically calibrated by an officially accredited

	entity - Calibration frequency (as per the application of the monitoring plan): yearly - Calibration Dates: 11/03/2015 (Calibration Certificate TT52/2015, issued by Pakari Indústria e Serviços LTDA.) - Validity of the performed calibration events: The calibration event dated 11/03/2015 is valid until 11/03/2016 (1 year).
Measuring/reading/recording frequency:	Continuously measurements are recorded/reported every minute.
Calculation method (if applicable):	-
QA/QC procedures:	Monitoring equipment/instruments are calibrated and maintained as per instrument specifications and/or recommendations of manufacturer. Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the project activity are performed at Essencis Soluções Ambientais S.A. in accordance with detailed working instructions that are included in the company's ISO 9001 and 14001 certified quality management and control (QA/QC) and environmental management system (EMS).
Purpose of data:	Calculation of baseline emissions
Additional comments:	Measurements outside the operational temperature specified/recommended by the manufacturer may indicate that the flare is not functioning correctly and may require maintenance. Unexpected changes such as a sudden increase/drop in temperature can occur for different reasons. As part of the monitoring procedure, these events are noted in the site records along with any corrective action that was implemented to correct the issue. Measurements are required to determine if manufacturer's flare specifications for operating temperature are met.

Data/parameter:	**$Flame_m$**
Unit	Flame status "*on*" or flame status "*off*"
Description	Flame detection of flare in the minute *m*
Measured/calculated/default	Continuously measured by Ultra violet (UV) flame detectors (one UV flame detector for each installed high temperature enclosed flare).
Source of data	For each one of the flares, whenever flame is detected in the flare, flame status "*on*" or "1" value is attributed. Whenever no flame is detected in the flare, flame status "*off*" or "0" is attributed.
Value(s) of monitored parameter	Values for each one of the installed 4 high temperature enclosed flares are reported in the monthly emission reduction calculation spreadsheets (that is enclosed to this Monitoring Report). Measurement data is recorded and reported with an every-minute frequency. While measurements are performed by 4 UV flame detectors (one UV flame detector installed in each individual installed flare), the monitoring parameter $Flame_m$ is thus measured, recorded and reported on the basis of the following sub-parameters: - $Flame_{m,flare\text{-}1}$: Flame detection in Flare 1 - $Flame_{m,flare\text{-}2}$: Flame detection in Flare 2 - $Flame_{m,flare\text{-}3}$: Flame detection in Flare 3

	- $Flame_{m,flare-4}$: Flame detection in Flare 4
Monitoring equipment	*Specifications and calibration details for the installed/utilized UV Flame detectors:* *UV Flame detector for measuring* $Flame_{m,flare-1}$ *(Flare 1):* - Manufacturer: SELCON Sistemas Eletrônicos de Controle Ltda. - Model: SEL-SV-UL-K4 - Serial Number: 323730808 - Instrument internal identification number: UV01 - Calibration frequency: No calibration is required as the equipment has a self-checking function. - Working hours (lifetime): 50,000 h *UV Flame detector for measuring* $Flame_{m,flare-2}$ *(Flare 2):* - Manufacturer: SELCON Sistemas Eletrônicos de Controle Ltda. - Model: SEL-SV-UL-K4 - Serial Number: 55600905 - Instrument internal identification number: UV02 - Calibration frequency: No calibration is required as the equipment has a self-checking function. - Working hours (lifetime): 50,000 h *UV Flame detector for measuring* $Flame_{m,flare-3}$ *(Flare 3):* - Manufacturer: Honeywell Analytics Ltd. - Model: C7061 - Serial Number: R7861 - Instrument internal identification number: UV03 - Calibration frequency: No calibration is required as the equipment has a self-checking function. - Working hours (lifetime): 40,000 h *UV Flame detector for measuring* $Flame_{m,flare-4}$ *(Flare 4):* - Manufacturer: SELCON Sistemas Eletrônicos de Controle Ltda. - Model: SEL-SV-210230-K6 - Serial Number: 565400312 - Instrument internal identification number: UV04 - Calibration frequency: No calibration is required as the equipment has a self-checking function. - Working hours (lifetime): 50,000 h
Measuring/reading/recording frequency:	Continuously measurements are recorded/reported every minute.
Calculation method (if applicable):	Not applicable
QA/QC procedures:	Monitoring equipment/instruments are calibrated and maintained as per instrument specifications and/or recommendations of manufacturer. Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the project activity are performed at Essencis Soluções Ambientais S.A. in accordance with detailed working instructions that are included in the company's ISO 9001 and 14001 certified quality management and control (QA/QC) and environmental management system (EMS).
Purpose of data:	Calculation of baseline emissions
Additional comments:	Not applicable

Data/parameter:	**Maintenance$_y$**
Unit	Calendar dates
Description	Maintenance events completed in year *y* as monitored by the project participants.
Measured/calculated/default	-
Source of data	Maintenance logs
Value(s) of monitored parameter	The following relevant maintenance events (inspection and maintenance services) are applicable for the flares during the considered monitoring period: - 07/02/2015: General inspection/maintenance service on Flares 1, 2, 3 and 4 (incl. inspection of the condition of the flare isolation ceramics revetment material, checking of conditions of the LPG supply valve for pilot flames, checking of condition/function of the air inlet dumpers, checking of the conditions of the thermocouples, checking of the condition of the UV flame detectors, checking of the condition of the flame arrester valves, checking of the conditions of the LFG injectors, checking of painting conditions). - 07/06/2015: General inspection/maintenance service on Flares 2 and 3 (incl. inspection of the condition of the flare isolation ceramics revetment material, checking of conditions of the LPG supply valve for pilot flames, checking of condition/function of the air inlet dumpers, checking of the conditions of the thermocouples, checking of the condition of the UV flame detectors, checking of the condition of the flame arrester valves, checking of the conditions of the LFG injectors, checking of painting conditions). - 08/06/2015: General inspection/maintenance service on Flares 1 and 4 (incl. inspection of the condition of the flare isolation ceramics revetment material, checking of conditions of the LPG supply valve for pilot flames, checking of condition/function of the air inlet dumpers, checking of the conditions of the thermocouples, checking of the condition of the UV flame detectors, checking of the condition of the flame arrester valves, checking of the conditions of the LFG injectors, checking of painting conditions). Note: In the same date, a service intervention was performed in each one of the installed 4 high temperature enclosed flares for addressing detected undesirable and abnormal intermittent/sporadic vibration + noise problems in the flares of which further details are included in Section B.2.6. - 03/08/2015: General inspection/maintenance service on Flares 1, 2, 3 and 4 (incl. inspection of the condition of the flare isolation ceramics revetment material, checking of conditions of the LPG supply valve for pilot flames, checking of condition/function of the air inlet dumpers, checking of the conditions of the thermocouples, checking of the condition of the UV flame detectors, checking of the condition of the flame arrester valves, checking of the conditions of the LFG injectors, checking of painting conditions). As per the applied maintenance practice for the project activity, general inspection/maintenance services on the flares are opportunely performed during planned or unplanned interruptions of operation of the flares within a time interval between 2 performed inspection/maintenance services events

