# Monitoring report form for CDM project activity
## (Version 07.0)

| MONITORING REPORT | | |
|---|---|---|
| **Title of the project activity** | Caieiras landfill gas emission reduction | |
| **UNFCCC reference number of the project activity** | 0171 | |
| **Version number of the PDD applicable to this monitoring report** | 9.0 | |
| **Version number of this monitoring report** | 1.0 | |
| **Completion date of this monitoring report** | 30/01/2020 | |
| **Monitoring period number** | #20 | |
| **Duration of this monitoring period** | 01/07/2019 – 31/12/2019 | |
| **Monitoring report number for this monitoring period** | Not applicable. | |
| **Project participants** | Essencis Soluções Ambientais S.A.<br>Nordic Environment Finance Corporation | |
| **Host Party** | Brazil | |
| **Applied methodologies and standardized baselines** | ACM0001 – “Flaring or use of landfill gas” (version 13.0.0) | |
| **Sectoral scopes** | 13 – Waste handling and disposal | |
| **Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period** | Amount achieved before 1 January 2013 | Amount achieved from 1 January 2013 |
| | - | 741,238 $tCO_2e$ |
| **Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD** | 683,801 $tCO_2e$ | |

## SECTION A. Description of project activity

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

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The registered CDM project activity “Caieiras landfill gas emission reduction” promotes methane destruction through collection and combustion of landfill gas (LFG) at the UVS - Caieiras landfill[1].

During the considered monitoring period from 01/07/2019 to 31/12/2019, combustion of collected LFG (rich in methane ($CH_4$)) has occurred as part of the operation of the project activity in the following methane destruction devices:

- Set of 4 high temperature enclosed flares,
- Set of 21 identical internal combustion gas engines (which since 01/07/2016 represents, at the same time, (i) additional/alternative methane destruction devices for the project activity and (ii) the major components for a grid-connected electricity generation infrastructure fuelled by LFG under operation within the geographical limits of the UVS – Caieiras landfill since July/2016)[2].

LFG is generated at the UVS - Caieiras landfill as a result of anaerobic decomposition of municipal solid waste (MSW) historically disposed at this landfill.

The construction of the UVS - Caieiras landfill was initiated in year 2002 and this landfill 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 flaring infrastructure (using high temperature enclosed flares) was initially implemented at the UVS – Caieiras landfill in February 2007. The construction of the project’s LFG capture and destruction infrastructure (using high temperature enclosed flares under its initial total combined LFG flaring capacity) was initiated in March 2006 and was concluded in December 2006. While related testing and commissioning phases for such initial project implementation phase occurred in January 2007, the official starting of the project activity encompassing LFG collection and destruction (with monitoring data measurements being recorded) is 01/02/2007. Two additional flares were later installed[3].

Upon completion of related testing and commissioning activities, the set of 21 identical internal combustion gas engines combusting LFG started operating in July/2016. This set of gas engines

[1] As indicated in the registered PDD, the designation of the landfill hosting the project activity was changed in early 2017 from “CTR Caieiras landfill” to “UVS - Caieiras landfill”, where “UVS” stands for “*Unidade de Valorização Sustentável*” in Portuguese language (contextually translated into English language as *“unit for sustainable valuation (of solid waste)”*).

[2] As detailed in the PDD, methane destruction through combustion of LFG (rich in methane) also occurring in a set of internal combustion gas engines (since July/2016) represents one of the more recently approved post-registration permanent changes in the design of the project activity. The installed set of internal combustion gas engines are the basis of 21 state-of-the-art engine-generators set type 4, model/series G-420 manufactured by GE Jenbacher GmbH & Co OHG (with nameplate power generation capacity of 1.4 MW each). With destruction of methane also occurring through combustion of collected LFG in such set of internal combustion gas engines (which are regarded as additional/alternative methane destruction devices for the project activity), the project activity remains encompassing methane destruction as its unique GHG abatement/mitigation measure.

It is relevant to note that, also under conformance with the PDD, no emission reductions associated to generation of electricity by such the grid-connected electricity generation infrastructure (entirely fuelled by LFG) is accounted and/or claimed as part of the project activity.

[3] The project’s LFG flaring infrastructure was commissioned and started operating in February/2007 with 2 high temperature enclosed flares installed (Flare 1 and Flare 2). Two additional high temperature enclosed flares were later installed: Flare 3 (operations starting in July 2011) and Flare 4 (operations starting in February 2012).

(regarded as additional/alternative methane destruction devices for the project activity) were installed and started operating as per the following milestone[4]:

- 01/07/2016: Connection of set of 21 internal combustion gas engines to the project's main LFG supply pipeline, thus technically allowing collected LFG to be sent to such methane devices.
- 07/07/2016: Starting of operations of the grid-connected electricity generation infrastructure (for which the set of 21 gas engines represents major components) as part of testing and commissioning related implementation phase for the whole power generation infrastructure fuelled uniquely by LFG. While the project's monitoring data gathering, processing and recording system was not yet fully/appropriately configured at that date, no monitoring records for combustion of LFG in the set of internal combustion gas engines are thus available for the period from 08/07/2016 to 11/07/2016.
- 11/07/2016: Upon conclusion of all related testing and commissioning activities for the grid-connected electricity generation infrastructure and upon conclusion of all required configuration of the project's monitoring data gathering/processing/recording infrastructure/system; continuous operation of the project activity (with all required monitoring data being measured, processed and recorded) has thus initiated.

As part of the operation of the project activity during the considered monitoring period, LFG historically generated at the landfill has been collected and was able to be converted into carbon dioxide ($CO_2$) through both combustion in both the set of 4 high temperature enclosed flares and set of 21 internal combustion gas engines (with appropriate monitoring being performed)[5]. The operation of the project activity thus mitigates emissions of the greenhouse gas (GHG) methane ($CH_4$) that would otherwise be directly emitted into the atmosphere in the absence of the project activity (baseline scenario).

By the end of the considered monitoring period, the implemented project's LFG collection system encompassed about 517 operational vertical LFG collection wells. No horizontal LFG collection trenches have so far been utilized for collecting LFG at the UVS - Caieiras landfill. During the considered monitoring period, LFG was collected at the UVS - Caieiras landfill with the utilization of 4 centrifugal blowers which are connected to the project's LFG collecting pipeline network.

*Consumption of electricity by the project activity (electricity regarded as sourced by the grid and electricity sourced by installed backup captive off-grid electricity generator (fuelled by diesel)):*

[4] The PDD includes a more detailed timeline with the most relevant facts and events related to the so far partially occurred implementation of the grid-connected electricity generation infrastructure fuelled by LFG and located within the geographical limits of the UVS – Caieiras landfill (under its 1st implementation phase) and its starting of operations in July/2016. The set of 21 identical internal combustion gas engines represents the major component for such power generation infrastructure entirely fuelled by LFG.

[5] During the whole considered monitoring period, two of the flares (Flare 1 and Flare 3) were completely out of service. Flares 1 and 3 are expected to start operating again when the flow of collected LFG becomes sufficiently high for maintaining all the 4 installed high temperature enclosed flares operating continuously. While Flare 2 has continuously operated during the whole period (with very short operational interruptions due to operational issues: power shortage, etc.), Flare 4 has operated during limited times of the considered monitoring period. As indicated in the PDD, as per the project design, collected LFG is primarily combusted in the set of internal combustion gas engines, with remaining share of captured LFG being directed to combustion in the flares. Thus, under normal project operational conditions, the number of flares under operation is dependent on the amount of excess LFG to be combusted by flaring.

During the considered monitoring period, electricity demand for the project activity was entirely met by consumption of electricity which is regarded as grid-sourced electricity[6]).
While a backup captive off-grid electricity generator (fuelled by diesel and with 700 kVA of nameplate installed capacity) is installed within the geographical limits of the UVS – Caieiras landfill since July/2016, it is noteworthy that this backup captive off-grid generator was not used during the considered monitoring period.

*Consumption of Liquefied Petroleum Gas (LPG) by project activity:*
Under conformance with the project design description (as outlined in the PDD), consumption of very low amount of fossil-fuel Liquefied Petroleum Gas (LPG) occurred during the considered monitoring period. LPG has been used as a start-up fuel to ignite the high temperature enclosed flares whenever it is required (e.g. only after maintenance/repair events, after temporary interruptions in grid electricity supply to the project activity, etc. whenever the operation of flare(s) needs to the reestablished).

*Monitoring:*
The flow and $CH_4$ content of stream of collected LFG which was sent to each one of the operational flares and to each operational gas engine during the considered monitoring period has been continuously measured, recorded and reported (under every-minute frequency) as part of the operations of the project activity. As defined in its monitoring plan, monitoring activities for the project activity encompass measuring, recording and reporting of (i) LFG flow sent to each individual flare, LFG flow sent to each internal combustion gas engine, (ii) $CH_4$ content of collected LFG sent to such devices, (iii) LFG temperature and (iv) LFG pressure.

Furthermore, the following additional monitoring tasks were continuously performed:
(v) status/conditions of the high temperature enclosed flares (incl. their compliance with operational requirements (as established by the flare equipment manufacturer)),
(vi) operational status of each internal combustion gas engine
(vii) Temperature of the exhaust gas of each flare and
(viii) operational status of each flare (flare "*on*" or flare "*off*")

Finally, (ix) Consumption of electricity by the project activity was also measured. Furthermore, (x) the amount of LPG consumed by the project was also monitored during the considered monitoring period.

All monitoring data is stored/archived in a computerized database located in the project's control room. Further details about installed methane destruction devices are included in Section B.1. Details about installed monitoring equipment/instruments are made available in Section D.2.

### A.2. Location of project activity

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The UVS - 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

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[6] Under normal project operational conditions, minor share of electricity generated by the grid-connected electricity generation infrastructure (for which the set of 21 internal combustion gas engines represents major components) is consumed by equipment of the project's LFG collection and flaring infrastructure (e.g. centrifugal blowers, control system, monitoring instruments/equipment, etc.). As established in the PDD, such electricity consumption is regarded as consumption of grid-sourced electricity (with related project emissions accounted accordingly). This represents a conservative approach which is under conformance with the following disclaimer included in the PDD:

> *"(…) while no emission reductions due to displacement of a more-GHG-intensive service (due to generation of electricity using collected LFG as fuel) are eligible and/or claimable for the project activity, for sake of conservativeness and integrity, any consumption by the project activity of electricity generated by the grid-connected electricity generation infrastructure fuelled by LFG located within the geographical limits of the UVS – Caieiras landfill (of which the set of internal combustion gas engines represents the major components) will be regarded and accounted as consumption of grid-sourced electricity (with related project emissions being determined ex-post)."*

Caieiras municipality. Caieiras is one of the municipalities encompassing the Metropolitan Region of São Paulo (RMSP).

The project site has the following geographical coordinates:

- 23º20'40" S (-23.3444)
- 46º46'20" W (-46.7722)

### A.3. Parties and project participants

| Parties involved | Project participants | Indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|
| Brazil (host) | Essencis Soluções Ambientais S.A. | No |
| Norway | Nordic Environment Finance Corporation | No |

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

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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:

- "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).
- "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);
- "Tool to calculate the emission factor for an electricity system" (version 04.0) (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.pdf)

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

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

## SECTION B. Implementation of project activity

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

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Total technical Municipal Solid Waste (MSW) disposal capacity for the UVS - Caieiras landfill is currently defined as about 60,000,000 ton of MSW. By the end of the considered monitoring period, an accumulated amount of more than 42,500,000 ton of MSW was disposed in this very well managed landfill site. The UVS - Caieiras landfill is currently not expected to close prior to year 2030.

The project's LFG collecting wells are used to extract LFG from inner section of the landfill. At the ending date of the considered monitoring period, the project's LFG collection system consisted of about 517 operational LFG collecting wells (all interconnected through a high-density polyethylene (HDPE) pipeline network). Through such pipeline network, all collected LFG passes through condensation pots where most of the moisture in collected LFG is removed through condensation prior of being sent to the project's methane destruction devices (i.e. set of high temperature enclosed flares and set of internal combustion gas engines) for controlled combustion. Stream of LFG sent to the set internal combustion gas engines passes through additional centrifugal blowers and through a LFG cooling/treatment unit where LFG is cooled in order to meet fuel requirements for such engines.

The quantity and quality of collected LFG sent to each one of the high temperature enclosed flares and to each internal combustion gas engine set are measured, recorded and reported as per applicable monitoring 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 $CH_4$ as well as flow of collected LFG stream sent to the project's methane destruction devices are continuously measured on the same moisture basis.

As per construction and operational design of the UVS - Caieiras landfill, a geo-membrane of PVC or similar material is expected to be eventually installed to cover disposed MSW only by the time of the closure of the cells of the landfill.

During the considered monitoring period encompassing the period from 01/07/2019 to 31/12/2019, the project activity encompassed the operation of the following equipment:

- 2 condensation traps to separate liquids in the collected LFG (leachate and condensate);
- 3 centrifugal blowers of 4-stage type, manufactured by Houston Service Industries – his and powered by electric motor (with nameplate power of 200 HP).
- 1 multistage centrifugal blower, manufactured by ABB S.p.A. and powered by electric motor (with nameplate power of 150 HP).
- Set of 4 high temperature enclosed flares manufactured by BTS - Termodinâmica de Sistemas Ltda. The flares are equipped with a pilot flame fuelled by LPG[7].
- One off-grid captive backup electricity generator (fuelled by diesel) with 700 kVA (560 kW for a power factor of 0.8) of nameplate power generation capacity. As per the project design, this backup off-grid electricity generator is used for emergency purposes only (during temporary situations when the supply of electricity regarded as sourced by the grid is interrupted to the project activity). The installed backup captive off-grid power generation unit is manufacturered by STEMAC S/A Grupos Geradores (Brazil) and is of model G – GMC / 440 V voltage / 60 Hz.
- Set of 21 identical internal combustion gas engines in which collected LFG is combusted. This set of internal combustion gas engines are the basis of 21 state-of-the-art engine-generators set type 4, model/series G-420 manufactured by GE Jenbacher GmbH & Co OHG (with nameplate power generation capacity of 1.4 MW each).
- Collected LFG passes through a LFG cooling/treatment unit (electrical LFG chilling and activated-carbon LFG purification/filtering equipment).

Details about monitoring instruments/equipment under operation during the considered monitoring period are included in Section C.

The following pictures provide overview of the project activity's available infrastructure as per the current configuration of the project activity:

[7] The pilot flame system for the installed high temperature enclosed flares are fuelled by LPG which is sourced (when required) by LPG cylinder with 45 kg of LPG each.


Figure 1 – Aerial view of the project's LFG flaring infrastructure

Figure 2 – Aerial view of the grid-connect electricity generation infrastructure located within the geographical limits of the UVS – Caieiras landfill (for which the set of 21 gas engines represents the major components).

Figure 3 – Aerial partial view of project's LFG flaring infrastructure + view of LFG treatment/cooling facility.

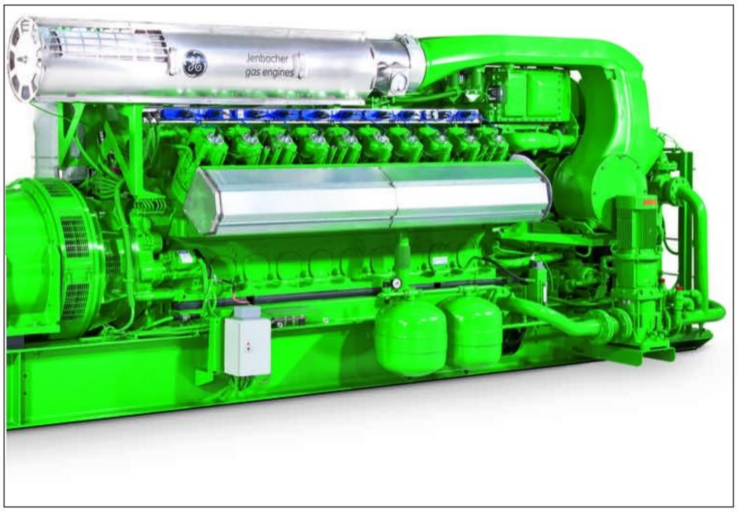


Figure 4: View of internal combustion gas engine fuelled by LFG that is part of the engine-generator set type 4, G420 series manufactured by GE Jenbacher GmbH & Co OHG

The project activity was implemented and has operated under full conformance with its design configuration (as described in the PDD) during the whole considered monitoring period.

During the considered monitoring period, the project activity faced events when it became temporarily out of operation due to different reasons (occurred temporarily interruption of supply of collected LFG to the set of 21 internal combustion gas engines, temporarily interruption in the supply of electricity to the project activity, occurrence of previously planned or unplanned equipment maintenance/repair events, performance regular calibration events, draining of excess of condensate material 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 lack of operational LFG collection infrastructure covering all the whole area of the UVS - Caieiras landfill, the project activity operated under limited activity level during the whole considered monitoring period (when compared to the quantitative estimates of the project's potential for promoting LFG collection and GHG emission reductions as outlined in the PDD). Due to that, collected LFG was not combusted in all of the methane destruction devices currently encompassed by the project activity (4 high temperature enclosed flares + 21 internal combustion gas engines).

The UVS - Caieiras landfill is regarded as a very well-designed and well-managed landfill. It currently applies the best practice available in Brazil in terms of MSW landfilling from both design and operation perspectives. As established by the valid environmental and operational permits, all disposed MSW is 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 UVS-landfill by using a preventative approach. No practice to deliberately increase the amount of methane generated at the UVS - Caieiras landfill has ever been applied. While the implementation and operation of 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 UVS - 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").

## B.2. Post-registration changes

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

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There are no temporary deviations from the registered monitoring plan and/or applied CDM baseline and monitoring methodology and/or applicable methodological tools encompassed specifically by the considered monitoring period.

It is however relevant to note that temporary deviations from the registered monitoring plan, and/or methodologies were previously approved under PRC-0171-002 (not in the context of the verification assessment for the considered monitoring period) as changes applicable/valid for monitoring period(s) prior to the considered monitoring period and within the currently expired 1st 7-year crediting period of the project activity (thus not in the context of the verification assessment for the considered monitoring period) as follows:

| Ref. of PRC processes so far encompassed by the project activity | Approval date | Description of the post-registration change(s) under the category “Temporary deviations from the registered monitoring plan, applied methodologies or standardized baselines” |
|---|---|---|
| PRC-0171-002 | 04/05/2015<br>(Issuance track) | Temporary deviations from the registered monitoring plan:<br>- During the period from 01/09/2011 to 31/03/2012 the time interval between the performed measurements for the determination of flare efficiency of the installed flares exceeded the every 3-month frequency (4 times per year) established by the monitoring plan of the registered PDD valid for the currently expired 1st 7-year crediting period of the project activity. |

### B.2.2. Corrections

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There are no corrections (in information that do not affect the project design) encompassed specifically by the considered monitoring period.