	never higher than 6 months. After the project's commissioning, the isolation ceramics revetment material of the Flare 1 and Flare 2 were replaced once in February 2009 and February 2012 respectively. For Flares 3 and Flare 4 (which were installed in July 2011 and February 2012 respectively), the isolation ceramics revetment material was not yet replaced. The expected lifetime for the isolation ceramics revetment material for the flares is of at least 10 years (as established in details for the ex-ante determined parameter "Manufacturer's flare specifications for temperature, flow rate and maintenance schedule interval" ($SPEC_{flare}$)). Performed maintenance and overhauling services in the flare are performed under by specialized technical service team under conformance with maintenance requirements for the flares (as established by equipment manufacturer) and as required by the ex-ante determined parameter $SPEC_{flare}$. Further details about the parameter $SPEC_{flare}$ are included in Section D.1.
Monitoring equipment	Not applicable.
Measuring/reading/recording frequency:	Not applicable.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	The maintenance event logs and documentation for the whole project activity are recorded as per requirement of the company's ISO 9001 and ISO 14001 certified quality and control (QA/QC) and environmental management (EMS) system that is implemented for activities undertaken at the CTR Caieiras landfill.
Purpose of data:	Calculation of baseline emissions
Additional comments:	Monitoring of this parameter is required for the case of enclosed flares and the project participant selects Option B to determine flare efficiency. These dates are required so that they can be compared to the maintenance schedule to check that maintenance events were completed within the minimum time between maintenance events specified by the manufacturer ($SPEC_{flare}$).

Data/parameter:	**$FC_{LPG,y}$**
Unit	ton
Description	Quantity of LPG consumed by the project activity in year *y*
Measured/calculated/default	Measured.
Source of data	Monitored values of $FC_{LPG,y}$ are based on measurements performed by the local LPG distribution company Cia Ultragas S.A. as part of LPG delivery events.
Value(s) of monitored parameter	As per the adopted monitoring procedure, the total amount of LPG consumed by the project activity during the considered monitoring period is

	180 kg (0.270 ton) of LPG. Thus, $FC_{LPG,y}$ = 0.270 ton_{LPG} LPG was consumed for lighting/igniting the flares (flare pilot). The reported value corresponds to all the LPG acquired during or before the considered monitoring period (in the present case 6 cylinders of 45 kg of LPG were acquired by the project participant), conservatively assuming that all the LPG was used during the monitoring period. .
Monitoring equipment	*Monitoring details for "Amount of consumed LPG" ($FC_{LPG,y}$)*: LPG consumption was monitored based on measurements performed by the local LPG distribution company Cia Ultragaz S.A. using the weight scale of which specifications are provided below. The adopted weighing procedure is as per working procedure IT-CO.61.0008 of the ISO9001 certified QA/QC management system of Cia Ultragaz S.A. *Specifications and calibration details for the installed weight scale for measurements of $FC_{LPG,y}$:* - Manufacturer: Mettler-Toledo Inc. - Model: 2180 - Capacity: max. 250 kg - Accuracy: ± 50g - Serial Number: 10423008 - Calibration frequency (as specified by the monitoring methodology/tool): The monitoring plan of the PDD and ACM0001 (version 13.0.0) do not specify any calibration frequency requirements for the weight scales. As per the PDD, all equipment must be calibrated periodically. As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion", meters should be installed, maintained and calibrated according to equipment manufacturer instructions and be in line with national standards, or, if these are not available, international standards (e.g. IEC, ISO). - Date of valid calibration: 28/11/2014 (Calibration Certificate 5778/14). - Entity/company responsible for the performed calibration events: Grupo Caieiras Balanças - Validity of the performed calibration events: The calibration event dated 28/11/2014 is valid until 28/11/2017 (3 years).
Measuring/reading/recording frequency:	Amount of LPG is measured upon the supply of cylinders of LPG with 45 kg capacity each.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	The amount of consumed LPG is cross-checked with internal records of cost expenditures for fuel LPG as per the internal financial/accounting management system of Essencis Soluções Ambientais S.A. Monitoring equipment/instruments are calibrated and maintained as per instrument specifications and/or recommendations of manufacturer. Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the project activity are performed at Essencis Soluções Ambientais S.A. in accordance with detailed working instructions that are included in the company's ISO 9001 and 14001 certified quality management and control (QA/QC) and environmental management system (EMS).
Purpose of data:	Calculation of project emissions (due to consumption of LPG by the project activity).

Additional comments:	-

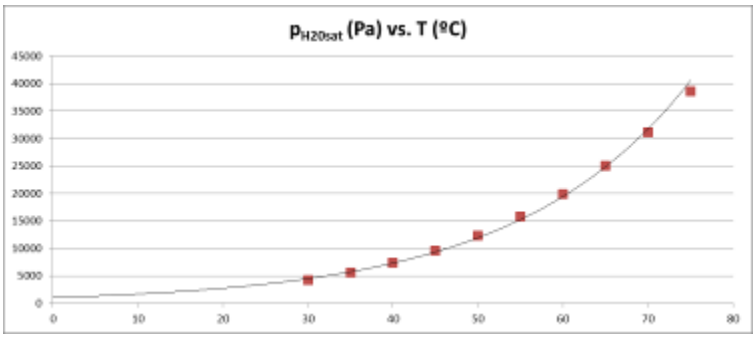
Data/parameter:	**$NCV_{LPG,y}$**
Unit	GJ/ton LPG
Description	Net calorific value of the fuel LPG
Measured/calculated/default	Default value is selected.
Source of data	National default value as per the Brazilian National Energetic Balance Report for year 2015 (Balanço Energético Nacional (BEN) – 20154) / Table VIII.9 – Specific Mass and Heating Values (Higher Heating Value). This annual report is the latest issued version and it is based on data valid for year 2014. This official document was published by the public entity Empresas de Pesquisas Energéticas (EPE). While create and established in accordance with the Federal Law 10.847 of 15/03/2004, the EPE is a governmental entity that undertakes energy planning related investigation and research services. The BEN-2015 report is available online: https://ben.epe.gov.br/BENRelatorioFinal.aspx?anoColeta=2015&anoFimColeta=2014 Reported value in kcal/kg is converted into GJ/ton.
Value(s) of monitored parameter	46.5
Monitoring equipment	Not applicable.
Measuring/reading/recording frequency:	In accordance with the PDD, as national default value is considered, an every year monitoring frequency is thus applied.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the project activity are performed in accordance with detailed working instructions that are included in the company's ISO 9001 and 14001 certified quality management and control (QA/QC) and environmental management system (EMS).
Purpose of data:	Calculation of project emissions (due to consumption of LPG by the project activity)
Additional comments:	-

Data/parameter:	**$EF_{CO2,LPG,y}$**
Unit	tCO_2/GJ LPG
Description	CO_2 emission factor of fuel LPG in year *y*
Measured/calculated/default	Default value is selected.