It is however relevant to note that corrections (in information that do not affect the project design) were previously approved (under PRC-0171-001, PRC-0171-003) as changes applicable/valid for monitoring period(s) prior to the considered monitoring period (thus not in the context of the verification assessment for the considered monitoring period) as follows:

| Ref. of PRC processes so far encompassed by the project activity | Approval date | Description of the post-registration change(s) under the category “Corrections” |
|---|---|---|
| PRC-0171-001 | 27/05/2013<br>(Issuance track) | Corrections (in information that do not affect the project design):<br>Previously existent not correct/updated information in the previously registered version of the PDD (version 3) and related to quantitative information about historical and forecasted disposal of municipal solid waste (MSW) at the UVS - Caieiras landfill were addressed, with ex-ante estimates of emission reductions to be achieved within the currently expired 1st 7-year crediting period being revised accordingly (by taking into account the updated and higher figures for MSW disposal for the period from 2007 onwards |

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| | | and historical information for year 2006).<br>Minor text corrections and improvements were also made in the revised version of the PDD (version 4). Minor corrections included the following:<br>- Inclusion of project's geographical location coordinates in decimal GPS format;<br>- Correct description of the name of one of the project participants was added;<br>- Updated contact information for the project participants were added;<br>- Clarification about the ownership of the UVS - Caieiras landfill was added;<br>- Clarification about the current situation in Brazil and region where the project activity is located regarding regulatory requirements for LFG management in landfills;<br>- Clarification about the version of the applied ACM0001 baseline and monitoring methodology (version 2) was added;<br>- Clarification about the occurred temporarily pilot tests/evaluations with a portable electricity generation station (fuelled by LFG collected at the UVS - Caieiras landfill as part of the project activity) during the period from April 2009 to June 2009 (including related explanations/justifications for not regard such initiative as a permanent change to the design of the project activity);<br>- Corrected name of the landfill was added;<br>- Figure notation was corrected in several sections of the PDD: use of "," for thousands (instead of ".");<br>- Other minor corrections. |
| PRC-0171-003 | 30/09/2016<br>(Issuance track) | Corrections (in information that do not affect the project design):<br>- 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<br>- Typo and grammar errors and mistakes were corrected in different sections of the PDD. |

It is also relevant to note that additional corrections (in information that do not affect the project design) were more recently approved (under PRC-0171-005) as changes applicable/valid for monitoring periods from 01/07/2016 onwards (including the considered monitoring period) as independent validation opinion assessment (thus not in not in the context of the verification assessment for the considered monitoring period) as follows:

| Ref. of PRC processes so far encompassed by the project activity | Approval date | Description of the post-registration change(s) under the category "Corrections" |
|---|---|---|
| PRC-0171-005 | 28/08/2018<br>(Prior approval track) | Corrections (in information that do not affect the project design):<br><br>- General text and terminology revision of project description in order to fully comply with the currently applicable requirements for completing the CDM-PDD form (version 10.1) (as established by its attachment "Instructions for completing this form") and to |

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| | | enhance/improve the project design description.<br><br>- Minor text improvements (incl. review of statements and correction of previously existent typographic mistakes) in order to improve the overall project description.<br><br>- Revision of ex-ante estimates of emission reductions to be achieved by the project activity during its 2nd 7-year crediting period (by inter alia taking into account the determination of project emissions due to consumption of electricity by the project activity through application of Scenario C of the methodological tool “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01)).<br><br>- The name of the landfill hosting the project activity was changed from “CTR Caieiras landfill” to “UVS - Caieiras landfill” reflecting the occurred change in early 2017 of the designation of the landfill hosting the project activity that was made by the project participant and project owner Essencis Soluções Ambientais S.A. as part of the operationalization of the company’s commercial, marketing and sustainability strategy.<br><br>- Updated contact information details for the project participant Essencis Soluções Ambientais S.A. was added (in line with the latest version of the completed Modalities of Communication (MoC) form for the project activity).<br><br>- Details about performed task-force involving capital and labour intensive maintenance, repair and parts replacement work in existing project’s LFG collection infrastructure and operational improvements for such infrastructure held during the period from July/2016 to July/2017 were added in Section A.3. |

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

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Not applicable for the considered and/or previous monitoring periods. There are no changes to start date of the crediting period encompassed by the considered monitoring period and/or previously approved by the CDM-EB. In fact, no change to start date of the crediting period was ever addressed in the context of any one of the previously performed and approved post-registration changes for the project activity (PRC-0171-001, PRC-0171-002, PRC-0171-003 and PRC-0171-005[8]).

### B.2.4. Inclusion of monitoring plan

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Not applicable for the considered and/or previous monitoring periods. There is no inclusion of monitoring plan (and/or applicable methodological tools) encompassed by the considered monitoring period and/or previously approved by the CDM-EB as being applicable for the

[8] The previously performed assessment and request of approval of post-registration changes for the project activity under ref. PRC-0171-004 was rejected by the CDB-EB on 01/03/2018.

considered monitoring period. In fact, no inclusion of monitoring plan was ever addressed in the context of previously performed and approved post-registration changes for the project activity (PRC-0171-001, PRC-0171-002, PRC-0171-003 and PRC-1071-005).

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

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There are no permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied CDM baseline and monitoring methodology and/or applicable methodological tools encompassed specifically by the considered monitoring period.

It is also relevant to note that permanent changes in the monitoring plan were more recently approved (under PRC-0171-005) as changes applicable/valid for monitoring periods from 01/07/2016 onwards (including the considered monitoring period) as independent validation opinion assessment (thus not in not in the context of the verification assessment for the considered monitoring period) as follows:

| Ref. of PRC processes so far encompassed by the project activity | Approval date | Description of the post-registration change(s) under the category "Permanent changes to the registered monitoring plan, or permanent deviation of monitoring form the applied methodologies, standardized baselines, or other applied standards or tools" |
|---|---|---|
| PRC-0171-005 | 28/08/2018 (Prior approval track) | Permanent changes from the registered monitoring plan:<br>- Revision of the applied monitoring and GHG calculation approaches by including additional monitoring requirements and calculation approaches for determining the following emissions as a result of the changes in the project design:<br>(i) Baseline emissions for methane (due to destruction of LFG (rich in methane) also occurring in the set of internal combustion gas engines (regarded as additional/alternative methane destruction devices).<br>(ii) Project emissions (due to the consumption of electricity sourced by the installed backup captive off-grid electricity generator (fuelled by diesel)).<br>Project emissions due to consumption of electricity (sourced by the grid or backup generator (fuelled by diesel)) by the project activity will determined by applying guidance of Scenario C of the methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01) to these sources of electricity consumption.<br>As a result of the related revision of the applied GHG calculation and monitoring approaches, additional ex-ante determined parameters and parameters monitored ex-post are added (i.e. $Op_{j,h}$, $EF_{EL,captive,y}$, $EF_{EL,grid,y}$, $EC_{PJ,captive,y}$, $FC_{Diesel,y}$, $NCV_{Diesel,y}$, $EF_{CO2,Diesel,y}$, $EG_{Diesel-Generator,y}$ and $TDL_{captive,y}$) and the parameter $TDL_{grid,y}$ will be monitored ex-post (as established by the methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"). |

### B.2.6. Changes to project design

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There are no changes to the project design encompassed specifically by the considered monitoring period.

It is however relevant to note that changes to the project design were previously approved under PRC-0171-003 as changes applicable/valid for monitoring period(s) prior to the considered monitoring period (thus not the context of the verification assessment for the considered monitoring period) as follows:

| Ref. of PRC processes so far encompassed by the project activity | Approval date | Description of the post-registration change(s) under the category "Changes to project design" |
|---|---|---|
| PRC-0171-003 | 30/09/2016 (Issuance track) | Permanent changes in the design of the project activity:<br>- *Occurred gradual moving of the whole installed project's LFG flaring infrastructure to other area/region within the UVS - Caieiras landfill during the period from mid-2015 to 12/04/2016:*<br>As result of a previously taken decision of Essencis Soluções Ambientais S.A. to convert the area/region within the UVS - Caieiras landfill where the project's LFG flaring infrastructure was previously implemented and has operated (since year 2007) into a new MSW disposal area, such project's infrastructure was thus moved to other area/region within the landfill. The project activity's LFG flaring infrastructure moving process was initiated in June/2015 and was concluded on 14/02/2016. In the context of such occurred infrastructure moving process, 3 new 4-stage and more efficient centrifugal blowers were purchased and were installed in the new location of the infrastructure (thus replacing the 4 previously installed and worn 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 storing/archiving of monitoring records were also installed (with operation starting on 18/12/2015 (with the old database being kept available for sake of historical monitoring data archiving)).<br><br>- *Performed service intervention in each one of the installed 4 high temperature enclosed flares for addressing previously detected undesirable and abnormal intermittent/sporadic vibration + noise problems in the flares (resulting in higher nameplate LFG flaring capacity for each flare):*<br>A service intervention was performed in each one of the project's 4 high temperature enclosed flares on 08/06/2015 and aimed addressing previously detected undesirable and abnormal intermittent/sporadic vibration + noise problems in the installed flares. This service intervention was performed by technical service representatives authorized by the flares' |

| | | |
|---|---|---|
| | | designer and manufacturer BTS - Termodinâmica de Sistemas Ltda. and included re-design of the LFG burner unit in each flare (through the replacement of the previously installed 5 LFG injectors in each flare burner unit by 5 new injectors (with slightly larger dimensions and slightly higher LFG firing capacity)) + related inspection/testing/commissioning services. By making use of slightly larger LFG injectors in the burner unit of the flares, the performed service intervention resulted in slight increase of the maximum nameplate LFG flaring capacity for each one of the installed flares (7,500 $Nm^3/h$ (and not any longer 6,500 $Nm^3/h$) as defined by the designer and manufacturer of the flares. Such flare specification change required 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” ($SPEC_{flare}$)). |

It is also relevant to note that additional permanent changes to the project design were more recently approved (under PRC-0171-005) as changes applicable/valid for monitoring periods from 01/07/2016 onwards (including the considered monitoring period) as independent validation opinion assessment (thus not in not in the context of the verification assessment for the considered monitoring period) as follows:

| Ref. of PRC processes so far encompassed by the project activity | Approval date | Description of the post-registration change(s) under the category “Changes to project design” |
|---|---|---|
| PRC-0171-005 | 28/08/2018 (prior approval track) | Permanent changes in the design of the project activity:<br>- Inclusion of destruction of methane through combustion of LFG in a set of internal combustion gas engines (with gradual/phased implementation schedule) that represents additional/alternative methane destruction devices for the project activity with operations since July/2016. Despite these gas engines represents major components for an electricity generation infrastructure located within the geographical limits of the UVS – Caieiras landfill, the project activity under its revised design configuration does not include electricity generation as an additional GHG abatement measure for which emission reductions is not to be claimed. Thus, $CO_2$ emission associated to generation of electricity (using LFG as renewable energy source) are not to be accounted/claimed as part of the project activity.<br><br>- Meeting of project’s electricity demand through electricity generated by a backup captive off-grid electricity generator (fuelled by diesel) (with nameplate installed capacity of 700 kVA (560 kW for a power factor of 0.8)) was added as an option since July/2016. |

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

>>

Not applicable.

## SECTION C. Description of monitoring system

>>

DATA ACQUISITION, STORAGE AND MANAGEMENT SYSTEM

As part of the application of the monitoring plan valid for the 2nd 7-year crediting period of the project activity (under its current design configuration), monitoring data is automatically measured, processed and recorded with the use of related monitoring instruments/equipment, two programmable logic controller (PLC) units [9] and a database (with design and configuration customized for the project activity). All of such infrastructure is integrated/linked to a data supervisory system (SCADA) of which design and configuration is also appropriately customized to the project activity. With exception of data related to consumption of electricity by the project activity, every-minute monitoring measures for the project activity are processed, recorded and archived by the use of such PLC units and database.

As part of the implemented data reporting and emission reduction calculation procedures, files with raw-data (primary data) are generated for each month of considered monitoring period. Files with raw-data contain monitoring records valid for every single minute of every month encompassed by the considered monitoring period. Monitoring data retrieved from the database is exported/reported in MS-Excel format and handled as a primary data input for the performance of emission reduction calculations. Through the application of a systematic working procedure, retrieved monitoring data is used as input data for the compilation of monthly emission reduction calculation spreadsheets + additional calculation spreadsheet with values of LFG flow to the project's methane devices which are all enclosed to this Monitoring Report.

The project's data supervisory system includes in its user interface functionalities for regular retrieval of monitoring data (generation of MS-Excel format files with raw-data). The figure below includes overview of the user interface of the project's supervisory system.

[9] One PLC unit is used for processing signals from monitoring instruments/equipment of the project's LFG collection and flaring infrastructure. One additional PLC unit is used for processing signals from monitoring instruments/equipment related to combustion of collected LFG in the set of 21 internal combustion gas engines. Monitoring data processed by both of such PLC units are recorded in the project's database and can be visualized in the project's supervisory (SCADA) system.

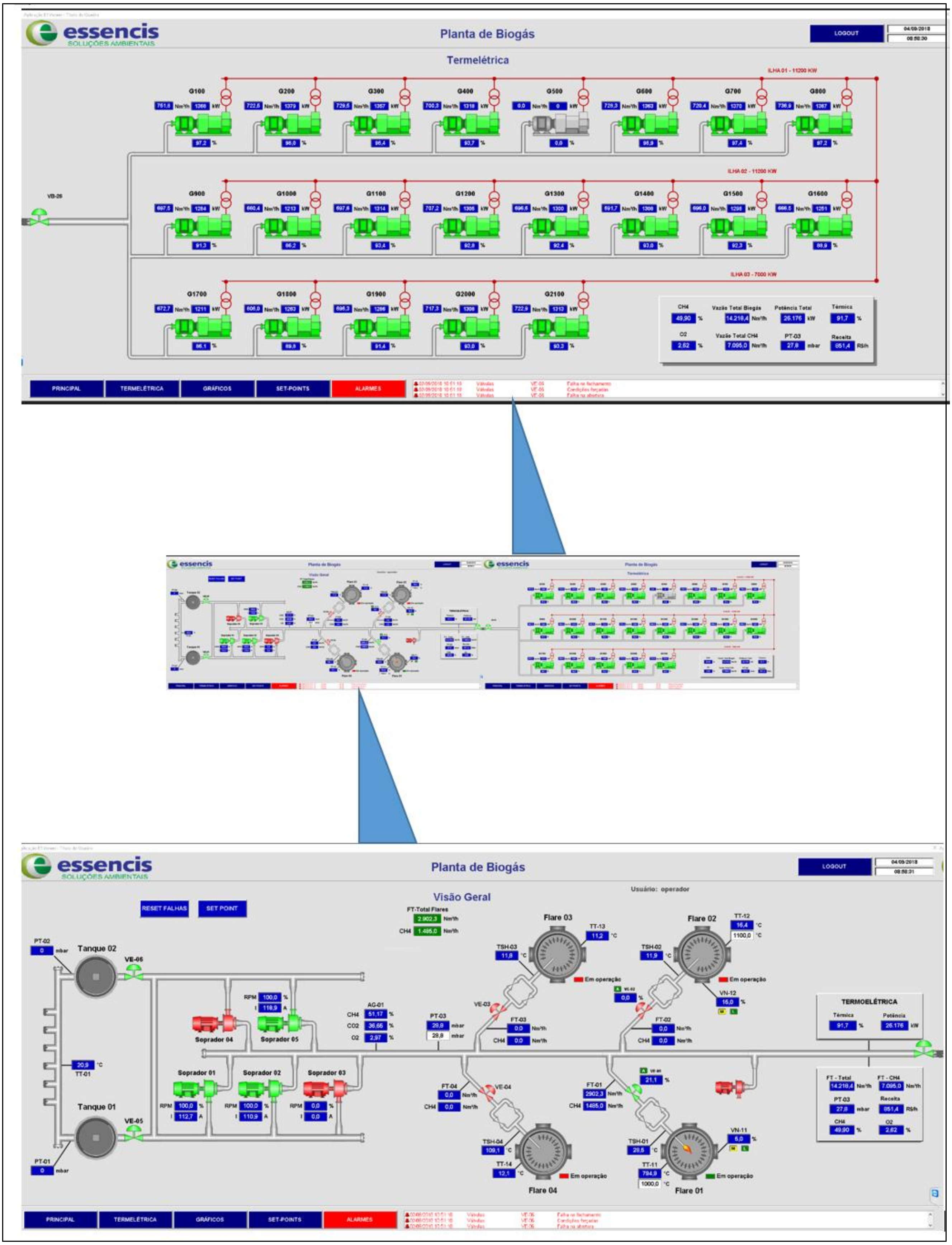


Figure 5 – View of the user interface (screen) of the project's supervisory system (complete screen is shown in the center image. Zoom view of the right and left sides of the screen are shown in the upper and bottom images respectively)

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 monitoring records and calculated achieved emission reductions:

1) Every month, a MS-Excel format spreadsheet data file with monitoring records (raw data files) is generated as part of regular retrieval of archived monitoring data for the project activity by using available functionality of the project's supervisory system. Each generated raw data file includes monitoring data reported for a full month.

2) Monitoring records of LFG flow sent to each one of the set of 21 internal combustion gas engines + monitoring records of LFG pressure and LFG temperature for each one of such engines are copied from the each generated monthly file with raw data and utilized as input for the determination (calculation) of every-minute values of LFG flow to each one of the 21 gas engines in normalized values (by taking into account standard conditions of temperature and pressure). Such calculations are made in a set of calculation spreadsheets which are also enclosed to this Monitoring Report (one calculation spreadsheet for each month).

3) The content of every-month raw data file (in MS-Excel format) (referred in item 1) and the content of the every-month calculation spreadsheets (referred in item 2) are both used as input data for the determination of baseline emissions due to combustion of LFG by the project activity in a 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 and currently valid 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 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 summarizes the hierarchy for the project management.

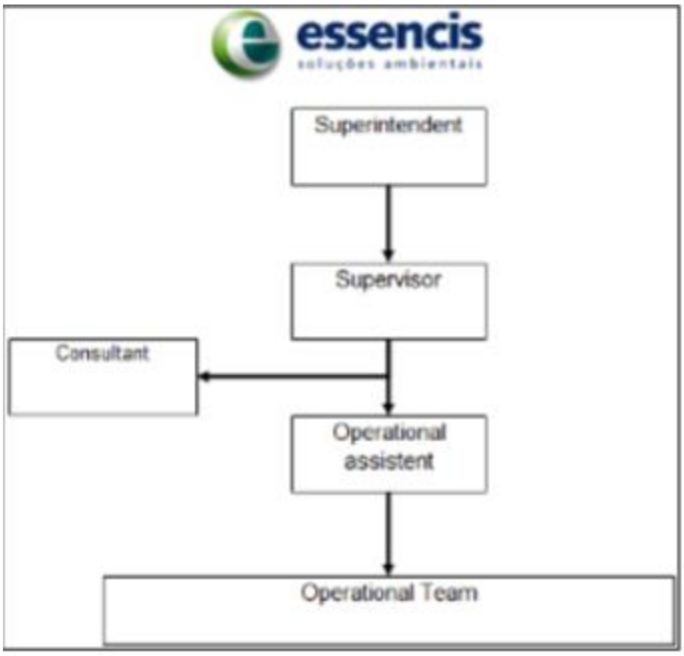


Figure 7 – Hierarchy for the project management of the project activity

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

a) General competence development about generation, collection of LFG;
b) General competence development about combustion of collected LFG in both flares and internal combustion gas engines (methane destruction devices)
c) Review of equipment operational principles and captors;
d) Maintenance and calibration requirements for project's related equipment/instruments;
e) Procedures for data monitoring (incl. data gathering, data handling and data archiving);
f) 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:

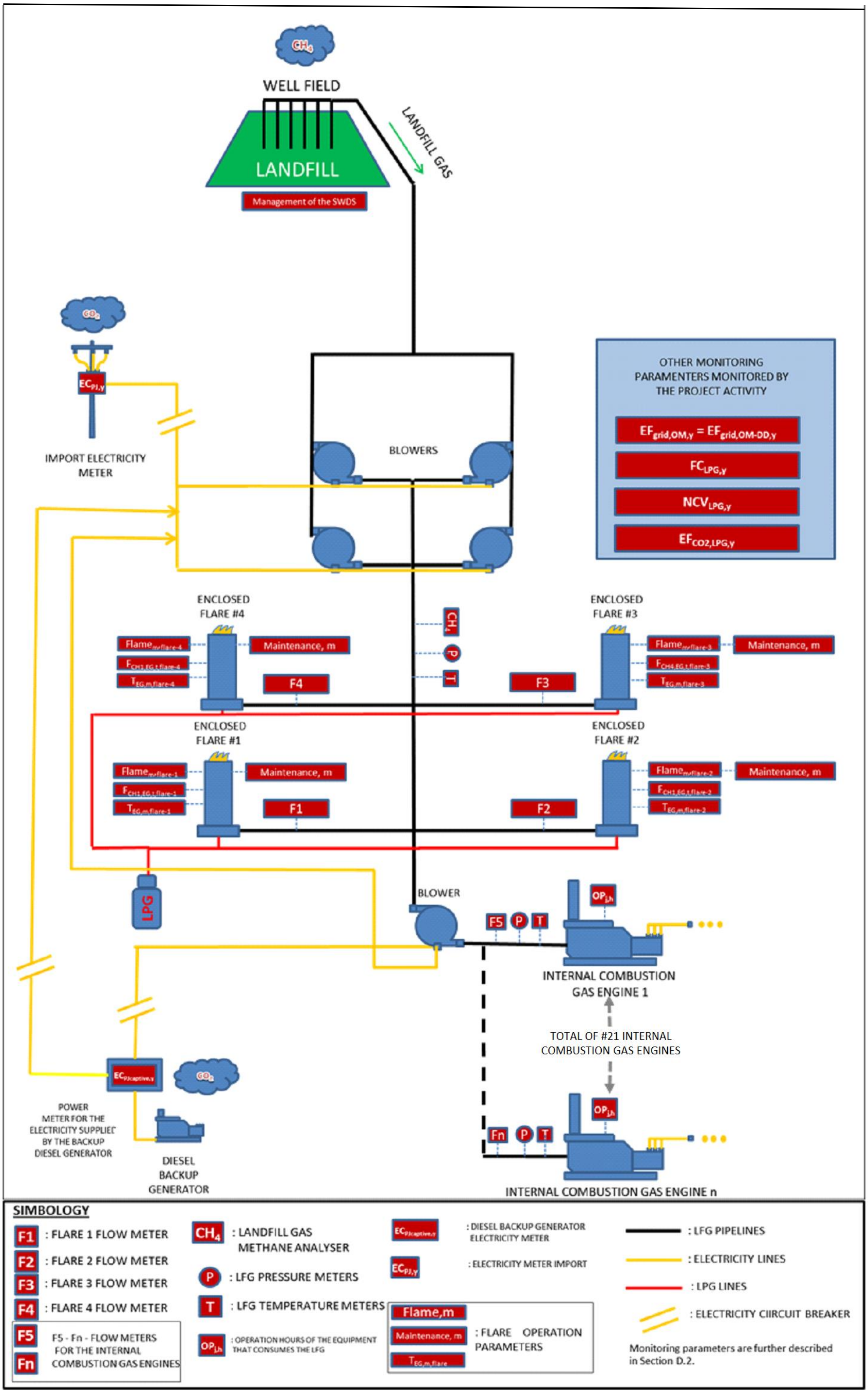


Figure 8 – Schematic instrumentation diagram of the project’s monitoring system

# SECTION D. Data and parameters

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

| **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 | Consistent with how oxidation is accounted for in the methodological tool “Emissions from solid waste disposal sites” (version 08.0) |
| 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/parameter | 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. Information is available online: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14<br><br>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/parameter | Calculation of baseline emissions |
| Additional comments | The applied value shall be updated according to any future COP/MOP decisions and/or decision by the CDM-EB. |

| **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 methodological tool “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/parameter | 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 methodological tool “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 MMi.<br><br>The following is defined by the applied methodological tool “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 02.0.0):<br><br>*“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*.”<br><br>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.<br><br>Compound: Nitrogen; Structure: $N_2$; Molecular mass (kg/kmol): 28.01 |
| Choice of data or measurement methods and procedures | - |

| Compound | Structure | Molecular mass (kg/kmol) |
|---|---|---|
| Nitrogen | $N_2$ | 28.01 |

| | |
|---|---|
| Purpose of data/parameter | 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 methodological tool "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 registered PDD, the following value of molecular mass is applicable for $CH_4$ (the only GHG which is considered):<br><br>Compound / Structure / Molecular mass (kg/kmol)<br>Methane / $CH_4$ / 16.04 |
| Choice of data or measurement methods and procedures | - |
| Purpose of data/parameter | 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 values as per the methodological tool "Tool to determine the mass flow of 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/parameter | Calculation of baseline emissions |
| Additional comments | - |

| **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 methodological tool “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/parameter | 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 methodological tool “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/parameter | Calculation of baseline emissions |
| Additional comments | - |

| **Data/Parameter** | **$w_{BM}$** |
|---|---|
| Unit | % |
| Description | Weighting of build margin emissions factor |
| Source of data | Applicable default value as per the methodological tool “Tool to calculate the emission factor for an electricity system” (version 04.0) |
| 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 methodological tool "Tool to calculate the emission factor for an electricity system" (Version 04.0) is selected. |
| Purpose of data/parameter | Calculation of project emissions. |
| Additional comments | It is relevant to note that, as further explained in Section E.2, for the determination of the $CO_2$ emission factor for electricity consumed by the project activity, the PDD defines the following generic approach of the methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01) regarding its determination by taking into account the potential sources for consumed electricity:<br><br>*"Where case C.III has been identified, as a conservative simple approach, the emission factor for electricity generation should be the more conservative value between the emission factor determined as per guidance for scenario A and B respectively. This means that the more conservative value should be chosen between a) the result of applying either option A1 or A2 and b) the result of applying either option B1 or B2."*<br><br>As further explained in Section E.2, the above-quoted options of the methodological tool (options A1, A2, B1 and B2) are thus all potentially applicable for the determination of $EF_{EL,grid,y}$ = $EF_{EL,captive,y}$ (with the determined value representing the most conservative (higher) value). In this context, the ex-ante determined value for $w_{BM}$ is thus applied for the determination of $EF_{EL,grid,y}$ as per Option A1[10]. |

| | |
|---|---|
| **Data/Parameter** | $w_{OM}$ |
| Unit | % |
| Description | Weighting of operating margin emissions factor |
| Source of data | Applicable default value as per the methodological tool "Tool to calculate the emission factor for an electricity system" (version 04.0) |
| 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 methodological tool "Tool to calculate the emission factor for an electricity system" (version 04.0) is selected. |

[10] As further explained in Section E.2, while in the particular case of the considered monitoring period the installed backup captive off-grid electricity generator (fuelled by diesel) was not used and no consumption by the project activity of electricity sourced by such captive power generation source thus occurred during the period, the following is thus applicable:

- Option A1 and Option A2 of the of the methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01) are directly selected and applied for the determination of $CO_2$ emission factor for consumed electricity (with the most conservative (higher) value being chosen) under conformance with additional guidance included in the PDD (and quoted in Section E.2.).
- Project emissions associated to such consumption of electricity genered with fossil fuel diesel ($PE_{EC,captive,y}$) are directly determined as being null (zero).

| | |
|---|---|
| Purpose of data/parameter | Calculation of project emissions |
| Additional comments | It is relevant to note that, as further explained in Section E.2, for the determination of the $CO_2$ emission factor for electricity consumed by the project activity, the PDD defines the following generic approach of the methodological tool “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01) regarding its determination by taking into account the sources for consumed electricity:<br><br>*“Where case C.III has been identified, as a conservative simple approach, the emission factor for electricity generation should be the more conservative value between the emission factor determined as per guidance for scenario A and B respectively. This means that the more conservative value should be chosen between a) the result of applying either option A1 or A2 and b) the result of applying either option B1 or B2.”*<br><br>As further explained in Section E.2, the above-quoted options of the methodological tool (options A1, A2, B1 and B2) are thus all potentially applicable for the determination of $EF_{EL,grid,y}$ = $EF_{EL,captive,y}$ (with the determined value representing the most conservative (higher) value). In this context, the ex-ante determined value for $w_{OM}$ is thus applied for the determination of $EF_{EL,grid,y}$ as per Option A1. |

<table>
<tr><td>Data/Parameter</td><td>$SPEC_{flare}$</td></tr>
<tr><td>Data unit</td><td>°C (for temperature values)<br>$Nm^3/h$ (for LFG flow values)<br>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>Flare manufacturer</td></tr>
<tr><td>Value(s) applied</td><td>Flare 1, Flare 2, Flare 3 and Flare 4:
<table>
<tr><th>$SPEC_{flare,flare\ 1}$<br>$SPEC_{flare,flare\ 2}$<br>$SPEC_{flare,flare\ 3}$</th><th>Min.</th><th>Max.</th></tr>
<tr><td>Operational LFG flow (for continuous operation):</td><td>650 $Nm^3/h$</td><td>6,500 $Nm^3/h$ (until the occurred performance of service intervention on 08/06/2015)<br>7,500 $Nm^3/h$ (after the occurred performance of service intervention on 08/06/2015)</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 (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:</td><td colspan="2">after 10 years of regular and appropriate operation</td></tr>
</table>
<table>
<tr><th>$SPEC_{flare,flare\ 4}$</th><th>Min.</th><th>Max.</th></tr>
<tr><td>LFG flow (for continuous operation):</td><td>650 $Nm^3/h$</td><td>6,500 $Nm^3/h$ (until the occurred performance of service intervention on 08/06/2015)<br>7,500 $Nm^3/h$ (after the occurred performance of service intervention on 08/06/2015)</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<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 service (incl. inspection in the conditions of the flare isolation ceramics revetment material):</td><td colspan="2">every 6 months</td></tr>
<tr><td>Required/recommended minimum frequency for replacement of the flare isolation ceramics revetment material:</td><td colspan="2">after 10 years of regular and appropriate operation</td></tr>
</table>
</td></tr>
<tr><td>Choice of data or measurement methods and procedures</td><td>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 $SPEC_{flare}$.<br>Selected data is to be compared against monitored data related to the operation of the flares, including:<br>a) Minimum and maximum monitoring records for data regarding inlet LFG flow rate,<br>(b) Minimum and maximum monitoring records for data of temperature in the exhaust gas of each individual high temperature enclosed flare; and<br>(c) Duration in days of time periods between maintenance events for each individual high temperature enclosed flare.</td></tr>
<tr><td>Purpose of data</td><td>Data is used for the determination of baseline emissions.</td></tr>
<tr><td>Additional comment</td><td>All flare specification and operation details/requirements are based on information provided by the equipment manufacturer.</td></tr>
</table>

| **Data/Parameter** | **$EF_{grid,BM,y}$** |
|---|---|
| Unit | $tCO_2$/MWh |
| Description | Build margin $CO_2$ emission factor in year *y* |
| Source of data | Data is ex-ante determined as per applicable guidance of the methodological tool “Tool to calculate the emission factor for an electricity system” (version 04.0) valid for 2nd crediting period.<br>The selected value valid for all years encompassed by the 2nd 7-year crediting period is the value calculated by the DNA of Brazil and valid for year 2012 ($EF_{grid,BM,2012}$).<br>Data is made available online:<br>https://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html |
| Value(s) applied | 0.2010 |
| Choice of data or measurement methods and procedures | Data is determined as per applicable guidance of the methodological tool “Tool to calculate the emission factor for an electricity system” valid for 2nd crediting period. |

| | |
|---|---|
| Purpose of data/parameter | Calculation of project emissions |
| Additional comments | It is relevant to note that, as further explained in Section E.2, for the determination of the $CO_2$ emission factor for electricity consumed by the project activity, the PDD defines the following generic approach of the methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01) regarding its determination by taking into account the sources for consumed electricity:<br><br>*"Where case C.III has been identified, as a conservative simple approach, the emission factor for electricity generation should be the more conservative value between the emission factor determined as per guidance for scenario A and B respectively. This means that the more conservative value should be chosen between a) the result of applying either option A1 or A2 and b) the result of applying either option B1 or B2."*<br><br>As further explained in Section E.2, the above-quoted options of the methodological tool (options A1, A2, B1 and B2) are thus all potentially applicable for the determination of $EF_{EL,grid,y}$ = $EF_{EL,captive,y}$ (with the determined value representing the most conservative (higher) value). In this context, the ex-ante determined value for $EF_{grid,BM,y}$ is thus applied for the determination of $EF_{EL,grid,y}$ as per Option A1. |

| **Data/Parameter** | **$EF_{EL,captive,y}$** |
|---|---|
| Unit | $tCO_2$/MWh |
| Description | $CO_2$ emission factor for electricity sourced by the captive off-grid electricity generator in year y |
| Source of data | Applicable default as per the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01) (under option B2 of such methodological tool). |
| Value(s) applied | 1.3 |
| Choice of data or measurement methods and procedures | Data is determined as per applicable guidance of the methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01). |

| | |
|---|---|
| Purpose of data/parameter | Calculation of project emissions. |
| Additional comments | It is relevant to note that, as further explained in Section E.2, for the determination of the $CO_2$ emission factor for electricity consumed by the project activity, the PDD defines the following generic approach of the methodological tool “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01) regarding its determination by taking into account the sources for consumed electricity:<br><br>*“Where case C.III has been identified, as a conservative simple approach, the emission factor for electricity generation should be the more conservative value between the emission factor determined as per guidance for scenario A and B respectively. This means that the more conservative value should be chosen between a) the result of applying either option A1 or A2 and b) the result of applying either option B1 or B2.”*<br><br>As further explained in Section E.2, the above-quoted options of the methodological tool (options A1, A2, B1 and B2) are thus all potentially applicable for the determination of $EF_{EL,grid,y}$ = $EF_{EL,captive,y}$ (with the determined value representing the most conservative (higher) value). In this context, the ex-ante determined default value for $EF_{EL,captive,y}$ is thus applied for the determination of $EF_{EL,captive,y}$ as per Option B2. |

| | |
|---|---|
| Data/Parameter | **$EF_{EL,grid,y}$** |
| Data unit | $tCO_2$/MWh |
| Description | $CO_2$ emission factor for grid-sourced electricity in year y |
| Source of data | Applicable conservative default value as per the methodological tool “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01) (under Option A.2 of such methodological tool). |
| Value(s) applied | 1.3 |
| Choice of data or measurement methods and procedures | Data is determined as per applicable guidance of the methodological tool “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01). |
| Purpose of data | Calculation of project emissions. |

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| Additional comment | It is relevant to note that, as further explained in Section E.2, for the determination of the $CO_2$ emission factor for electricity consumed by the project activity, the PDD defines the following generic approach of the methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01) regarding its determination by taking into account the sources for consumed electricity:<br><br>*"Where case C.III has been identified, as a conservative simple approach, the emission factor for electricity generation should be the more conservative value between the emission factor determined as per guidance for scenario A and B respectively. This means that the more conservative value should be chosen between a) the result of applying either option A1 or A2 and b) the result of applying either option B1 or B2."*<br><br>As further explained in Section E.2, the above-quoted options of the methodological tool (options A1, A2, B1 and B2) are thus all potentially applicable for the determination of $EF_{EL,grid,y}$ = $EF_{EL,captive,y}$ (with the determined value representing the most conservative (higher) value). In this context, the ex-ante determined default value for $EF_{EL,grid,y}$ is thus applied for the determination of $EF_{EL,grid,y}$ as per Option A2. |

***<u>Ex-ante determined parameters not used in the context of ex-post determination and calculation of emission reductions achieved by the project activity during the considered monitoring period:</u>***

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 ($\eta_{PJ}$)

- 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) (DOCj)

- Decay rate for the waste type *j* (kj)

- Weight fraction of the waste type *j* (Wj)

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** |
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| Unit | Dimensionless |
| Description | Management of SWDS |
| Measured/calculated/ Default | As per the adopted monitoring procedure for the project activity, the management of the UVS - Caieiras landfill is on an at least yearly frequency compared against the previously conceived original construction and operational design for this particular landfill in order to confirm that its overall management and operation (including relevant aspects related to landfilling practice) were not deliberately modified with the unique aim to increase generation of methane on site.<br><br>As part of the performed checking, it is monitored whether any practice aiming to increase methane generation in the landfill has occurred or promoted. 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 from the latest performed evaluation are reported in a declaration document issued by such company and dated 03/01/2020 (where the most recent document represents an updated version of the previous document (dated 08/07/2019), thus also including/encompassing the finding from the evaluation the period between the issuance dates of such documents).<br><br>As part of the performed technical evaluation, the current configuration and operational conditions of the UVS - 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:<br><br>- Original design documents of the landfill (as described in the documentation required for all phases of the environmental licensing for the UVS - Caieiras landfill);<br>- Applicable local or national regulations<br>- Expertise and experience of "Cepollina Engenheiros Consultores Ltda." with the UVS - Caieiras landfill.<br><br>Since January 2007 "Cepollina Engenheiros Consultores Ltda." has performed regular technical inspections at the UVS - Caieiras landfill (as part of the continuously performed assessment/control of geotechnical stability monitoring for the landfill cells). As required by the competent environmental authority from São Paulo State (Companhia de Tecnologia de Saneamento |