Source of data	Value is selected as per 2006 IPCC Guidelines on National GHG Inventories (applicable value at upper limit of uncertainty at 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy)).
Value(s) of monitored parameter	0.0656
Monitoring equipment	Not applicable.
Measuring/reading/recording frequency:	In accordance with the PDD, as IPCC default value is considered, an every year monitoring frequency is thus applied.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the project activity are performed in accordance with detailed working instructions that are included in the company's ISO 9001 and 14001 certified quality management and control (QA/QC) and environmental management system (EMS).
Purpose of data:	Calculation of project emissions (due to consumption of LPG by the project activity)
Additional comments:	-

Data/parameter:	$p_{H2O,t,Sat}$
Unit	Pa
Description	Saturation pressure of H_2O at temperature T_t in time interval *t*
Measured/calculated/default	Default values as per selected literature.
Source of data	Data selected as per the literature "*Fundamentals of Classical Thermodynamics*". Authors: Gordon J. Van Wylen, Richard E. Sonntag and Borgnakke; 3rd Edition 1986. Published by John Wiley & Sons, Inc.
Value(s) of monitored parameter	$p_{H2O,t,Sat}$ is determined as a function of temperature of LFG (T_t by the equation: $p_{H2O,t,sat} = 1{,}031.3 * e^{(0.049 * Tt)}$, with a correlation coefficient of $R^2 = 0.998$. Further details are presented below in "Calculation Method".
Monitoring equipment	Not applicable.
Measuring/reading/recording frequency:	Not applicable.
Calculation method (if applicable):	The Absolute Vapor Pressure of Water was obtained from the mentioned literature and is presented in the following table within the rage of interest for the required calculations:

Temperature	$p_{H2O,t,Sat}$
ºC	Pa
30	4,246
35	5,628

	40 | 7,384 45 | 9,593 50 | 12,349 55 | 15,758 60 | 19,940 65 | 25,030 70 | 31,190 75 | 38,580 The following graphic represents the above data and the regression calculated to adjust data:  As $p_{H2O,t,Sat}$ is a function of temperature and best represented by an exponential function, the exponential regression method is applied to the above data and the following equation is obtained: $p_{H2O,t,sat} = 1{,}031.3 * e^{(0.049 * Tt)}$ This equation represents the above data with a correlation coefficient of R^2 = 0.998. Thus, by applying the above equation, $p_{H2O,t,sat}$ is determined as a function of the temperature.
QA/QC procedures:	Not applicable.
Purpose of data:	Calculation of baseline emissions.
Additional comments:	It is important to note that $p_{H2O,t,Sat}$ is only used in the context of the determination of the methane mass flow in the residual gas (in a dry basis) for each minute *m* of the two time periods in year *y* during which the flare efficiency is measured (parameter $F_{CH4,RG,t}$). The calculations of every-minute values of $p_{H2O,t,Sat}$ for the 2 time periods during which the flare efficiency is measured is thus presented only in the flare efficiency calculation spreadsheet. "*MR 11 - Caieiras - V.2 - 03.07.2015 – FE*".

The following monitoring parameters (which are also included in the monitoring plan of the registered PDD) were not monitored as the methodological options for which they are applicable were not selected as the monitoring or calculation approaches for the determination of baseline emissions achieved by the project activity during the considered monitoring period:

- Volumetric flow of LFG stream in time interval t on a dry basis ($V_{t,db}$)
- Volumetric fraction of CH4 in the collected LFG in time interval t on a dry basis ($v_{CH4,t,db}$)
- Mass flow of the LFG stream in time interval t on dry basis ($M_{t,db}$)

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

>>
Under conformance with provisions and calculation approaches of both the registered and revised versions of the PDD, Baseline emissions (BE_y) for the considered monitoring period are determined (in tCO_2e) as follows:

$$BE_y = BE_{CH4,y}$$

Where:

$BE_{CH4,y}$ Baseline emissions of methane from the SWDS[23]. As established by ACM0001 (version 13.0.0), the determination of $BE_{CH4,y}$ is based on the amount of methane that is actually captured and combusted (destroyed) by the project activity and also by taking into account the amount of methane that, in the absence of the project activity (baseline scenario), would be otherwise captured and destroyed in the landfill by the pre-project conventional LFG destruction system. In addition, the effect of methane oxidation (that, as per ACM0001 (version 13.0.0), is assumed as existing in the baseline and not in the project scenario) is also taken into account. $BE_{CH4,y}$ is thus determined as follows:

$$BE_{CH4,y} = (1 - OX_{top\_layer}) * (F_{CH4,PJ,y} - F_{CH4,BL,y}) * GWP_{CH4}$$

Where:

OX_{top_layer} Fraction of methane in the LFG that would be oxidized in the top layer of the SWDS in the baseline scenario. OX_{top_layer} is ex-ante determined as 10%. Further details about the selection of the value for OX_{top_layer} is included in Section D.1 and in the PDD.

$GWP_{CH4,y}$ Global warming potential of CH_4. GWP_{CH4} is ex-ante determined as 25. Further details about the selection of the value for GWP_{CH4} is included in Section D.1 and in the PDD.

$F_{CH4,BL,y}$ Amount of methane in the LFG that would be flared in the baseline scenario (absence of project activity). As outlined in Section B.6.1 of the PDD, $F_{CH4,BL,y}$ is calculated as follows:

$$F_{CH4,BL,y} = 0.2 * F_{CH4,PJ,capt,y}$$

Where:

$F_{CH4,PJ,capt,y}$ Amount of methane collected by the project activity. In the particular case of the project activity, $F_{CH4,PJ,capt,y}$ is determined as follows:

[23] SWDS = Solid Waste Disposal Site. For the case of the project activity, the SWDS is the CTR Caieiras landfill.

$F_{CH4,PJ,capt,y} = F_{CH4,sent,flare,y}$

Where:

$F_{CH4,sent,flare,y}$ Amount of methane in the LFG which is sent to the flares. Details for the determination of every-minute values for $F_{CH4,sent\_flare,y}$ are presented below (under "*Determination of every-minute values for the calculation parameter $F_{CH4,sent\_flare,y}$*").

For the considered monitoring period, the accumulated value for $F_{CH4,BL,y}$ is calculated as 4,200 tCH_4.

$F_{CH4,PJ,y}$ Amount of methane in the LFG which is flared and/or used in the project activity.