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| | Ambiental - CETESB), such particular assessments/controls performed by 2007 “Cepollina Engenheiros Consultores Ltda.” are performed on monthly basis as a prerequisite for the compliance with environmental monitoring and maintenance of the validity of the environmental and safety permit/licensing for the UVS - Caieiras landfill. |
| Value(s) of monitored parameter | As outlined in the latest issued technical evaluation/declaration report dated 03/01/2020, the previously conceived original design of the landfill (that was conceived prior to the implementation of the project activity) is confirmed as not to being modified during the whole period from 01/02/2007 (date when the project activity started to operate) until its issuance date (thus completely covering the monitoring period from 01/07/2019 to 31/12/2019).<br><br>This most recently issued technical evaluation report confirms that no practices to increase methane generation at the UVS - Caieiras landfill have ever occurred (when compared to management and MSW landfilling practices prior to implementation of the project activity or after its implementation).<br><br>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.<br><br>It is relevant to note that MSW management business (collection and disposal of MSW) in Brazil (and in other developing and even developed countries) has its own economics, dynamics, politics and related regulations. That makes MSW disposal activity for the UVS - Caieiras landfill and other similar landfills in Brazil completely independent from the CDM mechanism and/or potential revenues associated to the commercialization of CERs generated by project based methane destruction/utilization initiatives implemented in landfill sites.<br><br>In the particular case of the UVS - Caieiras landfill, it is important to note that the landfill was designed and it has operated inter alia as per terms and conditions of the public service concession contracts for MSW management previously established with the Administration of the Municipality of São Paulo. The design and operation of the UVS - Caieiras landfill is also under conformance with terms and conditions for the environmental licensing that were previously defined and of which indicators/operational requirements are regularly monitored by the competent environmental authority from São Paulo State (CETESB).<br><br>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.<br><br>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 UVS - Caieiras landfill).<br><br>In this context, it is crucial to note that, regarding the amount of methane that is generated at the UVS - Caieiras landfill and collected by the project activity, as outlined in the PDD, significant amount of methane generated at the UVS - Caieiras landfill has unfortunately not been collected and |

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| | destroyed as part of the operation of the project activity due to the lack of complete LFG collection infrastructure covering all regions of the very large UVS - Caieiras landfill. |
| Monitoring equipment | Not applicable. No measuring equipment is used for monitoring management of the UVS - 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/parameter | 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** | $V_{t,wb,j}$ |
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| Unit | $m^3$ wet gas/h |
| Description | Volumetric flow of LFG stream in time interval *t* on a wet basis for *j* (where *j* is the LFG delivery pipeline to each internal combustion gas engine and LFG delivery pipeline to each flare). |
| Measured/calculated/ Default | Measured |

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| Source of data | Measured as part of the operation of the project activity by applying appropriate monitoring instruments (sets of 4 and 21 LFG flow meters with recordable electronic signal).<br><br>Continuously measurements are performed by sets of 4 and 21 LFG flow meters which are installed in different positions along the LFG pipeline of the project activity as follows:<br>- 4 identical LFG flow meters (one individual LFG flow meter for each one of the 4 installed high temperature enclosed flares)<br>- 21 identical LFG flow meters (one individual LFG flow meter for each one of the 21 installed internal combustion gas engines) |
| Value(s) of monitored parameter | While related measurements are performed by installed set of 4 identical LFG flow meters (one flow meter for each flare) + installed set of 21 identical LFG flow meters (one flow meter for each internal combustion gas engine), the monitoring parameter $V_{t,wb,j}$ is thus measured, recorded and reported on the basis of the following 25 sub-parameters:<br><br>- $V_{t,wb,flare-1}$: Volumetric flow of LFG to Flare 1<br>- $V_{t,wb,flare-2}$: Volumetric flow of LFG to Flare 2<br>- $V_{t,wb,flare-3}$: Volumetric flow of LFG to Flare 3<br>- $V_{t,wb,flare-4}$: Volumetric flow of LFG to Flare 4<br>- $V_{t,wb,engine-1}$: Volumetric flow of LFG to the internal combustion gas engine 1<br>- $V_{t,wb,engine-2}$: Volumetric flow of LFG to the internal combustion gas engine 2<br>- $V_{t,wb,engine-3}$: Volumetric flow of LFG to the internal combustion gas engine 3<br>- $V_{t,wb,engine-4}$: Volumetric flow of LFG to the internal combustion gas engine 4<br>- $V_{t,wb,engine-5}$: Volumetric flow of LFG to the internal combustion gas engine 5<br>- $V_{t,wb,engine-6}$: Volumetric flow of LFG to the internal combustion gas engine 6<br>- $V_{t,wb,engine-7}$: Volumetric flow of LFG to the internal combustion gas engine 7<br>- $V_{t,wb,engine-8}$: Volumetric flow of LFG to the internal combustion gas engine 8<br>- $V_{t,wb,engine-9}$: Volumetric flow of LFG to the internal combustion gas engine 9<br>- $V_{t,wb,engine-10}$: Volumetric flow of LFG to the internal combustion gas engine 10<br>- $V_{t,wb,engine-11}$: Volumetric flow of LFG to the internal combustion gas engine 11<br>- $V_{t,wb,engine-12}$: Volumetric flow of LFG to the internal combustion gas engine 12<br>- $V_{t,wb,engine-13}$: Volumetric flow of LFG to the internal combustion gas engine 13<br>- $V_{t,wb,engine-14}$: Volumetric flow of LFG to the internal combustion gas engine 14<br>- $V_{t,wb,engine-15}$: Volumetric flow of LFG to the internal combustion gas engine 15<br>- $V_{t,wb,engine-16}$: Volumetric flow of LFG to the internal combustion gas engine 16<br>- $V_{t,wb,engine-17}$: Volumetric flow of LFG to the internal combustion gas engine 17<br>- $V_{t,wb,engine-18}$: Volumetric flow of LFG to the internal combustion gas engine 18<br>- $V_{t,wb,engine-19}$: Volumetric flow of LFG to the internal combustion gas engine 19<br>- $V_{t,wb,engine-20}$: Volumetric flow of LFG to the internal combustion gas engine 20<br>- $V_{t,wb,engine-21}$: Volumetric flow of LFG to the internal combustion gas engine 21<br><br>The set of monthly emission reduction calculation spreadsheets (that are enclosed to this Monitoring Report) includes all every-minute records of measurements of LFG flow sent to each one of the installed 4 high temperature enclosed flare valid for the considered monitoring period (records of the sub-parameters $V_{t,wb,flare-1}$, $V_{t,wb,flare-2}$, $V_{t,wb,flare-3}$ and $V_{t,wb,flare-4}$).<br><br>**Note:** Since Flares 1 and 3 were not under operational status during the whole considered monitoring period, no collected LFG was combusted by these particular flares and no related emission reduction is claimed. Every-minute null value measurements for $V_{t,wb,flare-1}$ and $V_{t,wb,flare-3}$ are anyway reported in the set of monthly emission reduction spreadsheets valid for the considered monitoring period for sake of completeness and transparency.<br><br>Every-minute records of measurements of LFG flow sent to each one of the installed 21 internal combustion gas engines during the considered |

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| | monitoring period (records of the sub-parameters $V_{t,wb,engine-1}$, $V_{t,wb,engine-2}$, (…), $V_{t,wb,engine-21}$) are reported in a separated calculation spreadsheet[11]. |

[11] As outlined below under "Additional comments" and also presented in Section E.1, differently than the case of records of LFG flow sent to the flares (measurements being performed by 4 LFG flow meters of which design and functioning ensure measurements to be automatically converted in normalized values); the 21 records of measurements of LFG flow sent to each one of the installed 21 internal combustion gas engines during every single minute *m* of the considered monitoring period are required to be converted into normalized values through calculations (by inter alia taking into account records of LFG pressure and LFG temperature (Monitoring parameters $P_t$ and $T_t$ respectively on the basis of the sub-monitoring parameters $P_{t,engine-1}$, $P_{t,engine-2}$, (…), $P_{t,engine-21}$ and sub-monitoring parameters $T_{t,engine-1}$, $T_{t,engine-2}$, (…), $T_{t,engine-21}$ respectively). The reason for such required additional calculations is that related measurements are performed by a set of 21 LFG flow meters of which design and functioning do not allow performed measurements to be automatically converted and recorded/reported into normalized values by the instruments. In order to avoid having each one of the 6 MS-Excel monthly emission reduction spreadsheets becoming with very high/heavy file size (i.e. easily exceeding 150 MB each in case related conversion calculations were included in the 6 MS-Excel monthly emission reduction spreadsheets), every-minute records of measurements of LFG flow sent to each one of the installed 21 internal combustion gas engines during each month of the considered monitoring period are thus converted into normalized values through calculations that are included in 6 separated calculation spreadsheets (1 spreadsheet for each month) for sake of completeness and transparency.

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| Monitoring equipment | Measurements of LFG flow sent to each flare are performed by 4 identical LFG flow meters, with each instrument being installed in an independent section of the LFG pipeline located between the centrifugal blowers and the flare in question, thus ensuring the flow of LFG sent to each one of the flares encompassed by the project activity is independently and continuously measured.<br><br>Measurements of LFG flow sent to each internal combustion gas engine are performed by 21 identical LFG flow meters, with each instrument being installed in an independent section of the LFG pipeline located between the centrifugal blowers and the internal combustion gas engine in question, thus ensuring that flow of LFG sent to each one of the gas engines encompassed by the project activity is independently and continuously measured.<br><br>*<u>Specifications and calibration details for the LFG flow meters used during the considered monitoring period for measuring the flow of LFG sent to the flares:</u>*<br><br>A set of 4 identical LFG flow meters is installed and is used for measuring $V_{t,wb,flare-1}$, $V_{t,wb,flare-2}$, $V_{t,wb,flare-3}$ and $V_{t,wb,flare-4}$:<br><br>*Flow meter used for measuring $V_{t,wb,flare-1}$ (Flare 1):*<br><br>- Manufacturer: Contech Indústria e Comércio de Equipamentos Eletrônicos Ltda.<br>- Model: FT-2<br>- Accuracy: ±1%<br>- Serial Number: 1412000235<br>- Required Calibration frequency[12]: Calibration events are to be performed every 2 years<br>- Date(s) for performed calibration event(s) valid for the considered monitoring period: 14/05/2018<br>- Validity of the performed calibration event(s): The calibration event dated 14/05/2018 is valid until 13/05/2020 (2 years)<br>- Entity/company responsible for performing the calibration event(s): The calibration event was performed by Contech Indústria e Comércio de Equipamentos Eletrônicos Ltda.<br><br>*Flow meter used for measuring $V_{t,wb,flare-2}$ (Flare 2):*<br><br>- Manufacturer: Contech Indústria e Comércio de Equipamentos Eletrônicos Ltda.<br>- Model: FT-2<br>- Accuracy: ±1%<br>- Serial Number: 1412000236<br>- Required Calibration frequency: Calibration events are to be performed every 2 years<br>- Date(s) for performed calibration event(s) valid for the considered monitoring period: 26/03/2018<br>- Validity of the performed calibration event(s): The calibration event dated 26/03/2018 is valid until 25/03/2020 (2 years)<br>- Entity/company responsible for performing the calibration event(s): |

[12] The reported required calibration frequencies for all installed monitoring instruments/equipment are as per the recommendations of related equipment/instrument manufacturers. The monitoring plan from the PDD and ACM0001 (version 13.0.0) do not specify any explicit frequency for the calibration of such equipment/instruments. The PDD includes the following general disclaimer:

> *"Calibration events in monitoring instruments/equipment will be periodically and appropriately performed as per applicable frequency, procedures and methods established or recommended by instrument/ equipment manufacturer, applicable national/international standards and/or best practice, as available."*

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| | The calibration event was performed by Contech Indústria e Comércio de Equipamentos Eletrônicos Ltda.<br><br>*Flow meter used for measuring $V_{t,wb,flare-3}$ (Flare 3):*<br><br>- Manufacturer: Contech Indústria e Comércio de Equipamentos Eletrônicos Ltda.<br>- Model: FT-2<br>- Accuracy: ±1%<br>- Serial Number: 1412000237<br>- Required Calibration frequency: Calibration events are to be performed every 2 years<br>- Date(s) for performed calibration event(s) valid for the considered monitoring period: 15/05/2018<br>- Validity of the performed calibration event(s): The calibration event dated 15/05/2018 is valid until 14/05/2020 (2 years)<br>- Entity/company responsible for performing the calibration event(s): The calibration event was performed by Contech Indústria e Comércio de Equipamentos Eletrônicos Ltda.<br><br>*Flow meter used for measuring $V_{t,wb,flare-4}$ (Flare 4):*<br><br>- Manufacturer:Contech Indústria e Comércio de Equipamentos Eletrônicos Ltda.<br>- Model: FT-2<br>- Accuracy: ±1%<br>- Serial Number: 1412000238<br>- Required Calibration frequency: Calibration events are to be performed every 2 years<br>- Date(s) for performed calibration event(s) valid for the considered monitoring period: 27/03/2018<br>- Validity of the performed calibration event(s): The calibration event dated 27/03/2018 is valid until 26/03/2020 (2 years)<br>- Entity/company responsible for performing the calibration event(s): The calibration event was performed by Contech Indústria e Comércio de Equipamentos Eletrônicos Ltda.<br><br>*Specifications and calibration details for the LFG flow meters used for measuring the flow of LFG sent to the internal combustion gas engines:*<br><br>A set of 21 identical LFG flow meters (each one incl. a measurement element (annubar) + a pressure signal processing & data transmission unit) are installed and are used for measuring $V_{t,wb,engine-1}$, $V_{t,wb,engine-2}$, (…), $V_{t,wb,engine-21}$.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: Rosemount 485 Annubar Primary Element<br>- Serial Number: 0153225<br>- Accuracy: ±1%<br>- Required Calibration frequency: The measurement element is tested |

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| | and quality assured by the manufacturer as part of its manufacturing process[13]. No regular calibration is required for the annubar element as declared by the equipment manufacturer in the instrument user/application technical manual, with appropriate testing/calibration of the Pressure signal processing + data transmission unit being required. Anyhow, by taking into account the application for the installed elements (LFG flow measurement subject to physical/chemical contamination of the instrument), the regional technical representative of the annubar element recommends the performance of a dimensional checking (metrology analysis) and cleaning in the annubar element at least after 5 years of continuous use in order to confirm the dimensional integrity of the instrument (which is a required condition for its proper functioning). While the measurement element is installed and operational since July/2016 and no abnormal functioning has so far been detected, a dimensional checking and cleaning of the sensor element is thus currently expected to be performed only by July/2022[14].<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034712<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years. |

[13] The following is also highlighted in reference manual for the Rosemount 485 Annubar Primary Element:

> *"The Rosemount Annubar primary flow element is a device used to measure the flow of a liquid, gas or steam fluid that flows through a pipe. It enables flow measurement by creating a differential pressure (DP) that is proportional to the square of the velocity of the fluid in the pipe, in accordance with Bernoulli's theorem. This DP is measured and converted into a flow rate using a secondary device, such as a DP pressure transmitter."*
>
> *The Rosemount 485 Annubar primary flow element is the fifth generation Annubar. This design is comprised of three separate tubes that are drawn to produce a unique geometrical shape that produces a high and low pressure signal and contains an integral thermowell."*

[14] All measurement records of LFG flow for the set of 21 installed internal combustion gas engines (as per available records of monitoring sub-parameter $V_{t,wb,engine-1}$, $V_{t,wb,engine-2}$, …, $V_{t,wb,engine-21}$) have been confirmed to be constantly within the typical LFG consumption range as declared by GE Jenbacher GmbH & Co OHG, the manufacturer of the state-of-the-art engine-generators set type 4, model/series G-420 manufactured (with nameplate power generation capacity of 1.4 MW each): about 600 $Nm^3/h$ (for LFG with 50% $CH_4$ fraction) for full load operation. No abnormal variations in measurement values have been detected either. These condictions *per se* sufficiently confirms appropriate functioning of the measurement elements (annubar) for all of the 21 LFG flow meters sets.

The following is also highlighted in reference manual for the Rosemount 485 Annubar Primary Element:

> *"One inherent advantage of an Annubar primary element over devices such as orifice plates is the ability to function in flows carrying dirt and grease. However, under extreme cases, some of the sensing ports are completely obstructed or the outside shape is drastically changed by build-up.*
>
> *There are two methods of cleaning the Annubar primary element to restore performance. Mechanical cleaning is the more certain method, but does require removal of the Annubar primary element. Purging is effective if the accumulation covers the sensing ports or blocks internal passages."*

Reference manuals for the Rosemount 485 Annubar Primary Element are available online:

https://www.emerson.com/documents/automation/manual-rosemount-annubar-flowmeter-series-en-76094.pdf

https://www.emerson.com/documents/automation/manual-rosemount-annubar-primary-flow-element-flow-test-data-book-en-74372.pdf

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| | - Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403471275048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-2}$ (internal combustion gas engine 2):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153224<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meter sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under “Required calibration frequency” for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-2}$ (internal combustion gas engine 2).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034710<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403471075048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-3}$ (internal combustion gas engine 3):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153217<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under “Required calibration frequency” for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-3}$ (internal combustion gas engine 3).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034700<br>- Accuracy: ±0.075% |

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| | - Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403470075048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-4}$ (internal combustion gas engine 4):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153222<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under “Required calibration frequency” for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-4}$ (internal combustion gas engine 4).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034706<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403470675048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-5}$ (internal combustion gas engine 5):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153221<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under “Required calibration frequency” for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-5}$ (internal combustion gas engine 5). |

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| | *Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034704<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403470475048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-6}$ (internal combustion gas engine 6):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153228<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under “Required calibration frequency” for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-6}$ (internal combustion gas engine 6).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034698<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403469875048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-7}$ (internal combustion gas engine 7):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153223<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under “Required calibration frequency” for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) |

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| | installed for measuring $V_{t,wb,engine-7}$ (internal combustion gas engine 7).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034708<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403470875048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-8}$ (internal combustion gas engine 8):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153220<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under “Required calibration frequency” for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-8}$ (internal combustion gas engine 8).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034702<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403470275048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-9}$ (internal combustion gas engine 9):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Accuracy: ±1%<br>- Serial Number: 0153212<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under “Required calibration frequency” for measurement element (annubar) of LFG flow meter |

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| | used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-9}$ (internal combustion gas engine 9).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034726<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403472675048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-10}$ (internal combustion gas engine 10):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153218<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under “Required calibration frequency” for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-10}$ (internal combustion gas engine 10).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034738<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403473875048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-11}$ (internal combustion gas engine 11):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153214<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion |

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| | gas engines, information details above under "Required calibration frequency" for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-11}$ (internal combustion gas engine 11).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034714<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403471475048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-12}$ (internal combustion gas engine 12):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153209<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under "Required calibration frequency" for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-12}$ (internal combustion gas engine 12).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034720<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403472075048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-13}$ (internal combustion gas engine 13):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153211<br>- Accuracy: ±1% |

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| | - Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under "Required calibration frequency" for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-13}$ (internal combustion gas engine 13).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034724<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403472475048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-14}$ (internal combustion gas engine 14):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153227<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under "Required calibration frequency" for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-14}$ (internal combustion gas engine 14).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034716<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403471675048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-15}$ (internal combustion gas engine 15):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.) |

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| | - Model: 485 Annubar Primary Element<br>- Serial Number: 0153226<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under "Required calibration frequency" for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-15}$ (internal combustion gas engine 15).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K64661403718<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403471875048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-16}$ (internal combustion gas engine 16):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153210<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under "Required calibration frequency" for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-16}$ (internal combustion gas engine 16).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034722<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403472275048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda. |

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| | *LFG flow meter used for measuring $V_{t,wb,engine-17}$ (internal combustion gas engine 17):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153219<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under "Required calibration frequency" for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-17}$ (internal combustion gas engine 17).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034742<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403474275048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-18}$ (internal combustion gas engine 18):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153229<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under "Required calibration frequency" for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-18}$ (internal combustion gas engine 18).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034730<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403473075048/18, issued by CEIME Calibração e |

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| | Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-19}$ (internal combustion gas engine 19):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153213<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under "Required calibration frequency" for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-19}$ (internal combustion gas engine 19).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034728<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>    • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403472875048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-20}$ (internal combustion gas engine 20):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153216<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under "Required calibration frequency" for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-20}$ (internal combustion gas engine 20).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034734<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>    • Calibration event dated 21/02/2018 valid until 20/02/2020, as |

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| | indicated in the Calibration Certificate Number 3K64661403473475048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG flow meter used for measuring $V_{t,wb,engine-21}$ (internal combustion gas engine 21):*<br><br>*Measurement element (annubar):*<br>- Manufacturer: Emerson Electric Co. (former Rosemount Inc.)<br>- Model: 485 Annubar Primary Element<br>- Serial Number: 0153215<br>- Accuracy: ±1%<br>- Required Calibration frequency: since 21 identical LFG flow meters sets are used for measuring LFG flow to the 21 internal combustion gas engines, information details above under “Required calibration frequency” for measurement element (annubar) of LFG flow meter used for measuring $V_{t,wb,engine-1}$ (internal combustion gas engine 1) are thus also applicable for the measurement element (annubar) installed for measuring $V_{t,wb,engine-21}$ (internal combustion gas engine 21).<br><br>*Pressure signal processing + data transmission unit:*<br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034740<br>- Accuracy: ±0.075%<br>- Required Calibration frequency: Calibration events are to be performed every 2 years.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403474075048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda. |
| Measuring/reading/recording frequency | Continuous measurements are recorded and reported with 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.<br><br>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/parameter | Calculation of baseline emissions |

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| Additional comments | The design and functioning of the installed set of 4 identical LFG flow meters (used for measuring the flow of LFG sent to each of the 4 flares) ensure that measurement data is automatically converted and recorded in normal cubic meters per hour ($Nm^3/h$). Due to that, as explained in Section E.1, measurements of LFG pressure and LFG temperature are not required for determining normalized LFG flow values of the calculation parameter $V_{t,wb,n,flare-n}$ (where flare-n = flare-1, flare-2, flare-3 and flare-4) in the context of calculation of achieved emission reductions. Due to that, reported values of the sub-parameters $V_{t,wb,flare-n}$ (where flare-n = flare 1, 2, 3 and 4) are thus equivalent to values of $V_{t,wb,n,flare-n}$ and are thus directly 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 “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (measurements of volume flow in a wet basis) (as outlined in the monthly emission reduction calculation spreadsheets enclosed to this Monitoring Report).<br><br>For the particular case of the set of 21 identical LFG flow meters (used for continuously measuring the flow of LFG sent to each one of the 21 internal combustion gas engines), the design and functioning of such instruments do not allow performed measurements being automatically converted into normal cubic meter per hour ($Nm^3/h$). Thus, measurements of LFG pressure and LFG temperature (monitoring parameters “Temperature of the LFG stream in time interval *t*” ($T_t$) and “Pressure of the LFG stream in time interval t“ ($P_t$) respectively) are thus considered for converting measurements of $V_{t,wb,engine-n}$ (where engine-n = engine-1, engine-2, (…), engine-21) into normalized values. As outlined in Section E.1, this is required for the determination of values for the calculation sub-parameters $V_{t,n,wb,engine-n}$ (where engine-n = engine-1, engine-2, (…), engine-21).<br><br>As explained under tables with details for the monitoring parameters “Temperature of the LFG stream in time interval *t*” ($T_t$) and “Pressure of the LFG stream in time interval t“ ($P_t$), measurements from 21 LFG temperature sensors + 21 pressure sensors are considered for the determination of normalized values for LFG flow sent to each one of the 21 internal combustion gas engines. While related measurements are performed by 21 LFG temperature sensors and 21 LFG pressure sensors installed in different sections of the LFG pipeline close/next to such 21 gas engines, the monitoring parameter $T_t$ and $P_t$ are thus measured, recorded and reported on the basis of the following 42 sub-parameters: $T_{t,engine-1}$, $T_{t,engine-2}$, (…),$T_{t,engine-21}$ + $P_{t,engine-1}$, $P_{t,engine-2}$, (…), $P_{t,engine-21}$. |

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| **Data/Parameter** | **$V_{CH4,t,wb}$** |
| Unit | $m^3CH_4/m^3$ wet gas |
| Description | Volumetric fraction of $CH_4$ in the collected LFG in time interval t on a wet basis |
| Measured/calculated/ Default | Measured |
| Source of data | Measured as part of the operation of the project activity by applying appropriate monitoring instruments (continuous $CH_4$ content gas analyser) with recordable electronic signal). |
| Value(s) of monitored parameter | The set of 6 monthly emission reduction calculation spreadsheets (that are enclosed to this Monitoring Report) includes measurement data for $v_{CH4,t,wb}$ that are recorded and reported for with an every-minute frequency. |

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| Monitoring equipment | *Specifications and calibration details for the installed continuous $CH_4$ content gas analyser:*<br><br>- Manufacturer: BGM Instrumentação Controle e Automação Ltda.<br>- Model: CENTRUM AG 4000<br>- Accuracy: ±2%<br>- Serial Number: NS 53159<br>- Required calibration frequency: Calibration events are to be performed every 3 months.<br>- Dates and validity of performed calibration events valid for the considered monitoring period:<br>  • Calibration event dated 18/06/2019 valid until 17/09/2019;<br>  • Calibration event dated 02/07/2019 valid until 01/10/2019;<br>  • Calibration event dated 22/07/2019 valid until 21/10/2019;<br>  • Calibration event dated 27/08/2019 valid until 26/11/2019;<br>  • Calibration event dated 02/10/2019 valid until 01/01/2020;<br>  • Calibration event dated 20/11/2019 valid until 19/02/2020;<br>  • Calibration event dated 30/12/2019 valid until 29/03/2020.<br><br>- 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:<br>  - Gas cylinders with a calibration mixture of 59.99 cmol/mol of $CO_2$: cylinder n° 4849745, certificate number IBG1911187, supplied by IBG – Indústria Brasileira de Gases Ltda.<br>  - Gas cylinders with a calibration mixture of 4.96 cmol/mol of $O_2$: cylinder n° 3932870, certificate number IBG1903033 supplied by IBG – Indústria Brasileira de Gases Ltda.<br>  - Gas cylinders with a calibration mixture of 60.01 cmol/mol of $CH_4$: cylinder n° 027113, certificate number IBG0420417 supplied by IBG – Indústria Brasileira de Gases Ltda.<br>  - Gas cylinders with a calibration mixture of 60.00 cmol/mol of $CH_4$: cylinder n° 027113, certificate number IBG0420417 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.<br><br>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/parameter | 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 | Measured |
| Source of data | Measured as part of the operation of the project activity by applying appropriate monitoring instruments (1 + 21 LFG temperature sensors with recordable electronic signal).<br><br>Continuously measurements are performed by a set of 1 + 21 LFG temperature sensors which are installed in different positions along the LFG pipeline of the project activity as follows:<br>- 1 LFG temperature sensor within the LFG collection and flaring infrastructure<br>- 21 identical LFG temperature sensors within each one of the 21 internal combustion gas engines.<br><br>Measurements of LFG temperature are primarily recorded and reported in $^{o}$C. Recorded/reported data is converted into Kelvin (K) and data is also reported in this unit, thus meeting the related monitoring requirement as per the PDD. |

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| Value(s) of monitored parameter | While measurements are performed by 1 and a set of 21 LFG temperature sensors installed in different sections of the LFG pipeline along the LFG pipeline of the project activity within the flaring facility and the set of 21 internal combustion gas engines, the monitoring parameter $T_t$ is thus measured, recorded and reported on the basis of the following sub-parameters:<br><br>- $T_{t,flares}$: Temperature of LFG sent to the flares<br>- $T_{t,engine-1}$: Temperature of LFG sent to the internal combustion gas engine 1<br>- $T_{t,engine-2}$: Temperature of LFG sent to the internal combustion gas engine 2<br>- $T_{t,engine-3}$: Temperature of LFG sent to the internal combustion gas engine 3<br>- $T_{t,engine-4}$: Temperature of LFG sent to the internal combustion gas engine 4<br>- $T_{t,engine-5}$: Temperature of LFG sent to the internal combustion gas engine 5<br>- $T_{t,engine-6}$: Temperature of LFG sent to the internal combustion gas engine 6<br>- $T_{t,engine-7}$: Temperature of LFG sent to the internal combustion gas engine 7<br>- $T_{t,engine-8}$: Temperature of LFG sent to the internal combustion gas engine 8<br>- $T_{t,engine-9}$: Temperature of LFG sent to the internal combustion gas engine 9<br>- $T_{t,engine-10}$: Temperature of LFG sent to the internal combustion gas engine 10<br>- $T_{t,engine-11}$: Temperature of LFG sent to the internal combustion gas engine 11<br>- $T_{t,engine-12}$: Temperature of LFG sent to the internal combustion gas engine 12<br>- $T_{t,engine-13}$: Temperature of LFG sent to the internal combustion gas engine 13<br>- $T_{t,engine-14}$: Temperature of LFG sent to the internal combustion gas engine 14<br>- $T_{t,engine-15}$: Temperature of LFG sent to the internal combustion gas engine 15<br>- $T_{t,engine-16}$: Temperature of LFG sent to the internal combustion gas engine 16<br>- $T_{t,engine-17}$: Temperature of LFG sent to the internal combustion gas engine 17<br>- $T_{t,engine-18}$: Temperature of LFG sent to the internal combustion gas engine 18<br>- $T_{t,engine-19}$: Temperature of LFG sent to the internal combustion gas engine 19<br>- $T_{t,engine-20}$: Temperature of LFG sent to the internal combustion gas engine 20<br>- $T_{t,engine-21}$: Temperature of LFG sent to the internal combustion gas engine 21<br><br>The set 6 monthly emission reduction calculation spreadsheets (that is enclosed to this Monitoring Report) includes measurement data for $T_t$ (sub-parameters $T_{t,flares}$, $T_{t,engine-1}$, $T_{t,engine-2}$, (…), $T_{t,engine-21}$) that are recorded and reported with an every-minute frequency. Measurement records of $T_t$ are also reported in the spreadsheet including calculation of normalized values of every-minute records of measurements of LFG flow sent to each one of the installed 21 internal combustion gas engines during the considered monitoring period. This additional spreadsheet is also enclosed to this Monitoring Report. |

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| Monitoring equipment | Measurements of temperature of LFG sent to the flares are performed by one installed LFG temperature sensor (that is installed in the main LFG pipeline within the flaring facility in a section between the centrifugal blowers and the high temperature enclosed flares).<br><br>Measurements of temperature of LFG sent to each one of the 21 internal combustion gas engines are performed by a set of 21 identical LFG temperature sensor sets (with each one being installed in an independent section of the LFG pipeline for each internal combustion gas engine).<br><br>It is thus ensured that temperature of LFG sent to the flares and to each internal combustion gas engine is independently and continuously measured.<br><br>*Specifications and calibration details for the LFG temperature sensors used for measuring temperature of LFG sent to the flares:*<br><br>*LFG temperature sensors used for measuring $T_{t,flares}$ (flares):*<br><br>- Manufacturer: Pressgage instrumentos de Medição e Controle Ltda.<br>- Model: STP-100<br>- Accuracy: ±1%<br>- Serial Number (S/N): 193238<br>- Required calibration frequency: calibration events are to be performed yearly<br>- Date(s) for performed calibration event(s) valid for the considered monitoring period:<br>    - Calibration event dated 21/12/2018 (Calibration Certificate 19323880794/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.) and calibration event dated 16/12/2019 (Calibration Certificate 32450-19, issued by VWC Equipamentos e Instrumentação e Comércio Ltda.)<br>    - Validity of the performed calibration event(s): The calibration event dated 21/12/2018 is valid until 20/12/2019 (1 year) and the calibration event dated 16/12/2019 is valid until 15/12/2020 (1 year).<br><br>*Specifications and calibration details for the LFG temperature sensors used for measuring temperature of LFG sent to the internal combustion gas engines:*<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-1}$ (internal combustion gas engine 1):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0009<br>- Accuracy: ± 0.5 $^{o}$C<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>    • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number E15PT000975048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda. |

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| | *LFG temperature sensor sets used for measuring $T_{t,engine-2}$ (internal combustion gas engine 2):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0008<br>- Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number E15PT000875048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-3}$ (internal combustion gas engine 3):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0003<br>- Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 26/02/2018 valid until 25/02/2020, as indicated in the Calibration Certificate Number E15PT000375048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-4}$ (internal combustion gas engine 4):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0006<br>- Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 22/02/2018 valid until 21/02/2020, as indicated in the Calibration Certificate Number E15PT000675048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-5}$ (internal combustion gas engine 5):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0005<br>- Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number E15PT000575048/18, |

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| | issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-6}$ (internal combustion gas engine 6):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0002<br>- Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 22/02/2018 valid until 21/02/2020, as indicated in the Calibration Certificate Number E15PT000275048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-7}$ (internal combustion gas engine 7):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E16TP0015<br>- Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 26/02/2018 valid until 25/02/2020, as indicated in the Calibration Certificate Number E15PT001575048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-8}$ (internal combustion gas engine 8):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0004<br>- Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 22/02/2018 valid until 21/02/2020, as indicated in the Calibration Certificate Number E15PT000475048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-9}$ (internal combustion gas engine 9):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0016<br>- Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period: |

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| | • Calibration event dated 26/02/2018 valid until 25/02/2020, as indicated in the Calibration Certificate Number E15PT001675048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-10}$ (internal combustion gas engine 10):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0021<br>- Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 22/02/2018 valid until 21/02/2020, as indicated in the Calibration Certificate Number E15PT002175048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-11}$ (internal combustion gas engine 11):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0007<br>- Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 26/02/2018 valid until 25/02/2020, as indicated in the Calibration Certificate Number E15PT000775048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-12}$ (internal combustion gas engine 12):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0013<br>- Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 23/02/2018 valid until 22/02/2020, as indicated in the Calibration Certificate Number E15PT001375048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-13}$ (internal combustion gas engine 13):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0024<br>- Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years |

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| | - Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 26/02/2018 valid until 25/02/2020, as indicated in the Calibration Certificate Number E15PT001475048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-14}$ (internal combustion gas engine 14):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0011<br>- Accuracy: ±0.5 $^{o}$C<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 22/02/2018 valid until 21/02/2020, as indicated in the Calibration Certificate Number E15PT001175048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-15}$ (internal combustion gas engine 15):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0012<br>- Accuracy: ±0.5 $^{o}$C<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 26/02/2018 valid until 25/02/2020, as indicated in the Calibration Certificate Number E15PT001275048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-16}$ (internal combustion gas engine 16):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0014<br>- Accuracy: ±0.5 $^{o}$C<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 22/02/2018 valid until 21/02/2020, as indicated in the Calibration Certificate Number E15PT001475048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-17}$ (internal combustion gas engine 17):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E16TP0016 |

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| | - Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 23/02/2018 valid until 22/02/2020, as indicated in the Calibration Certificate Number E15PT001675048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-18}$ (internal combustion gas engine 18):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E16TP0018<br>- Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 26/02/2018 valid until 25/02/2020, as indicated in the Calibration Certificate Number E15PT001875048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-19}$ (internal combustion gas engine 19):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0017<br>- Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 23/02/2018 valid until 22/02/2020, as indicated in the Calibration Certificate Number E15PT001775048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG temperature sensor sets used for measuring $T_{t,engine-20}$ (internal combustion gas engine 20):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15PT0023<br>- Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 23/02/2018 valid until 22/02/2020, as indicated in the Calibration Certificate Number E15PT002375048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda. |

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| | *LFG temperature sensor sets used for measuring $T_{t,engine-21}$ (internal combustion gas engine 21):*<br><br>- Manufacturer: Elsi s.r.l.<br>- Model: Y1-SEM203/P<br>- Serial number (S/N): E15TP0019<br>- Accuracy: ±0.5 ºC<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Calibration frequency and maintenance requirements: Every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 23/02/2018 valid until 22/02/2020, as indicated in the Calibration Certificate Number E15PT001975048/18, issued by CEIME Calibração e Comércio de Instrumentos 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.<br><br>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/parameter | Calculation of baseline emissions |
| Additional comments | - |

| **Data/Parameter** | **$P_t$** |
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| Unit | Pa |
| Description | Pressure of the LFG stream in time interval *t* |
| Measured/calculated/<br>Default | Measured |
| Source of data | Measured as part of the operation of the project activity by applying appropriate monitoring instruments (set of 1 + 21 LFG pressure sensors with recordable electronic signal).<br><br>Continuously measurements are performed by set of 1 + 21 LFG pressure sensors which are installed in different positions along the LFG pipeline of the project activity as follows:<br>- 1 LFG pressure sensor within the LFG collection and flaring infrastructure<br>- 21 identical LFG pressure within each one of the 21 internal combustion gas engines.<br><br>Measurements of LFG pressure are primarily recorded and reported in milibars (mbar). Recorded/reported data is converted into Pascal (Pa) and data is also reported in this unit, thus meeting the related monitoring requirement as per the PDD. |