In the particular case of the project activity, $F_{CH4,PJ,y}$ is determined as follows:

$F_{CH4,PJ,y} = F_{CH4,flared,y}$

$F_{CH4,flared,y}$ Amount of methane in the LFG flared by the project activity (in tCH_4). In accordance with calculation guidance included in the PDD and by following applicable guidance of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", for each individual flare every-minute values for $F_{CH4,flared,y}$ are determined as the difference between the amount of methane supplied to the flares and residual methane emissions from combustion of LFG in the flares, as follows:

$F_{CH4,flared,y} = F_{CH4,sent\_flare,y} – (PE_{flare,y} / GWP_{CH4})$

Where:

$F_{CH4,sent\_flare,y}$ Amount of methane in the LFG which is sent to the flares. Details for the determination of every-minute values for $F_{CH4,sent\_flare,y}$ for each individual flare are presented below (under "*Determination of every-minute values for the calculation parameter $F_{CH4,sent\_flare,y}$*").

$PE_{flare,y}$ Project emissions from flaring of the residual gas stream. Details for the determination of every-minute values for $PE_{flare,y}$ for each individual flare are presented below (under "*Determination of $PE_{flare,y}$*").

Determination of every-minute values for the calculation parameter $F_{CH4,sent\_flare,y}$:

For the considered monitoring period, Option C of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (where the gaseous stream the tool shall be applied to is the stream of collected LFG that is sent to the flares)[24] is the selected option for determination of values of $F_{CH4,sent\_flare,y}$ valid for each installed flare (calculation sub-parameters $F_{CH4,sent\_flare,y,flare-1}$, $F_{CH4,sent\_flare,y,flare-2}$, $F_{CH4,sent\_flare,y,flare-3}$ and $F_{CH4,sent\_flare,y,flare-4}$). By following calculation option C (that is one of the applicable calculation methods the PDD refers to), the mass flow of greenhouse gas *i* ($F_{i,t}$) (*i* = CH_4) for each installed flare is determined as follows:

$$F_{CH4,sent\_flare,y,flare-n} = F_{CH4,t,flare-n} = V_{t,wb,n,flare-n} * v_{CH4,t,wb} * \rho_{CH4,n}$$

Where:

Sulfix "*Flare-n*": (flare in question: Flare 1, Flare 2, Flare 3 and Flare 4)

For each one of the flares:

$V_{t,wb,n,flare-n}$ Volumetric flow of the gaseous stream (LFG) in time interval *t* on a wet basis at normal conditions. For the considered monitoring period, every-minute values of the calculation parameter $V_{t,wb,n,flare-n}$ valid for each flare (calculation sub-parameters $V_{t,wb,n,flare-1}$, $V_{t,wb,n,flare-2}$, $V_{t,wb,n,flare-3}$ and $V_{t,wb,n,flare-4}$) are measured and reported (in Nm^3 wet gas/h) in the monthly emission reduction calculation spreadsheets valid for the considered monitoring period (and enclosed to this Monitoring Report). While in the particular case of the project activity, during the considered monitoring period, volumetric flow of the gaseous stream (LFG) valid for each flare is already measured in Nm^3 wet gas/h (normal conditions), the following assumption is valid:

$V_{t,wb,n,flare-n}$ is equivalente to $V_{t,wb,flare-n}$

Where:

$V_{t,wb,flare-n}$ Volumetric flow of the gaseous stream (LFG) in time interval *t* on a wet basis for flare *n* (n = 1, 2, 3 and 4).

Note: in accordance with the PDD, since measurements of LFG flow are automatically converted and recorded in normalized cubic meters (by considering standard temperature and pressure

[24] It is relevant to note that the PDD states the following regarding the calculation approach for values of $F_{CH4,sent\_flare,y}$:

"*Applicable guidance of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" will be applied to determine $F_{CH4,sent\_flare,y}$ by using Option 2: Simplified calculation without measurement of the moisture content, and one of the options A, C or D. The selection of the determination option will depend on project conditions and equipment to be installed."*

(STP) conditions), monitoring of "Pressure of the LFG stream in time interval t" (P_t) and "Temperature of the LFG stream in time interval *t*" (T_t) are not required for the determination of $V_{t,wb,n,flare-n}$. Moreover, the ex-ante determined parameters Temperature at normal conditions (T_n) and Total pressure at normal conditions (P_n) are not considered either.

$v_{CH4,t,wb}$ Volumetric fraction of CH_4 in the gaseous stream in time interval *t* on a wet basis. As per the applied monitoring procedure, every-minute values of the monitoring parameter $v_{CH4,t,wb}$ (in m^3 of CH_4 / m^3 of wet LFG) are reported in the monthly emission reduction calculation spreadsheet valid for the considered monitoring period (and enclosed to this Monitoring Report). Further monitoring details about the monitoring parameter $v_{CH4,t,wb}$ are included in Section D.2.

$\rho_{CH4,n}$ Density of CH_4 in the gaseous stream (LFG) at normal conditions. For the considered monitoring period, value of $\rho_{CH4,n}$ (in kg of CH_4 / m^3 of CH_4) is calculated and reported in the monthly emission reduction calculation spreadsheet valid for the considered monitoring period (and enclosed to this Monitoring Report) as follows:

$\rho_{CH4,n} = (P_n * MM_i) / (R_u * T_n)$

Where:

P_n Absolute pressure at normal conditions. P_n is ex-ante determined as 101,325 Pa. Further details about the ex-ante determined parameter P_n are included in Section D.1 and in the registered PDD valid for the 2nd 7-year renewable crediting period for the project activity.

T_n Temperature at normal conditions. T_n is ex-ante determined as 273.15 Kelvin. Further details about the ex-ante determined parameter T_n are included in Section D.1 and in the registered PDD valid for the 2nd 7-year renewable crediting period for the project activity.

MM_i Molecular mass of greenhouse gas *i* (*i* = CH_4). MM_i (*i* = CH_4) is ex-ante determined as 16.04 kg/mol. Further details about the ex-ante determined parameter MM_i (*i* = CH_4) are presented in Section D.1 and in the registered PDD valid for the 2nd 7-year renewable crediting period for the project activity.

R_u Universal ideal gases constant. R_u is ex-ante determined as 8,314 $Pa.m^3$ /kmol.K. Further

details about the ex-ante determined parameter R_u are presented in Section D.1 and in the registered PDD valid for the 2nd 7-year renewable crediting period for the project activity.

$\rho_{CH4,n}$ is calculated as 0.7156650 $kgCH_4$ / m^3CH_4 as reported in the monthly emission reduction calculation spreadsheet valid for the considered monitoring period.

While for each installed flare, the calculated every-minute values of $F_{i,t,flare-n}$ are equivalent to every-minute values for $F_{CH4,sent\_flare,y,flare-n}$, (where *n* = 1, 2, 3 and 4) the monthly emission reduction calculation spreadsheets valid for the considered monitoring period include the determination of every minute values of $F_{CH4,sent\_flare,y,flare-n}$ that is applicable for each one of the installed 4 high temperature enclosed flares for which collected LFG is sent for combustion.