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| Value(s) of monitored parameter | While measurements are performed by 1 and a set of 21 LFG pressure sensors installed in different sections along the LFG pipeline along the project activity within the LFG flaring facility and the set of 21 internal combustion gas engines, the monitoring parameter $P_t$ is thus measured, recorded and reported on the basis of the following sub-parameters:<br><br>- $P_{t,flares}$: Pressure of the LFG sent to the Flares<br>- $P_{t,engine-1}$: Pressure of the LFG sent to the internal combustion gas engine 1<br>- $P_{t,engine-2}$: Pressure of the LFG sent to the internal combustion gas engine 2<br>- $P_{t,engine-3}$: Pressure of the LFG sent to the internal combustion gas engine 3<br>- $P_{t,engine-4}$: Pressure of the LFG sent to the internal combustion gas engine 4<br>- $P_{t,engine-5}$: Pressure of the LFG sent to the internal combustion gas engine 5<br>- $P_{t,engine-6}$: Pressure of the LFG sent to the internal combustion gas engine 6<br>- $P_{t,engine-7}$: Pressure of the LFG sent to the internal combustion gas engine 7<br>- $P_{t,engine-8}$: Pressure of the LFG sent to the internal combustion gas engine 8<br>- $P_{t,engine-9}$: Pressure of the LFG sent to the internal combustion gas engine 9<br>- $P_{t,engine-10}$: Pressure of the LFG sent to the internal combustion gas engine 10<br>- $P_{t,engine-11}$: Pressure of the LFG sent to the internal combustion gas engine 11<br>- $P_{t,engine-12}$: Pressure of the LFG sent to the internal combustion gas engine 12<br>- $P_{t,engine-13}$: Pressure of the LFG sent to the internal combustion gas engine 13<br>- $P_{t,engine-14}$: Pressure of the LFG sent to the internal combustion gas engine 14<br>- $P_{t,engine-15}$: Pressure of the LFG sent to the internal combustion gas engine 15<br>- $P_{t,engine-16}$: Pressure of the LFG sent to the internal combustion gas engine 16<br>- $P_{t,engine-17}$: Pressure of the LFG sent to the internal combustion gas engine 17<br>- $P_{t,engine-18}$: Pressure of the LFG sent to the internal combustion gas engine 18<br>- $P_{t,engine-19}$: Pressure of the LFG sent to the internal combustion gas engine 19<br>- $P_{t,engine-20}$: Pressure of the LFG sent to the internal combustion gas engine 20<br>- $P_{t,engine-21}$: Pressure of the LFG sent to the internal combustion gas engine 21<br><br>The set 6 monthly emission reduction calculation spreadsheets (that is enclosed to this Monitoring Report) includes measurement data for $P_t$ (sub-parameters $P_{t,flares}$, $P_{t,engine-1}$, $P_{t,engine-2}$, (…), $P_{t,engine-21}$) that are recorded and reported with an every-minute frequency. Measurement records of $P_t$ are also reported in the spreadsheet including calculation of normalized values of every-minute records of measurements of LFG flow sent to each one of the installed 21 internal combustion gas engines during the considered monitoring period. This additional spreadsheet is also enclosed to this Monitoring Report. |

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| Monitoring equipment | Measurements of pressure of LFG sent to the flares are performed by one installed LFG pressure sensor (that is installed in the main LFG pipeline within the flaring facility in a section between the centrifugal blowers and the high temperature enclosed flares).<br><br>Measurements of pressure of LFG sent to each one of the 21 internal combustion gas engines are performed by a set of 21 identical LFG pressure sensors (with each one being installed in an independent section of the LFG pipeline for each internal combustion gas engine).<br><br>It is thus ensured that pressure of LFG sent to the flares and to each internal combustion gas engine is independently and continuously measured.<br><br>*Specifications and calibration details for the LFG pressure sensor used for measuring temperature of LFG sent to the flares:*<br><br>- Manufacturer: Warme do Brasil Intrumentação e Automação Industrial Ltda.<br>- Model: WTP-3000<br>- Accuracy: ±0.5%<br>- Serial Number: 4817<br>- Required calibration frequency: calibration events are to be performed yearly.<br>- Date(s) for performed calibration event(s) valid for the considered monitoring period: Calibration event dated 29/05/2019 (Calibration Certificate M03725-19, issued by Setting Comercio Industrializacao e Servicos de Calibracoes e Ensaios Ltda.).<br>- Validity of the performed calibration event(s): The calibration event dated 29/05/2019 is valid until 28/05/2020.<br><br>*Specifications and calibration details for the LFG pressure sensors used for measuring pressure of LFG sent to the internal combustion gas engines:*<br><br>*LFG pressure sensor used for measuring $P_{t,engine-1}$ (internal combustion gas engine 1):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034761<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403476175048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring $P_{t,engine-2}$ (internal combustion gas engine 2):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034760<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period: |

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| | • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403476075048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring $P_{t,engine-3}$ (internal combustion gas engine 3):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034755<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 26/02/2018 valid until 25/02/2020, as indicated in the Calibration Certificate Number 3K64661403475575048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring $P_{t,engine-4}$ (internal combustion gas engine 4):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034758<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 22/02/2018 valid until 21/02/2020, as indicated in the Calibration Certificate Number 3K64661403475875048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring $P_{t,engine-5}$ (internal combustion gas engine 5):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034757<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 21/02/2018 valid until 20/02/2020, as indicated in the Calibration Certificate Number 3K64661403475775048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring $P_{t,engine-6}$ (internal combustion gas engine 6):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T |

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| | - Serial number (S/N): 3K646614034754<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 22/02/2018 valid until 21/02/2020, as indicated in the Calibration Certificate Number 3K64661403475475048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring $P_{t,engine-7}$ (internal combustion gas engine 7):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034759<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 26/02/2018 valid until 25/02/2020, as indicated in the Calibration Certificate Number 3K64661403475975048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring $P_{t,engine-8}$ (internal combustion gas engine 8):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034756<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 22/02/2018 valid until 21/02/2020, as indicated in the Calibration Certificate Number 3K64661403475675048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring $P_{t,engine-9}$ (internal combustion gas engine 9):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034768<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 26/02/2018 valid until 25/02/2020, as indicated in the Calibration Certificate Number 3K64661403476875048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda. |

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| | *LFG pressure sensor used for measuring $P_{t,engine-10}$ (internal combustion gas engine 10):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034773<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 22/02/2018 valid until 21/02/2020, as indicated in the Calibration Certificate Number 3K64661403477375048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring $P_{t,engine-11}$ (internal combustion gas engine 11):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034762<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 26/02/2018 valid until 25/02/2020, as indicated in the Calibration Certificate Number 3K64661403476275048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring $P_{t,engine-12}$ (internal combustion gas engine 12):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034765<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 23/02/2018 valid until 22/02/2020, as indicated in the Calibration Certificate Number 3K64661403476575048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring $P_{t,engine-13}$ (internal combustion gas engine 13):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034767<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the |

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| | considered monitoring period:<br>• Calibration event dated 26/02/2018 valid until 25/02/2020, as indicated in the Calibration Certificate Number 3K64661403476775048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring* $P_{t,engine-14}$ *(internal combustion gas engine 14):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034763<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 22/02/2018 valid until 21/02/2020, as indicated in the Calibration Certificate Number 3K64661403476375048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring* $P_{t,engine-15}$ *(internal combustion gas engine 15):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K64661403764<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 26/02/2018 valid until 25/02/2020, as indicated in the Calibration Certificate Number 3K64661403476475048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring* $P_{t,engine-16}$ *(internal combustion gas engine 16):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034766<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 22/02/2018 valid until 21/02/2020, as indicated in the Calibration Certificate Number 3K64661403476675048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda. |

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| | *LFG pressure sensor used for measuring $P_{t,engine-17}$ (internal combustion gas engine 17):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3 3K646614034774<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 23/02/2018 valid until 22/02/2020, as indicated in the Calibration Certificate Number 3K64661403477475048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring $P_{t,engine-18}$ (internal combustion gas engine 18):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034770<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 22/02/2018 valid until 21/02/2020, as indicated in the Calibration Certificate Number 3K64661403477075048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring $P_{t,engine-19}$ (internal combustion gas engine 19):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034769<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  • Calibration event dated 23/02/2018 valid until 22/02/2020, as indicated in the Calibration Certificate Number 3K64661403476975048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring $P_{t,engine-20}$ (internal combustion gas engine 20):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034772<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the |

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| | considered monitoring period:<br>• Calibration event dated 23/02/2018 valid until 22/02/2020, as indicated in the Calibration Certificate Number 3K64661403477275048/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.<br><br>*LFG pressure sensor used for measuring* $P_{t,engine-21}$ *(internal combustion gas engine 21):*<br><br>- Manufacturer: ABB S.p.A.<br>- Model: 2600T<br>- Serial number (S/N): 3K646614034771<br>- Accuracy: ±1%<br>- Required calibration frequency: calibration events are to be performed every 2 years<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>• Calibration event dated 23/02/2018 valid until 22/02/2020, as indicated in the Calibration Certificate Number 3K64661403477175048/18, issued by CEIME Calibração e Comércio de Instrumentos 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.<br><br>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/parameter | Calculation of baseline emissions |
| Additional comments | - |

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| **Data/Parameter** | **$EC_{PJ,grid,y}$** |
| Unit | MWh |
| Description | Amount of grid electricity consumed by the project activity during the year *y* |
| Measured/calculated/ Default | Measured. |
| Source of data | Measured as part of the operation of the project activity by applying appropriate monitoring instrument (one electricity meter with recordable electronic signal). |
| Value(s) of monitored parameter | Monthly records of grid-sourced electricity consumption valid for the considered monitoring period: |

| Month | Amount of consumed grid-sourced electricity (MWh) |
|---|---|
| Jul./2019 | 265 |
| Aug./2019 | 199 |
| Sep./2019 | 274 |
| Oct./2019 | 332 |
| Nov./2019 | 255 |
| Dec./2019 | 219 |

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|---|---|
| Monitoring equipment | <u>*Specifications and calibration details for the electricity meter used alternately for measuring consumption of grid-sourced electricity:*</u><br><br>- Manufacturer: KRON Instrumentos Elétricos Ltda.<br>- Model: MULT-K<br>- Accuracy: ±0.2%<br>- Serial Number (S/N): 1995567<br>- Required calibration frequency (as specified by the monitoring methodology/ methodological 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:<br><br>"*(...) 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)*".<br><br>- Calibration frequency (as per the recommendation of the meter manufacturer): it is important to note that the installed meter is approved/certified by INMETRO (The Brazilian national authority for metrology and standardization issues), and it is thus in conformance with INMETRO's requirements for maintenance and testing of electricity meters. According to the instruments manufacturer, the meter is to be calibrated every 5 years. A calibration frequency of 5 years is thus adopted.<br>- Date(s) and validity of performed calibration event(s) valid for the considered monitoring period:<br>  - Calibration event dated 02/10/2018 valid until 01/10/2023, as indicated in the Calibration Certificate Number 199556780794/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda. |
| Measuring/reading/recording frequency | Accumulated monthly measurement values for consumption of grid-sourced electricity are recorded once a month. |
| Calculation method (if applicable) | - |
| QA/QC procedures | Monitoring equipment/instruments are calibrated and maintained as per instrument specifications and/or recommendations of manufacturer.<br><br>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/parameter | Calculation of project emissions |

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| Additional comments | As outlined in the PDD, all electricity generated by the grid-connected electricity generation infrastructure fuelled by LFG (of which the set of 21 internal combustion gas engines combusting collected LFG represents major components) and consumed by equipment of the project's LFG collection and flaring infrastructure (e.g. centrifugal blowers, control system, monitoring instruments/equipment, etc.) is to be regarded/accounted as consumption of grid-sourced electricity (with related project emissions accounted accordingly) as a conservative approach.<br><br>Under normal circumstances, very small share of the net-generated electricity by the 29.4 MW grid-connected electricity generation infrastructure fuelled by LFG is continuously supplied to the equipment of the project's LFG collection and flaring infrastructure, with additional very small share being continuously used for meeting the even smaller electricity demand of other facilities located within the limits of the UVS – Caieiras landfill and with the remaining larger share of net generated electricity being exported to the grid through a high voltage power substation connected to an electricity transmission line within the grid.<br><br>Under unusual circumstances when the grid-connected electricity generation infrastructure fuelled by LFG is not under operational status (and with supply of grid-sourced electricity to the landfill site under normal conditions), the electricity demand of all equipment of the project's LFG collection and flaring infrastructure is thus directly met by supply of grid-sourced electricity.<br><br>Under both circumstances, consumption of electricity regarded as supplied by the grid is measured by one common installed electricity meter. The electricity meter used for monitoring the parameter $EC_{PJ,grid,y}$ provides accumulated measurement records for grid-sourced electricity consumed by the project's LFG collection and flaring infrastructure. Accounting all consumption by the project activity of electricity generated by the grid-connected electricity generation infrastructure (fuelled uniquely by LFG) (of which the set of 21 internal combustion gas engines represents major components) represents a conservative measure which is under conformance with the following disclaimer included in the PDD:<br><br>*"while no emission reductions due to displacement of a more-GHG-intensive service (due to generation of electricity using collected LFG as fuel) are eligible and/or claimable for the project activity, for sake of conservativeness and integrity, any consumption by the project activity of electricity generated by the grid-connected electricity generation infrastructure fuelled by LFG located within the geographical limits of the UVS – Caieiras landfill (of which the set of internal combustion gas engines represents the major components) will be regarded and accounted as consumption of grid-sourced electricity (with related project emissions being determined ex-post)."*<br><br>Meeting of electricity demand of the project's LFG collection and flaring infrastructure with electricity generated by installed backup captive off-grid electricity generator is only expected to occur under very unusual and improbable situations when supply of grid-sourced electricity to the landfill site is not available[15]. Under such circumstances, electricity consumption by the project activity is performed by an independent electricity meter located/positioned between such backup captive electricity generator (fuelled by diesel) and the project's equipment within the internal wiring for electricity supply. |

[15] Both the project's LFG collection and flaring infrastructure and the grid-connected electricity generation infrastructure fuelled by LFG (of which the set of 21 internal combustion represents major components) are connected to the National Electricity Grid of Brazil through a high voltage transmission line which is made very reliable and is well controlled by its electricity transmission/distribution operators (by taking into account its importance for the supply of electricity to São Paulo region). Due to that, interruptions in the supply of grid-sourced electricity to the project activity are regarded as very unusual and improbable.

| **Data/Parameter** | **$EF_{grid,OM,y} = EF_{grid,OM-DD,y}$** |
|---|---|
| Unit | $CO_2$/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 | Data will be determined as per applicable calculation guidance for dispatch data analysis operating margin $CO_2$ emission factor of the methodological tool “Tool to calculate the emission factor for an electricity system” (version 04.0). |
| Source of data | The selected annual average value valid for year 2019 (year of which encompasses the whole considered monitoring period) are calculated by the DNA of Brazil and are made public available at the website of the DNA of Brazil:<br><br>http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/textogeral/emissao_despacho.html |
| Value(s) of monitored parameter | 0.5181 $tCO_2$/MWh |
| Monitoring equipment | Not applicable. |
| Measuring/reading/recording frequency | Value(s) valid for the year encompassed by the considered monitoring period are to be used. |
| Calculation method (if applicable) | Value 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 quality management and control (QA/QC) and environmental management system (EMS). |
| Purpose of data/parameter | Calculation project emissions. |

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| Additional comments | It is relevant to note that, as further explained in Section E.2, for the determination of the $CO_2$ emission factor for electricity consumed by the project activity, the PDD defines the following generic approach of the methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01) regarding its determination by taking into account the sources for consumed electricity:<br><br>*"Where case C.III has been identified, as a conservative simple approach, the emission factor for electricity generation should be the more conservative value between the emission factor determined as per guidance for scenario A and B respectively. This means that the more conservative value should be chosen between a) the result of applying either option A1 or A2 and b) the result of applying either option B1 or B2."*<br><br>As further explained in Section E.2, the above-quoted options of the methodological tool (options A1, A2, B1 and B2) are thus all potentially applicable for the determination of $EF_{EL,grid,y}$ = $EF_{EL,captive,y}$ (with the determined value representing the most conservative (higher) value). In this context, monitored value for $EF_{grid,OM,y}$ = $EF_{grid,OM-DD,y}$ is applied for the determination of $EF_{EL,grid,y}$ as per Option A1[16]. |

[16] As further explained in Section E.2, while in the particular case of the considered monitoring period the installed backup captive off-grid electricity generator (fuelled by diesel) was not used and no consumption by the project activity of electricity sourced by such captive power generation source thus occurred during the period, the following is thus applicable:

- Option A1 and Option A2 of the of the methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01) are directly selected and applied for the determination of $CO_2$ emission factor for consumed electricity (with the most conservative (higher) value being chosen) under conformance with additional guidance included in the PDD (and quoted in Section E.2.).
- Project emissions associated to such consumption of electricity generated with fossil fuel diesel ($PE_{EC,captive,y}$) are directly determined as being null (zero).

| | |
|---|---|
| **Data/Parameter** | **$Op_{j,h}$** |
| Unit | - |
| Description | Operation of the equipment that consumes LFG (i.e. internal combustion gas engines (as additional/alternative methane destruction devices)). |
| Measured/calculated/ Default | For each equipment unit *j* using the LFG monitor that the plant is operating in hour h by the monitoring any one or more of the following three parameters:<br>(a) Temperature. Determine the location for temperature measurements and minimum operational temperature based on manufacturer's specifications of the burning equipment. Document and justify the location and minimum threshold in the PDD;<br>(b) Flame. Flame detection system is used to ensure that the equipment is in operation;<br>(c) Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnaces. This option is not applicable to brick kilns.<br><br>$O_{pj,h}$ = 0 when:<br>(a) One of more temperature measurements are missing or below the minimum threshold in hour h (instantaneous measurements are made at least every minute);<br>(b) Flame is not detected continuously in hour h (instantaneous measurements are made at least every minute); (c) No products are generated in the hour h.<br><br>Otherwise, $O_{pj,h}$ = 1 |
| Source of data | The electronic control system for each internal combustion gas engine continuously monitors operational status of the engine (internal combustion gas engine under operation "*on*" or not under operation "*off*"), generating recordable electronic signal. |

| | |
|---|---|
| Value(s) of monitored parameter | While the operational status for each individual internal combustion gas engine consuming LFG is independently monitored, the monitoring parameter $O_{pj,h}$ is recorded and reported on the basis of the following sub-parameters:<br><br>- $Op_{engine-1,h,}$: Operation of the internal combustion gas engine 1<br>- $Op_{engine-2,h}$: Operation of the internal combustion gas engine 2<br>- $Op_{engine-3,h}$: Operation of the internal combustion gas engine 3<br>- $Op_{engine-4,h}$: Operation of the internal combustion gas engine 4<br>- $Op_{engine-5,h}$: Operation of the internal combustion gas engine 5<br>- $Op_{engine-6,h}$: Operation of the internal combustion gas engine 6<br>- $Op_{engine-7,h}$: Operation of the internal combustion gas engine 7<br>- $Op_{engine-8,h}$: Operation of the internal combustion gas engine 8<br>- $Op_{engine-9,h}$: Operation of the internal combustion gas engine 9<br>- $Op_{engine-10,h}$: Operation of the internal combustion gas engine 10<br>- $Op_{engine-11,h}$: Operation of the internal combustion gas engine 11<br>- $Op_{engine-12,h}$: Operation of the internal combustion gas engine 12<br>- $Op_{engine-13,h}$: Operation of the internal combustion gas engine 13<br>- $Op_{engine-14,h}$: Operation of the internal combustion gas engine 14<br>- $Op_{engine-15,h}$: Operation of the internal combustion gas engine 15<br>- $Op_{engine-16,h}$: Operation of the internal combustion gas engine 16<br>- $Op_{engine-17,h}$: Operation of the internal combustion gas engine 17<br>- $Op_{engine-18,h}$: Operation of the internal combustion gas engine 18<br>- $Op_{engine-19,h}$: Operation of the internal combustion gas engine 19<br>- $Op_{engine-20,h}$: Operation of the internal combustion gas engine 20<br>- $Op_{engine-21,h}$: Operation of the internal combustion gas engine 21<br><br>For each one of the 21 installed internal combustion gas engines, records for every-minute operational status of the engine (internal combustion gas engine under operation (“*on*”) = 1 or not under operation (“*off*”) = 0) are made available in the emission reduction calculation spreadsheets. |
| Monitoring equipment | Not applicable. |
| Measuring/reading/recording frequency | Values are reported on a minute basis. |
| 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 quality management and control (QA/QC) and environmental management system (EMS). |
| Purpose of data/parameter | Calculation baseline emissions. |
| Additional comments | In the particular case of the project activity the only equipment that consumes LFG (and for which the monitoring parameter $Op_{j,h}$ is applicable to) are the internal combustion gas engines (additional/alternative destruction methane devices). As per ACM0001 (version 13.0.0), the monitoring parameter $Op_{j,h}$ is not applicable to the project’s high temperature enclosed flares. |

| **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 service company “Merieux NutriSciences / Bioagri Ambiental Ltda.”<br>- Measurements for Flare 1, Flare 2 and Flare 4 were performed on 01/07/2019,<br>- Sequential measurements for Flare 2 were performed on 21/01/2020,<br>- Sequential measurements for Flare 4 were performed on 19/12/2019,<br><br>**Note:** Since Flares 1 and 3 were not under operational status during the whole considered monitoring period, no collected LFG was combusted by these particular flares and no related emission reduction is claimed. Every-minute null value measurements for $V_{t,wb,flare-1}$ and $V_{t,wb,flare-3}$ are anyway reported in the set of monthly emission reduction spreadsheets valid for the considered monitoring period for sake of completeness and transparency.<br><br>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:<br><br>- US-EPA Method 18 – Measurement of Gaseous Organic Compound Emission by Gas Chromatography (available online: https://www3.epa.gov/ttnemc01/promgate/m-18.pdf);<br><br>- 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)<br><br>- 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)<br><br>- 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)<br><br>- 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) |

<table>
<tr><td>Value(s) of monitored parameter</td><td>While a set 2 biannual related measurements were performed for Flare 1, Flare 2 and Flare 4 (with only one measurement being performed for Flare 3), the monitoring parameter $F_{CH4,EG,t}$ is thus measured, recorded and reported on the basis of the following sub-parameters:<br>- $F_{CH4,EG,t,flare-1}$: Mass flow of methane in the exhaust gas of Flare 1<br>- $F_{CH4,EG,t,flare-2}$: Mass flow of methane in the exhaust gas of Flare 2<br>- $F_{CH4,EG,t,flare-3}$: Mass flow of methane in the exhaust gas of Flare 3<br>- $F_{CH4,EG,t,flare-4}$: Mass flow of methane in the exhaust gas of Flare 4<br><br>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).<br><br>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:<br><br>
<table>
<tr><th>Flare</th><th>Dates of performed measurements</th><th>Company responsible for the performance of measurements</th><th>Identified value of $F_{CH4,EG,t,flare-n}$</th></tr>
<tr><td rowspan="2">Flare 2 ($F_{CH4,EG,t,flare-2}$)</td><td>01/07/2019</td><td>Merieux NutriSciences / Bioagri Ambiental Ltda.</td><td>0.0160</td></tr>
<tr><td>21/01/2020</td><td>Merieux NutriSciences / Bioagri Ambiental Ltda.</td><td>0.0160</td></tr>
<tr><td rowspan="2">Flare 4 ($F_{CH4,EG,t,flare-4}$)</td><td>01/07/2019</td><td>Merieux NutriSciences / Bioagri Ambiental Ltda.</td><td>0.0260</td></tr>
<tr><td>19/12/2019</td><td>Merieux NutriSciences / Bioagri Ambiental Ltda.</td><td>0.071</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>Measurements were performed by the independent 3rd party inspection service company “Merieux NutriSciences / Bioagri Ambiental Ltda.” using appropriated chromatographer and a pitot tube.</td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Biannual</td></tr>
<tr><td>Calculation method (if applicable)</td><td>-</td></tr>
<tr><td>QA/QC procedures</td><td>Procedures related to collection/gathering, recording, storing and reporting of monitoring data for the project activity are performed at Companhia Riograndense de Valorização de Resíduos S/A in accordance with detailed working instructions that are included in the company’s quality management and control (QA/QC) and environmental management system (EMS).<br><br>BIOAGRI Ambiental Ltda / Mérieux NutriSciences Brasil is an independent third party inspections services company specialized in inspections and testing of air emissions from stationary sources accredited by the Instituto Nacional de Metrologia, Qualidade e Tecnologia (INMETRO) (the Brazilian national authority for metrology and certification affairs), which is responsible for the regulation of operation of inspection entities and labs.</td></tr>
<tr><td>Purpose of data/parameter</td><td>Calculation of baseline emissions.</td></tr>
</table>

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| Additional comments | The flare efficiency calculation spreadsheet (which is enclosed to this Monitoring Report) also calculates the average flow rate of LFG sent to the flare during the 6 months prior to each measurement event performed by “BIOAGRI Ambiental Ltda / Mérieux NutriSciences Brasil” in order to demonstrate that related average value is lower than the average flow rate of LFG sent to the flare during each one of considered 1-hour period when measurement events for $F_{CH4,EG}$ were performed.<br><br>As demonstrated in the flare efficiency calculation spreadsheet (which is enclosed to this Monitoring Report), the average flow rate sent to all the 4 flarws during the period in which measurements for $F_{CH4,EG,t}$ were made are greater than the average flow rate observed for the previous six months for the flares as required by the methodological tool “Project emissions from flaring” (version 02.0.0) for the application of its Option B.1.<br><br>Among the standards of which guidance and requirements were followed as part of performed biannual determination of $F_{CH4,EG,t}$ for the installed flare within the considered monitoring period, the US-EPA Method 18 – Measurement of Gaseous Organic Compound Emission by Gas Chromatography has been widely internationally recognized and/or accepted by different national and international organizations as a standard for performance of emission measurements from stationary emission sources in a wide range of industries (e.g. The California Air Resources Board (CARB), Scottish Environment Protection Agency (SEPA). Different agencies in the United States (USA) and in other countries require or recommend that determination of concentration of VOC portion in landfill gas is to be performed by applying US-EPA Method 18. The US-EPA Method 18 is also referred in the most popular and acknowledged pollution control handbooks and guides (i.e. Pollution Control Handbook for Oil and Gas Engineering, 2016, published by John Wiley & Sons, Inc. – USA, US-EPA Guidance for evaluating landfill gas emissions from closed or abandoned facilities, SEPA Guidance for monitoring landfill gas engine emissions, Pollution Prevention and Abatement Handbook 1998 – The World Bank Group, etc.).<br><br>The technical test/evaluation reports for the performed biannual determination of $F_{CH4,EG,t}$ for the installed flare within the considered monitoring period (reports issued by the independent 3rd party inspection service company “BIOAGRI Ambiental Ltda / Mérieux NutriSciences Brasil) also refer to methods recommended by the environmental authority of São Paulo State in Brazil. Compliance with these methods has also been acknowledged as best practice for performance of air emission measurements by different environmental regulatory agencies in Brazil. |

| **Data/Parameter** | $\mathbf{T_{EG,m}}$ |
|---|---|
| Unit | °C |
| Description | Temperature in the exhaust gas of the enclosed flare in minute *m* |
| Measured/calculated/ Default | Measured |

| | |
|---|---|
| Source of data | Measured as part of the operation of the project activity by applying appropriate monitoring instruments (thermocouples) (with recordable electronic signal).<br><br>Continuously measurements are performed by 4 thermocouples (each thermocouple installed in the upper section of each one of the 4 high temperature enclosed flares). |
| 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.<br><br>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:<br>- $T_{EG,m,flare-1}$: Temperature in the exhaust gas of Flare 1<br>- $T_{EG,m,flare-2}$: Temperature in the exhaust gas of Flare 2<br>- $T_{EG,m,flare-3}$: Temperature in the exhaust gas of Flare 3<br>- $T_{EG,m,flare-4}$: Temperature in the exhaust gas of Flare 4<br><br>**Note:** Since Flares 1 and 3 were not under operational status during the whole considered monitoring period, no collected LFG was combusted by these particular flares and no related emission reduction is claimed. Every-minute null value measurements for $V_{t,wb,flare-1}$ and $V_{t,wb,flare-3}$ are anyway reported in the set of monthly emission reduction spreadsheets valid for the considered monitoring period for sake of completeness and transparency. |

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|---|---|
| Monitoring equipment | <u>*Specifications and calibration details for the installed/utilized thermocouples:*</u><br><br>*Two different thermocouples were used during the considered monitoring period for measuring $T_{EG,m,flare-1}$ (Flare 1). Their specifications are as follows:*<br><br>*Thermocouple installed during the period from 01/07/2019 to 26/07/2019:*<br>- Manufacturer: Iope Instrumentos de Precisão Ltda.<br>- Model: IEC 584-2/1982, type N<br>- Accuracy: ±2.2ºC<br>- Serial Number: 95719/1/1<br>- Calibration requirements: frequency (as specified by the monitoring methodology/tool): periodically calibrated by an officially accredited entity<br>- Calibration frequency (as per the application of the monitoring plan): yearly<br>- Calibration Date(s): Calibration event dated 21/12/2018 (Calibration Certificate 96723/1/680794/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.)<br>- Validity of the performed calibration event(s): The calibration event dated 21/12/2018 is valid until 20/12/2019 (1 year)<br><br>*Thermocouple installed during the period from 26/07/2019 to 31/12/2019:*<br>- Manufacturer: Warme do Brasil Intrumentação e Automação Industrial Ltda.<br>- Model: WTT-6000N, type N<br>- Accuracy: ±1.0%<br>- Serial Number: Not available.<br>- Calibration requirements: frequency (as specified by the monitoring methodology/tool): periodically calibrated by an officially accredited entity<br>- Calibration frequency (as per the application of the monitoring plan): yearly<br>- Calibration Date(s): Calibration event dated 18/07/2019 (Calibration Certificate LT-233139, issued by Escala Produtos e Serviços de Calibração Ltda.)<br>- Validity of the performed calibration event(s): The calibration event dated 18/07/2019 is valid until 17/07/2020 (1 year)<br><br>*Two different thermocouples were used during the considered monitoring period for measuring $T_{EG,m,flare-2}$ (Flare 2). Their specifications are as follows:*<br><br>*Thermocouple installed during the period from 01/07/2019 to 26/07/2019:*<br>- Manufacturer: Iope Instrumentos de Precisão Ltda.<br>- Model: IEC 584-2/1982, type N<br>- Accuracy: ±2.2ºC<br>- Serial Number: 95719/1/2<br>- Calibration frequency (as specified by the monitoring methodology/tool): periodically calibrated by an officially accredited entity<br>- Calibration frequency (as per the application of the monitoring plan): yearly<br>- Calibration Date(s): Calibration event dated 21/12/2018 (Calibration Certificate 96723/1/580794/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.)<br>- Validity of the performed calibration event(s): The calibration event dated 21/12/2018 is valid until 20/12/2019 (1 year)<br><br>*Thermocouple installed during the period from 26/07/2019 to 31/12/2019:*<br>- Manufacturer: Warme do Brasil Intrumentação e Automação Industrial Ltda.<br>- Model: WTT-6000N, type N<br>- Accuracy: ±1.0%<br>- Serial Number: Not available.<br>- Calibration requirements: frequency (as specified by the monitoring methodology/tool): periodically calibrated by an officially accredited entity<br>- Calibration frequency (as per the application of the monitoring plan): |

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| | yearly<br>- Calibration Date(s): Calibration event dated 18/07/2019 (Calibration Certificate LT-233138, issued by Escala Produtos e Serviços de Calibração Ltda.)<br>- Validity of the performed calibration event(s): The calibration event dated 18/07/2019 is valid until 17/07/2020 (1 year)<br><br>*Two different thermocouples were used during the considered monitoring period for measuring $T_{EG,m,flare-3}$ (Flare 3). Their specifications are as follows:*<br><br>*Thermocouple installed during the period from 01/07/2019 to 26/07/2019:*<br>- Manufacturer: Iope Instrumentos de Precisão Ltda.<br>- Model: IEC 584-2/1982, type N<br>- Accuracy: ±2.2ºC<br>- Serial Number: 95719/1/3<br>- Calibration frequency (as specified by the monitoring methodology/tool): periodically calibrated by an officially accredited entity<br>- Calibration frequency (as per the application of the monitoring plan): yearly<br>- Calibration Date(s): Calibration event dated 21/12/2018 (Calibration Certificate 96723/1/480794/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.).<br>- Validity of the performed calibration event(s): The calibration event dated 21/12/2018 is valid until 20/12/2019 (1 year)<br><br>*Thermocouple installed during the period from 26/07/2019 to 31/12/2019:*<br>- Manufacturer: Warme do Brasil Intrumentação e Automação Industrial Ltda.<br>- Model: WTT-6000N, type N<br>- Accuracy: ±1.0%<br>- Serial Number: Not available.<br>- Calibration requirements: frequency (as specified by the monitoring methodology/tool): periodically calibrated by an officially accredited entity<br>- Calibration frequency (as per the application of the monitoring plan): yearly<br>- Calibration Date(s): Calibration event dated 18/07/2019 (Calibration Certificate LT-233135, issued by Escala Produtos e Serviços de Calibração Ltda.)<br>- Validity of the performed calibration event(s): The calibration event dated 18/07/2019 is valid until 17/07/2020 (1 year)<br><br>*Two different thermocouples were used during the considered monitoring period for measuring $T_{EG,m,flare-4}$ (Flare 4). Their specifications are as follows:*<br><br>*Thermocouple installed during the period from 01/07/2019 to 26/07/2019:*<br>- Manufacturer: Iope Instrumentos de Precisão Ltda.<br>- Model: IEC 584-2/1982, type N<br>- Accuracy: ±2.2ºC<br>- Serial Number: 95719/1/4<br>- Calibration frequency (as specified by the monitoring methodology/tool): periodically calibrated by an officially accredited entity<br>- Calibration frequency (as per the application of the monitoring plan): yearly<br>- Calibration Date(s): Calibration event dated 21/12/2018 (Calibration Certificate 96723/1/880794/18, issued by CEIME Calibração e Comércio de Instrumentos Ltda.).<br>- Validity of the performed calibration event(s): The calibration event dated 21/12/2018 is valid until 20/12/2019 (1 year) |

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|---|---|
| | *Thermocouple installed during the period from 26/07/2019 to 31/12/2019:*<br>- Manufacturer: Warme do Brasil Intrumentação e Automação Industrial Ltda.<br>- Model: WTT-6000N, type N<br>- Accuracy: ±1.0%<br>- Serial Number: Not available.<br>- Calibration requirements: frequency (as specified by the monitoring methodology/tool): periodically calibrated by an officially accredited entity<br>- Calibration frequency (as per the application of the monitoring plan): yearly<br>- Calibration Date(s): Calibration event dated 18/07/2019 (Calibration Certificate LT-233134, issued by Escala Produtos e Serviços de Calibração Ltda.)<br>- Validity of the performed calibration event(s): The calibration event dated 18/07/2019 is valid until 17/07/2020 (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.<br><br>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/parameter | 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 | Measured |
| Source of data | Continuously measurements are performed by Ultra violet (UV) flame detectors (one UV flame detector for each installed high temperature enclosed flare with recordable electronic signal) .<br><br>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. |

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|---|---|
| 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.<br><br>While measurements are performed by 4 UV flame detectors (one UV flame detector installed in each individual installed flare), the monitoring parameter Flamem is thus measured, recorded and reported on the basis of the following sub-parameters:<br><br>- $Flame_{m,flare-1}$: Flame detection in Flare 1<br>- $Flame_{m,flare-2}$: Flame detection in Flare 2<br>- $Flame_{m,flare-3}$: Flame detection in Flare 3<br>- $Flame_{m,flare-4}$: Flame detection in Flare 4<br><br>**Note:** Since Flares 1 and 3 were not under operational status during the whole considered monitoring period, no collected LFG was combusted by these particular flares and no related emission reduction is claimed. Every-minute null value measurements for $V_{t,wb,flare-1}$ and $V_{t,wb,flare-3}$ are anyway reported in the set of monthly emission reduction spreadsheets valid for the considered monitoring period for sake of completeness and transparency. |
| Monitoring equipment | *Specifications and calibration detals for the installed/utilized UV Flame detectors:*<br><br>*UV Flame detector for measuring* $Flame_{m,flare-1}$ *(Flare 1)*:<br>- Manufacturer: SELCON Sistemas Eletrônicos de Controle Ltda.<br>- Model: SEL-SV-UL-K4<br>- Serial Number: 323730808<br>- Calibration frequency: No calibration is required as the equipment has a self-checking function.<br><br>*UV Flame detector for measuring* $Flame_{m,flare-2}$ *(Flare 2)*:<br>- Manufacturer: SELCON Sistemas Eletrônicos de Controle Ltda.<br>- Model: SEL-SV-UL-K4<br>- Serial Number: 55600905<br>- Calibration frequency: No calibration is required as the equipment has a self-checking function.<br><br>*UV Flame detector for measuring* $Flame_{m,flare-3}$ *(Flare 3):*<br>- Manufacturer: Honeywell Analytics Ltd.<br>- Model: C7061<br>- Serial Number: R7861<br>- Calibration frequency: No calibration is required as the equipment has a self-checking function.<br><br>*UV Flame detector for measuring* $Flame_{m,flare-4}$ *(Flare 4):*<br>- Manufacturer: SELCON Sistemas Eletrônicos de Controle Ltda.<br>- Model: SEL-SV-210230-K6<br>- Serial Number: 565400312<br>- Calibration frequency: No calibration is required as the equipment has a self-checking function. |
| Measuring/reading/recording frequency | Continuously measurements are recorded/reported every minute. |
| Calculation method (if applicable) | Not applicable |