Determination of $PE_{flare,y}$:

$PE_{flare,y}$ is determined for each one of the installed flares ($PE_{flare,y,flare-1}$, $PE_{flare,y,flare-3}$ and $PE_{flare,y,flare-4}$) by following the applicable stepwise guidance of the methodological tool "Project emissions from flaring" (version 2). Every minute values for $PE_{flare,y,flare-1}$, $PE_{flare,y,flare-2}$, $PE_{flare,y,flare-3}$ and $PE_{flare,y,flare-4}$ are determined as a function of every-minute records of mass flow of methane sent to the flare in question (for each flare *n*, $F_{CH4,RG,m,flare-n} = F_{CH4,sent\_flare,y,flare-n}$, where *n* = 1, 2, 3 and 4) as well as based on calculated values for flare efficiency ($\eta_{flare,m} = \eta_{flare,calc,y}$) for each one of the flares as follows:

$$PE_{flare,y} = GWP_{CH4} * \sum_{m=1}^{525,600} F_{CH4,RG,m} * (1 - \eta_{flare,m}) * 10^{-3}$$

Where:

$F_{CH4,RG,m}$ Methane mass flow in the residual gas for the considered flare. For each minute *m* of the considered monitoring period and for each individual flare *n*, values for $F_{CH4,RG,m}$ are equal to every-minute reported measurement records of the calculation sub-parameter "Amount of methane in the LFG which is sent to the flares" ($F_{CH4,sent\_flare,y}$) that is valid for each individual flare (calculation sub-parameters $F_{CH4,sent\_flare,y,flare-1}$, $F_{CH4,sent\_flare,y,flare-2}$, $F_{CH4,sent\_flare,y,flare-3}$ and $F_{CH4,sent\_flare,y,flare-4}$)).

$\eta_{flare,m}$ Flare efficiency in minute m. For the considered monitoring period, $\eta_{flare,m}$ is calculated based on performed measurements of methane in exhaust gas of the flare by following applicable guidance as per Option B (Measured flare efficiency) of the methodological tool "Project emissions from flaring" from which the following related guidance of the PDD is applied:

> *"(…)*
> *Option B: Measured flare efficiency:*
> *For each one of the high temperature enclosed flares which are part of the project activity, the flare efficiency in the minute m is determined as a value which is calculated based on performed related measurements ($\eta_{flare,m} = \eta_{flare,calc,m}$) when the following two conditions are simultaneously met (in order to demonstrate that the flare is operating):*
> *(1) The temperature of the exhaust gas of the flare (monitoring parameter $T_{EG.m}$) and the flow rate LFG to the flare (monitoring parameter $F_{CH4,RG,m}$)*

is within the manufacturer's specification for the flare ($SPEC_{flare}$) in minute m

(2) Flame is detected in the flare in minute m (monitoring parameter $Flame_m$).

Otherwise $\eta_{flare,m}$ is set as 0%.
(…)"

In applying Option B, the project participants chose to determine $\eta_{flare,calc,m}$ for each individual flare by applying guidance of Option B.1 (with related measurements of emission of methane in the exhaust gas of the flare being performed by an accredited independent third party entity (e.g. an independent inspection/analysis service company) on a biannual basis).

In order to calculate the flare efficiency value for each flare ($\eta_{flare,calc,m}$) biannual values for the monitoring parameter "Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the time period t" ($F_{CH4,EG,t}$)) are considered as per the following calculation formula:

Option B.1: Biannual measurement of the flare efficiency":
For each individual flare, the calculated flare efficiency $\eta_{flare,calc,y}$ is determined as follows:

$$\eta_{flare,calc,y} = 1 - \frac{1}{2}\sum_{t=1}^{2}\left(\frac{F_{CH4,EG,t}}{F_{CH4,RG,t}}\right)$$

Where:

$F_{CH4,EG,t}$ Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the time period *t*. As established by the PDD, for the considered monitoring period, $F_{CH4,EG,t}$ was measured for each individual flare as per appropriate national or international standard during 2 set of measurement events within the year encompassed by the considered monitoring period (year of 2015). For each flare, 1-hour length biannual measurements of residual methane in the exhaust gas of the flare and measurements of speed of exhaust gas of the flare (for the determination of flow of methane exhaust gas of the flares) were performed by the third party inspection service companies "Ecosampling Avaliações Ambientais Ltda." (measurements performed in June 2015) and "Merieux NutriSciences" / "Bioagri Ambiental Ltda." (measurements performed on December 2015 and February 2016), which are inspection service companies specialized in emission measurements and air pollution inspections.

t The two time periods in year y during which the flare efficiency is measured, each a minimum of one hour and separated by at least six months.

$F_{CH4,RG,t}$ Mass flow of methane in the residual gas on a dry basis at reference conditions in the time period *t.* Details for the determination of every-minute values for $F_{CH4,RG,t}$ for each individual flare are presented below.

Determination of $F_{CH4,RG,t}$:

As per the applicable guidance of the methodological tool "Project emissions from flaring" and also as per the PDD, the methane mass flow in the residual gas (in a dry basis) for each minute *m* of the two time periods in year *y* during which the flare efficiency is measured shall be calculated by following the applicable guidance of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream". Values for the parameter $F_{CH4,RG,t}$ valid for each flare (calculation sub-parameters $F_{CH4,RG,t,flare-1}$, $F_{CH4,RG,t,flare-2}$, $F_{CH4,RG,t,flare-3}$ and $F_{CH4,RG,t,flare-4}$) are thus calculated as follows:

$$F_{CH4,RG,t,flare-n} = V_{t,db,n,flare-n} * v_{CH4,t,db} * \rho_{CH4,n}$$

Where:

$\rho_{CH4,n}$ Density of greenhouse gas *i* (*i* = CH_4) in the gaseous stream (LFG) at normal conditions. Further details for the determination of $\rho_{CH4,n}$ are presented above under the sub-section "*Determination of every-minute values for the calculation parameter $F_{CH4,sent\_flare,y}$*".

$v_{CH4,t,db}$ Volumetric fraction of greenhouse gas *i* (*i* = CH_4) in the gaseous stream in a time interval *t* on a dry basis. The following is stated in footnote 3 of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream":

> "*(…) Flow measurement on a dry basis is not feasible at reasonable costs for a wet gaseous stream, so there will be no difference in the readings for volumetric fraction in wet basis analyzers and dry basis analyzers (…)*."

Thus, every-minute values of $v_{CH4,t,db}$ are regarded as equal to every-minute values of the monitoring parameter $v_{CH4,t,wb}$ (for which further details are presented above under the sub-section "*Determination of every-minute values for the calculation parameter $F_{CH4,sent\_flare,y}$*").

$V_{t,db,n,flare-n}$ Volumetric flow of the gaseous stream (LFG) in time interval *t* on a dry basis for flare *n* (n = 1, 2, 3 and 4). As per Option B of the applicable methodological "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", the volumetric flow of the gaseous stream on a dry basis for each flare (calculation sub-parameters $V_{t,db,n,flare-1}$, $V_{t,db,n,flare-2}$, $V_{t,db,n,flare-3}$ and $V_{t,db,n,flare-4}$) is determined by converting the measured volumetric flow from wet basis to dry basis as follows:

$$V_{t,db,n,flare-n} = V_{t,wb,n,flare-n} / (1 + v_{H2O,t,db})$$

Where:

$V_{t,wb,n,flare-n}$ Volumetric flow of the gaseous stream (LFG) in time interval *t* on a wet basis at normal conditions. Further details of $V_{t,wb,n,flare-n}$ are presented above under the sub-section "*Determination of*

every-minute values for the calculation parameter $F_{CH4,sent\_flare,y}$"

$v_{H2O,t,db}$ Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis. As per applicable guidance of the methodological "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", $v_{H2O,t,db}$ is calculated as follows:

$$v_{H2O,t,db} = \frac{m_{H2O,t,db} * MM_{t,db}}{MM_{H2O}}$$

Where:

MM_{H2O} Molecular mass of H_2O. MM_{H2O} is ex-ante determined as 18.0152 kg/kmol. Further details about the ex-ante determined parameter MM_{H2O} are included in Section D.1 and in the registered PDD.

$MM_{t,db}$ Molecular mass of the gaseous stream in time interval *t* on a dry basis. As per applicable guidance of the methodological "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", $MM_{t,db}$ is calculated as follows:

$$MM_{t,db} = \sum_{k} (v_{k,t,db} * MM_k)$$

Where:

k All gases, except H_2O, contained in the gaseous stream (e.g. N_2, CO_2, O_2, CO, H_2, CH_4, N_2O, NO, NO_2, SO_2, SF_6 and PFCs). See simplification below.

$V_{k,t,db}$ Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis. As per applicable guidance of the methodological "Tool to determine the mass flow of a greenhouse gas in a gaseous stream":

	"*(…) The determination of the molecular mass of the gaseous stream ($MM_{t,db}$) requires measuring the volumetric fraction of all gases (k) in the gaseous stream. However, as a simplification, the volumetric fraction of only the gases k that are greenhouse gases and are considered in the emission reduction calculation in the underlying methodology must be monitored and the difference to 100% may be considered as pure nitrogen."*
	ACM0001 (version 13.0.0) does not include any restriction to such simplification. Thus, only the volumetric fraction of gases that are greenhouse gases and are considered in related calculations (CH_4 in the particular case of the project activity) should be measured and the difference to 100% is just considered as pure nitrogen. Further details for the determination of the volumetric fraction of CH_4 in the gaseous stream ($V_{k,t,db}$ = $v_{CH4,t,db}$) are presented above under the calculation parameter $v_{CH4,t,db}$.
MM_k	Molecular mass of gas *k* (*k* = CH_4 and N_2). The molecular mass of CH_4 and N_2 are ex-ante determined as 16.04 and 28.01, respectively. Further details about the ex-ante determined values for MM_k are included in Section D.1 and in the registered PDD.

$m_{H2O,t,db}$ Absolute humidity in the gaseous stream in time interval *t* n a dry basis. As per Option 2 of the methodological "Tool to determine the mass flow of a greenhouse gas in a gaseous stream", by conservatively assuming that the gaseous stream is saturated ($m_{H2O,t,db} = m_{H2O,t,db,Sat}$), $m_{H2O,t,db}$ is calculated as follows [25]:

$$m_{H2O,t,db,Sat} = \frac{p_{H2O,t,Sat} * MM_{H2O}}{(P_t - p_{H2O,t,Sat}) * MM_{t,db}}$$

Where:

MM_{H2O} Molecular mass of H_2O. MM_{H2O} is ex-ante determined as 18.0152 kg/kmol. Further details about the ex-ante determined values for MM_{H2O} are included in Section D.1 and in the registered PDD.

P_t Absolute pressure of the gaseous stream in time interval *t*. Further monitoring details for P_t are included in Section D.2.

$MM_{t,db}$ Molecular mass of the gaseous stream in a time interval *t* on a dry basis. Further details for the determination of $MM_{t,db}$ are presented above.

$p_{H2O,t,Sat}$ Saturation pressure of H_2O at temperature T in time *t*, Further monitoring details about the

[25] It is important to note that the simplified calculation for the absolute humidity of the gaseous stream ($m_{H2O,t,db}$) presented in Option 2 of the methodological "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" shall be applied by assuming the gaseous stream is dry or saturated depending on which is the conservative situation. Footnote 4 of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" states the following: "*An assumption that the gaseous stream is saturated is conservative for the situation that the mass flow of greenhouse gas I is underestimated (applicable for calculating baseline emissions). Conversely, an assumption that the gas stream is dry is conservative for the situation that the greenhouse gas t is overestimated (applicable for calculating project emissions).*" In this particular case, $m_{H2O,t,db}$ is calculated for the determination of the mass flow of methane in the residual gas on a dry basis during the time period t ($F_{CH4,RG,t}$). While $F_{CH4,RG,t}$ is used for the determination of the parameter $PE_{flare,y}$ (project emissions from flaring the residual gas), the assumption that the gaseous stream is dry (conservatively applicable for calculating project emissions) would not be conservative in this case as an overestimation of the amount of methane in the residual gas would actually increase the calculated efficiency of the flares, thus resulting in a reduction of $PE_{flare,y}$ and consequent increment of emission reductions.

monitoring parameter $p_{H2O,t,Sat}$ are included in Section D.2.

In summary, for the considered monitoring period, the following values of $\eta_{flare,m} = \eta_{flare,calc,y}$ were obtained:

	Flare 1 ($\eta_{flare,calc,y,flare-1}$)	Flare 2 ($\eta_{flare,calc,y,flare-2}$)	Flare 3 ($\eta_{flare,calc,y,flare-3}$)	Flare 4 ($\eta_{flare,calc,y,flare-4}$)
Determined (calculated) values for $\eta_{flare,m} = \eta_{flare,calc,y}$ for the considered monitoring period	0.9999397	0.9979330	0.9999716	0.9999589

As per the applied monitoring procedure, compliance with operational and maintenance requirements for the flares, as established by the *ex-ante* determined parameter "Manufacturer's flare specifications for temperature, flow rate and maintenance schedule interval" ($SPEC_{flare}$), is also considered for the determination and application of the values of $\eta_{flare,m} = \eta_{flare,calc,y}$ for the determination of $F_{CH4,PJ,y} = F_{CH4,flared,y}$ along the considered monitoring period[26]. This is reflected in the monthly emission reduction spreadsheets. Data records for the monitoring parameter "Flame detection of flare in the minute *m*" ($Flame_m$) are also considered for the determination and application of the values of $\eta_{flare,m}$ for the determination of values of $F_{CH4,PJ,y} = F_{CH4,flared,y}$ along the considered monitoring period. This is reflected in the monthly emission reduction spreadsheet.

For each installed flare, the time the flare has operated is determined by monitoring the flame combustion status/condition by using an UV flame detector (of which status signal (flame status "*on*" or "*off*") is continuously recorded and reported). Moreover, the monitoring requirements related to operational requirements/conditions for the flare (as established in the specifications for operational conditions defined by the flares' designer and manufacturer as per the ex-ante determined parameter $SPEC_{flare}$ (min. and max. flow of LFG to the flares + temperature of exhaust gas of the flares + meeting of maintenance requirements)) are also considered in the context of the application of determined values for $\eta_{flare,m}$ along the considered monitoring period. As outlined in the monthly emission reduction spreadsheets, for each minute *m* within the considered monitoring period when the flare have combusted LFG by not operating in accordance with the operational criteria as established by the ex-ante estimated parameter $SPEC_{flare}$ (in terms of LFG flow, temperature of exhaust gas or maintenance practice), no destruction of methane is accounted for the flare as part of the calculation values of $F_{CH4,PJ,y} = F_{CH4,flared,y}$ achieved by the project activity.

For the considered monitoring period, the accumulated value for $F_{CH4,PJ,y} = F_{CH4,flared,y}$ is calculated as 20,849 tCH_4.

[26] The calculation criteria/conditions in terms of maximum LFG flow for each individual flare required for the determination of the flare efficiency values for each flare that are added as a footnote under details for the ex-ante determined parameter $SPEC_{flare}$ due the performed service intervention in the flares on 08/06/2015 are also taken into account as reported in the monthly emission reduction calculation spreadsheets that are enclosed to this Monitoring Report.

For the considered monitoring period, baseline emissions of methane from the SWDS (BE_y = $BE_{CH4,y}$) are calculated as 374,603 tCO_2e. The summarized emission reduction calculation spreadsheets (that are enclosed to this Monitoring Report) summarizes the determination of BE_y = $BE_{CH4,y}$ for the considered monitoring period.

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

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As outlined in both the registered and revised versions of the PDD, the operation of the project activity requires consumption of both grid-sourced electricity and Liquefied Petroleum Gas (LPG). As also established in the PDD, project emissions due to consumption of these energy carriers are determined by following the applicable guidance of the "Tool to calculated baseline, project and/or leakage emissions from electricity consumption" and "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion", respectively.

Under conformance with provisions and calculation approaches of both the registered and revised versions of the PDD, project emissions (PE_y) for the considered monitoring period are determined (in tCO_2e) as follows:

$PE_y = PE_{EC,grid,y} + PE_{LPG,y}$

Where:

$PE_{EC,grid,y}$ Project emissions due to the consumption of grid-sourced electricity by the project activity

$PE_{LPG,y}$ Project emissions due to the consumption of LPG by the project activity

Project emissions due to the consumption of grid-sourced electricity by the project activity:

Project emissions due to the consumption of grid-sourced electricity by the project activity ($PE_{EC,grid,y}$) are calculated as per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01) as follows:

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

Where:

$TDL_{grid,y}$ Average technical transmission and distribution losses for grid-sourced electricity consumed by the project activity in year *y.* $TDL_{grid,y}$ is ex-ante selected as 20%. Further details about the ex-ante determined parameter $TDL_{grid,y}$ are included in Section D.1 and in the registered PDD valid for the 2nd 7-year renewable crediting period for the project activity.

$EC_{PJ,grid,y}$ Quantity of grid sourced electricity consumed by the project activity in year y. As per the applied monitoring procedure, monthly records of grid-sourced electricity consumption valid for the considered monitoring period are summarized below:

Month	Amount of consumed grid-sourced electricity (MWh)
May 2015 (16/05/2015 to 31/05/2015)	188.425

Jun. 2015	265.992
Jul. 2015	228.391
Aug. 2015	198.985
Sep. 2015	208.642
Oct. 2015	219.714
Nov. 2015	176.593
Dec. 2015	178.625

Additional monitoring details about the monitoring parameter $EC_{PJ,grid,y}$ are included in Section D.2.

$EF_{EL,grid}$ Emission factor for grid sourced electricity in year *y*. $EF_{EL,grid}$ is determined as the combined margin emission factor ($EF_{grid,CM,y}$) that is calculated as the weighted average of the operating margin and build margin emission factors. To weight these two factors, the default values applicable to both for the 2nd crediting period are applied. The combined margin emission factor is thus obtained as follows:

$$EF_{grid,CM,y} = w_{OM} * EF_{grid,OM,y} + w_{BM} * EF_{grid,BM,y}$$

Where:

w_{OM} Weighting of operating margin emissions factor. w_{OM} is ex-ante selected as 25%. Further details about the ex-ante selected parameter w_{OM} are included in Section D.1 and in the registered PDD valid for the 2nd 7-year renewable crediting period for the project activity.

w_{BM} Weighting of operating margin emissions factor. w_{BM} is ex-ante selected as 75%. Further details about the ex-ante selected parameter w_{BM} are included in Section D.1 and in the registered PDD valid for the 2nd 7-year renewable crediting period for the project activity.

$EF_{grid,OM}$ Operating margin CO_2 emission factor in year *y*. As per the applied monitoring procedure, the selected value for the monitoring parameter $EF_{grid,OM,y} = EF_{grid,OM-DD,y}$ (0.5580 tCO_2/MWh) represents to the official average value for year (vintage) 2015 as calculated and made public available by the DNA of Brazil. Further details about the monitoring parameter $EF_{grid,OM}$ are included in Section D.2.

$EF_{grid,BM}$ Build margin CO_2 emission factor in year *y*. $EF_{grid,BM}$ is ex-ante determined as 0.2010 tCO_2/MWh. Further details about the ex-ante determined parameter $EF_{grid,BM}$ are included in Section D.1.

For the considered monitoring period, project emissions due to the consumption of grid-sourced electricity by the project activity ($PE_{EC,grid,y}$) are calculated as follows:

$PE_{EC,grid,y}$ = 1,665.367 MWh * (0.25 * 0.5580 tCO_2/MWh + 0.75 * 0.2010 tCO_2/MWh) = 580 tCO_2 (rounded value)

The summarized emission reduction calculation spreadsheet (that is enclosed to this Monitoring Report) includes all calculations related to the determination of $PE_{EC,grid,y}$ for the considered monitoring period.

Project emissions due to consumption of LPG by the project activity:

Project emissions due to the consumption of LPG by the project activity ($PE_{LPG,y}$) are calculated as per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 02) as follows:

$PE_{LPG,y} = FC_{LPG,y} * COEF_{LPG,y}$

Where:

$FC_{LPG,y}$ Quantity of LPG consumed by the project activity in year *y*. As per the adopted monitoring procedure, during the considered monitoring $FC_{LPG,y}$ is determined as 270 kg (0.270 ton) of LPG. Additional monitoring details for the monitoring parameter $FC_{LPG,y}$ are included in Section D.2.

$COEF_{LPG,y}$ CO2 emission coefficient for LPG. As established in the PDD valid for the 2nd 7-year crediting period of the project activity, $COEF_{LPG,y}$ is determined by following applicable guidance as per Option B of the "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion" as follows:

$COEF_{LPG,y} = NCV_{LPG,y} * EF_{CO2,LPG,y}$

Where:

$EF_{CO2,LPG,y}$ CO_2 emission factor of fuel LPG (in energy basis). As per the applied monitoring procedure, $EF_{CO2,LPG,y}$ is determined as 0.0656 tCO_2/GJ. Further details about the monitoring parameter $EF_{CO2,LPG,y}$ are included in Section D.2.

$NCV_{LPG,y}$ Net calorific value of the fuel LPG. As per the applied monitoring procedure, $NCV_{LPG,y}$ is determined as 49.2 GJ/ton for the considered monitoring period. Further details about the monitoring parameter $NCV_{LPG,y}$ are included in Section D.2

Thus, $COEF_{LPG,y}$ = 0.0656 tCO_2/GJ * 46.5 GJ/ton = 3.05 tCO_2/ton

In summary, $PE_{LPG,y}$ is calculated as follows:

$PE_{LPG,y}$ = 0.270 ton LPG * 3.05 tCO_2/ton LPG = 0.55 tCO_2

Project emissions due to the consumption of LPG are thus determined as 1 tCO_2 (rounded value). The summarized emission reduction calculation spreadsheet (that is enclosed to this Monitoring Report) includes all calculations related to the determination of $PE_{LPG,y}$ for the considered monitoring period.

Total project emissions (PE_y) are calculated as 581 tCO_2 (rounded value).

E.3. Calculation of leakage

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Not applicable.

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

Emission reductions achieved by the project activity during the considered monitoring period are determined as the difference between baseline emissions (BE_y) and project emissions (PE_y) determined for such period. Calculations of baseline emissions (BE_y) are presented in Section E.1. Calculations of project emissions (PE_y) are presented in Section E.2. As summarized in the table below, during the monitoring period from 16/05/2015 to 31/12/2015, achieved emission reductions are calculated and reported as 374,022 tCO_2e (rounded value):

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	374,603	581	-	-	374,022	374,022

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)	692,343[27]	374,022

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

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Achieved emission reductions for the project activity are about ~54% lower than the calculated value of ex-ante estimation of emission reductions as per both the currently registered and revised version of the PDD that is valid for the considered 230-day monitoring period within the year of 2015. The following aspects justify and explain the relative difference between such value for ex-ante estimation of emission reductions as per the PDD (calculated as applicable for the considered monitoring period) and emission reductions actually achieved by the project activity during the considered monitoring period:

Aspects/conditions which represent a decrease factor of reported emission reductions for the considered monitoring period when compared against the *ex-ante* estimation of emission reduction for the same period in the PDD:

1) *Uncertainties associated with the application of First Order Decay (FOD) multi-phased model for estimating the emission reductions in the PDD:*
   As outlined in the PDD, like other similar CDM project activities encompassing LFG collection and destruction/utilization, the amount of methane to be generated by decomposition of MSW disposed at the CTR Caieiras landfill and collected by the project activity was derived by applying the First Order Decay (FOD) model as per the

[27] The 692,343 tCO_2e value is calculated as the share of the estimated total emission reductions for year 2015 to be achieved during the 230-day length considered monitoring period within year 2015. Such estimates are calculated as 1,098,719 tCO_2e * 230 / 365.

methodological tool “Emission from Solid Waste Disposal Sites” (version 06.0.1) in the context of the determination of ex-ante estimated emission reductions to be achieved during the 2nd 7-year renewable crediting period. By taking in account all potential uncertainties associated with the application of such multi-phased decay model, it is reasonable to assume that, in the particular case of the project activity during the considered monitoring period, the application of this model somehow overestimated the amount of LFG to be actually generated and collected by the project activity. In this particular context, it is crucial to note that, while the PDD assumes a LFG collection efficiency of 92.80% (ex-ante determined parameter “Efficiency of the LFG capture system that will be installed in the project activity” (η_{PJ})) in the context of the ex-ante estimates of emission reductions, as outlined in Section A.1 and B.2, during the considered monitoring period there were relevant number of LFG collection wells and conventional LFG venting/combustion drains that were not connected to project activity, thus negatively affecting the collection efficiency of LFG generated in the site during the considered period. Besides of minor uncertainty aspects, this particular aspect represents a relevant negative impact over emission reductions achieved during the period (when compared to estimates in the PDD).

2) *Lack of LFG collection infrastructure covering all area of the very large CTR Caieiras landfill:*
As outlined in the PDD (under Footnote 63 (Section B.6.1) and Footnote 79 (Section B.6.2)), significant amount of methane generated by the project activity has unfortunately not been collected and destroyed due to the lack of LFG collection infrastructure covering all area of the very large CTR Caieiras landfill. Moreover, as further outlined in Section B.1, due to this significant reduction in the amount of LFG sent to the high temperature enclosed flares, only 2 of the 4 installed flares were under regular operation during the considered monitoring period.

3) *Occurred gradual moving of the whole installed project’s LFG destruction (combustion) infrastructure (project’s LFG flaring facility) to other area/region within the CTR Caieiras landfill during the period from mid-June 2015 to 12/04/2016:*
As further explained in Section B.1, in order to address a previously taken decision of Essencis Soluções Ambientais S.A. of utilizing the area/region where the project’s LFG destruction infrastructure (project’s LFG flaring facility) was previously implemented (and has operated since year 2007) as a new MSW disposal area/region within the CTR Caieiras landfill, the whole project’s LFG flaring facility (incl. flares, centrifugal blowers, valves, safety system/equipment, other ancillary and monitoring equipment/instruments, etc.) thus had to be gradually decommissioned and moved to other area/region within the limits of the CTR Caieiras landfill. The occurred gradual moving of the project’s LFG destruction facility was planned and performed in a way that the project activity could be kept under operation during its performance with minimum interruptions, however with the project activity operating under reduced LFG flaring activity level, negatively affecting emission reductions achieved by the project activity during the considered monitoring period.

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	Essencis Soluções Ambientais S.A.
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Project participant and/or responsible person/ entity	☒ Project participant ☐ Person/entity responsible for completing the CDM-MR-FORM
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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).
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