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|---|---|
| QA/QC procedures | Monitoring equipment/instruments are calibrated and maintained as per instrument specifications and/or recommendations of manufacturer.<br><br>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/parameter | Calculation of baseline emissions |
| Additional comments | - |

| **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:<br><br>- 13/01/2019: General inspection/maintenance service on Flares 1, 2, 3 and 4 (incl. inspection of the condition of the flares 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).<br><br>- 08/07/2019: General inspection/maintenance service on Flares 1, 2, 3 and 4 (incl. inspection of the condition of the flares 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).<br><br>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.<br><br>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. Furthermore, the isolation ceramics revetment material of the Flare 1 was once more replaced more recently in February 2019. |

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| | 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” ($SPEC_{flare}$)).<br><br>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.<br><br>**Note:** Since Flares 1 and 3 were not under operational status during the whole considered monitoring period, no collected LFG was combusted by these particular flares and no related emission reduction is claimed. Every-minute null value measurements for $V_{t,wb,flare-1}$ and $V_{t,wb,flare-3}$ are anyway reported in the set of monthly emission reduction spreadsheets valid for the considered monitoring period for sake of completeness and transparency. |
| 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 UVS - Caieiras landfill. |
| Purpose of data/parameter | Calculation of baseline emissions |
| Additional comments | 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 and through the use of weight scales. |
| 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 (0.180 ton) of LPG. Thus,<br>$FC_{LPG,y}$ = 0.180 $ton_{LPG}$<br><br>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 4 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 | 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.<br><br>*Specifications and calibration details for the installed weight scale for measurements of $FC_{LPG,y}$:*<br>- Manufacturer: Mettler-Toledo Inc.<br>- Model: 2180<br>- Capacity: max. 250 kg<br>- Accuracy: ±50g<br>- Serial Number: 10423008<br>- 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).<br>- Date of valid calibration: 29/03/2017 (Calibration Certificate 1573/17).<br>- Entity/company responsible for the performed calibration events: Grupo Caieiras Balanças<br>- Validity of the performed calibration events: The calibration event dated 29/03/2017 is valid until 28/03/2020 (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. |

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| 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.<br><br>Monitoring equipment/instruments are calibrated and maintained as per instrument specifications and/or recommendations of manufacturer.<br><br>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/parameter | 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 2019 (Balanço Energético Nacional (BEN) – 2019) / Table VIII.9 – Specific Mass and Heating Values (Higher Heating Value). 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.<br><br>The BEN-2019 report is available online:<br>http://www.epe.gov.br/pt/publicacoes-dados-abertos/publicacoes/balanco-energetico-nacional-2019<br><br>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/parameter | 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/parameter | Calculation of project emissions (due to consumption of LPG by the project activity) |
| Additional comments | - |

| **Data/Parameter** | **$EC_{PJ,captive,y}$ = $EG_{Diesel\text{-}Generator,y}$** |
|---|---|
| Unit | MWh |
| Description | Quantity of electricity generated in captive diesel backup generator during the year *y* = Quantity of electricity generated in captive diesel backup generator during the year *y* |
| Measured/calculated/ Default | Measured |
| Source of data | Measured as part of the operation of the project activity by applying appropriate monitoring instrument (one electricity meter with recordable electronic signal). |

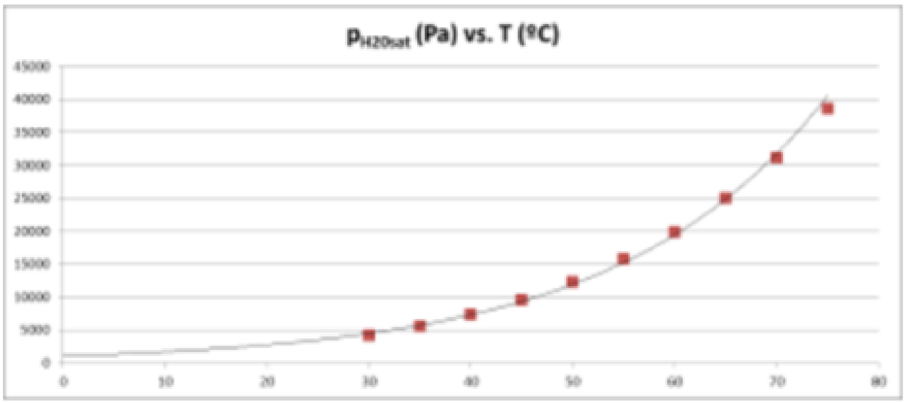
| | |
|---|---|
| Value(s) of monitored parameter | 0<br>(No electricity was generated by the installed backup captive off-grid electricity generator (fuelled by diesel) during the considered monitoring period) |
| Monitoring equipment | - Manufacturer: Schneider Eletric<br>- Model: PM820MG<br>- Serial Number: 26207716<br>- Class: ±0.2<br>- Accuracy: ±0.2%<br>- Date of valid calibration event(s): 11/05/2017 (Calibration Certificate KD201705000018)<br>- Entity/company responsible for the performed calibration events: Schneider Electric.<br>- Validity of the performed calibration event(s): The calibration event dated 11/05/2017 is valid until 10/05/2019 (2 years). Since the generator has not operated since 2016 and it is not expected to be under operation until the end of the project's lifetime, no further calibration events were yet performed for this particular instrument. |
| Measuring/reading/recording frequency | Continuous measurements performed by installed electricity meters are recorded/reported every hour. |
| 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/parameter | Calculation of the project emissions. |
| Additional comments | - |

| **Data/Parameter** | $\mathbf{P_{H2O,t,Sat}}$ |
|---|---|
| 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; 4th Edition 1994. 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 following equation:<br>$P_{H2O,t,sat} = 1,031.3 * e^{(0.049 * Tt)}$<br>Correlation coefficient of $R^2 = 0.998$ is applied.<br>Further details are presented below in "Calculation Method". |

<table>
<tr><td>Monitoring equipment</td><td>Not applicable.</td></tr>
<tr><td>Measuring/reading/recording frequency</td><td>Not applicable.</td></tr>
<tr><td>Calculation method<br>(if applicable)</td><td>
The Absolute Vapor Pressure of Water is obtained from the above-mentioned literature and is presented in the following table within the rage of interest for the required calculations:

<table>
<tr><th>Temperature</th><th>$P_{H2O,t,Sat}$</th></tr>
<tr><td>ºC</td><td>Pa</td></tr>
<tr><td>30</td><td>4,246</td></tr>
<tr><td>35</td><td>5,628</td></tr>
<tr><td>40</td><td>7,384</td></tr>
<tr><td>45</td><td>9,593</td></tr>
<tr><td>50</td><td>12,349</td></tr>
<tr><td>55</td><td>15,758</td></tr>
<tr><td>60</td><td>19,940</td></tr>
<tr><td>65</td><td>25,030</td></tr>
<tr><td>70</td><td>31,190</td></tr>
<tr><td>75</td><td>38,580</td></tr>
</table>

The following graphic represents the above summarized 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.
</td></tr>
<tr><td>QA/QC procedures</td><td>Not applicable.</td></tr>
<tr><td>Purpose of data/parameter</td><td>Calculation of baseline emissions.</td></tr>
<tr><td>Additional comments</td><td>-</td></tr>
</table>

| Data/Parameter | $FC_{Diesel,y}$ |
|---|---|
| Unit | Liters |
| Description | Quantity of fuel diesel combusted by the captive off-grid electricity generator |
| Measured/calculated/ Default | Measured. |
| Source of data | Measured as part of the operation of the project activity by applying appropriate fuel meter. |
| Value(s) of monitored parameter | 0<br>(While no electricity was generated installed backup captive off-grid electricity generator (fuelled by diesel) during the considered monitoring period, its consumption of fuel diesel during the period is thus null (zero)) |

| | |
|---|---|
| Monitoring equipment | *Specifications and calibration details for the fuel meter used for measuring quantity of fuel diesel combusted by the captive off-grid electricity generator:*<br><br>- Manufacturer: Macnaught Pty Ltd.<br>- Model: DM100<br>- Serial number (S/N): n/a<br>- Accuracy: ±1%<br>- Required calibration frequency: As per the PDD, periodic calibration events are to be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations.<br>Also as per the PDD, the instrument is to be subject to a regular maintenance and testing regime in accordance to appropriate national /international standards/requirements and/or best practice. For the particular case of the installed fuel meter (positioned in the fuel supply hose of a backup captive off-grid electricity generator (fuelled by diesel), there are no applicable national/international standards/requirements to be applied. By taking into account the design[17] and construction of the fuel meter (i.e. the fuel meter is tested as part of its manufacturing and delivery processes) and by also taking into account the not frequent use of the backup captive off-grid electricity generator (in which the fuel meter is installed) as part of the operation of the project activity, and also taking into account good practices for calibration of this type of instrument, it is defined that testing/calibration events are to be performed in the instrument with at least an every 3 years frequency.<br>- Dates for performed testing/calibration events valid for the considered monitoring period: Since the generator has not operated since 2016 and it is not expected to be under operation until the end of the project's lifetime, no calibration event was yet performed for this particular instrument. |
| Measuring/reading/recording frequency | Accumulated measurements records of consumption of diesel by the backup captive off-grid electricity generator (fuelled by diesel) are reported at with at least once a week, with values being aggregated on a monthly basis. |
| 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/parameter | Calculation of project emissions |

[17] The following is established in the instruction manual for the installed fuel meter model DM100:

> *"The Macnaught DM100 fuel meter has incorporated the oval rotor principal into its design. This has proven to be a highly reliable and highly accurate method of measuring flow, providing exceptional repeatability and high accuracy."*

The instruction manual and the specification sheet for the fuel meter model DM100, manufactured by Macnaught Pty Ltd. Are available online:
http://www.redashe.com/sites/default/files/Data_Sheets/Instruction-Manuals/Macnaught/Macnaught-DM100-Instruction-Manual.pdf
https://www.omniprocess.se/fileadmin/user_upload/omniprocess/pdf/datasheets/dm100.pdf

| | |
|---|---|
| Additional comments | It is relevant to note that in the context of the determination of emission reductions achieved by the project activity during the considered monitoring period, monitoring records for the parameter $FC_{Diesel,y}$ are considered uniquely for the determination of the value for $CO_2$ emission factor for electricity consumed by the project activity through the application of guidance valid for Scenario C.III, Option B1 of the methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01).<br><br>Project emissions due to consumption by the project activity of electricity generated by the installed backup captive off-grid electricity generator (fuelled by diesel) are primarily determined based on measurement records of the amount of electricity consumed by the project activity and generated by such backup electricity generator (monitoring parameter $EC_{PJ,captive,y}$ = $EG_{Diesel-Generator,y}$). Therefore, monitoring records for the parameter $FC_{Diesel,y}$ are therefore not directly used for the determination of project emissions associated to consumption of fossil fuel diesel for generation of electricity that is consumed by the project activity. |

| **Data/Parameter** | **$NCV_{Diesel,y}$** |
|---|---|
| Unit | TJ/Gg |
| Description | Net calorific value of the fuel diesel in year *y* |
| Measured/calculated/ Default | Default |
| Source of data | IPCC default values (at upper limit of uncertainty at 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories is selected. |
| Value(s) of monitored parameter | 43.3 |
| 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 assumed as being 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/parameter | Calculation of project emissions |

| | |
|---|---|
| Additional comments | It is relevant to note that in the context of the determination of emission reductions achieved by the project activity during the considered monitoring period, monitoring records for the parameter $NCV_{Diesel,y}$ are considered uniquely for the determination of the value for $CO_2$ emission factor for electricity consumed by the project activity through the application of guidance valid for Scenario C.III, Option B1 of the methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01).<br><br>Project emissions due to consumption by the project activity of electricity generated by the installed backup captive off-grid electricity generator (fuelled by diesel) are primarily determined on the application of both default and conservative value for emission factor for electricity generated by such backup captive power generation source + measurement records of the amount of electricity consumed by the project activity and generated by such backup electricity generator (monitoring parameter $EC_{PJ,captive,y}$ = $EG_{Diesel-Generator,y}$). Therefore, the selected value for the parameter $NCV_{Diesel,y}$ is not used for the determination of project emissions associated to consumption of fossil fuel diesel for generation of electricity that is consumed by the project activity. |

| **Data/Parameter** | $\mathbf{EF_{CO2,Diesel,y}}$ |
|---|---|
| Unit | $tCO_2/GJ$ |
| Description | $CO_2$ emission factor of fuel diesel in year y |
| Measured/calculated/ Default | Default |
| Source of data | IPCC default values (at upper limit of uncertainty at 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories is selected. |
| Value(s) of monitored parameter | 74,800 |
| 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 assumed as being 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/parameter | Calculation of project emissions |

| | |
|---|---|
| Additional comments | It is relevant to note that in the context of the determination of emission reductions achieved by the project activity during the considered monitoring period, monitoring records for the parameter $EF_{CO2,Diesel,y}$ are considered uniquely for the determination of the value for $CO_2$ emission factor for electricity consumed by the project activity through the application of guidance valid for Scenario C.III, Option B1 of the methodological tool “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01).<br><br>Project emissions due to consumption by the project activity of electricity generated by the installed backup captive off-grid electricity generator (fuelled by diesel) are primarily determined on the application of both default and conservative value for emission factor for electricity generated by such backup captive power generation source + measurement records of the amount of electricity consumed by the project activity and generated by such backup electricity generator (monitoring parameter $EC_{PJ,captive,y}$ = $EG_{Diesel-Generator,y}$). Therefore, the selected value for the parameter $EF_{CO2,Diesel,y}$ is therefore not used for the determination of project emissions associated to consumption of fossil fuel diesel for generation of electricity that is consumed by the project activity. |

| **Data/Parameter** | **$TDL_{grid,y}$** |
|---|---|
| Unit | - |
| Description | Average technical transmission and distribution losses for providing electricity to the grid and/or for grid sourced electricity consumed by the project activity |
| Measured/calculated/ Default | Default |
| Source of data | Applicable default value for consumption of grid-sourced electricity as per Option C.III of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01) is selected. |
| Value(s) of monitored parameter | 20% |
| Monitoring equipment | Not applicable. |
| Measuring/reading/recording frequency | In accordance with the PDD, default value as per Option C.III of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01) is considered, an every year monitoring frequency is thus assumed as being 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/parameter | Calculation of project emissions |
| Additional comments | - |

| **Data/Parameter** | **$TDL_{captive,y}$** |
|---|---|
| Unit | - |
| Description | Average technical transmission and distribution losses for electricity sourced by the captive electricity generator |
| Measured/calculated/ Default | Default |
| Source of data | Applicable default value as per Option C.III of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01) is selected. |
| Value(s) of monitored parameter | 20% |
| Monitoring equipment | Not applicable. |
| Measuring/reading/recording frequency | In accordance with the PDD, default value as per Option C.III of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01) is considered, an every year monitoring frequency is thus assumed as being 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/parameter | Calculation of project emissions |
| Additional comments | - |

The following monitoring parameters (which are also included in the monitoring plan of the PDD) were not monitored as the methodological options for which they are applicable/valid 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 $CH_4$ 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 net anthropogenic removals

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

>>

Under conformance with provisions and calculation approaches of the PDD, baseline emissions ($BE_y$) for the project activity under its current design configuration are determined (in $tCO_2e$) for the considered monitoring period as follows:

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

Where:

$BE_{CH4,y}$ Baseline emissions of methane from the SWDS (in $tCO_2e$)[18]. 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 in its methane destruction devices and by also 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 (conventional passive flares).

In addition, the effect of methane oxidation (that, as per ACM0001 (version 13.0.0), is assumed as existing in the baseline scenario 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) (in $tCH_4$). 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 $tCH_4$). In the particular case of the determination of $F_{CH4,BL,y}$, the calculation parameter $F_{CH4,PJ,capt,y}$ is determined as the sum of the amount of methane that is sent to the project's methane destruction devices (i.e. amount of $CH_4$ sent to the set of 21 internal

[18] SWDS = Solid Waste Disposal Site. For the case of the project activity, the SWDS is the UVS-Caieiras landfill.

combustion gas engines and to the set of 4 high temperature enclosed flares) as follows:

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

Where:

$F_{CH4,EL,y}$ Amount of methane which is destroyed through combustion of collected LFG in the internal combustion gas engines (in $tCH_4$). Details for the determination of every-minute values for $F_{CH4,EL,y}$ are presented below (under "*Determination of every-minute values for the calculation parameters $F_{CH4,sent\_flare,y}$ and $F_{CH4,EL,y}$*"). It is relevant to note that for the particular context of determination of $F_{CH4,BL,y}$, the working hours and/or other status/conditions of which each device and status of the internal combustion gas engines are not accounted, thus potentially maximizing the determined value for $F_{CH4,BL,y}$ as a conservative approach.

$F_{CH4,sent,flare,y}$ Amount of methane in the LFG which is sent to the flares (in $tCH_4$). 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 parameters $F_{CH4,sent\_flare,y}$ and $F_{CH4,EL,y}$*").

For the considered monitoring period, the accumulated value for $F_{CH4,BL,y}$ is calculated as 8,280 $tCH_4$.

$F_{CH4,PJ,y}$ Amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices (in $tCH_4$). $F_{CH4,PJ,y}$ is determined as follows:

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

Where:

$F_{CH4,EL,y}$ Amount of methane which is destroyed through combustion of collected LFG in the internal combustion gas engines (in $tCH_4$). Details for the determination of every-minute values for $F_{CH4,EL,y}$ for each individual internal combustion gas engine during the are presented below (under "*Determination of every-minute values for the calculation parameters $F_{CH4,sent\_flare,y}$ and $F_{CH4,EL,y}$*").

$F_{CH4,flared,y}$ Amount of methane which is destroyed through combustion of collected LFG in the flares (in $tCH_4$). In accordance with calculation guidance included in the PDD and by following applicable guidance of the methodological

tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0), 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 flare and residual methane emissions from combustion of LFG in the flare, 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 parameters $F_{CH4,sent\_flare,y}$ and $F_{CH4,EL,y}$*"). |
| $PE_{flare,y}$ | 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 $PE_{flare,y}$*"). |
| $GWP_{CH4}$ | 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. |

*Determination of $F_{CH4,sent\_flare,y}$ (calculation of sub-parameters $F_{CH4,sent\_flare,flare-1}$, $F_{CH4,sent\_flare,flare-2}$, $F_{CH4,sent\_flare,flare-3}$ and $F_{CH4,sent\_flare,flare-4}$):*

By following calculation Option C of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0)[19], the mass flow of greenhouse gas *i* ($F_{i,t}$) (*i* = $CH_4$) for each installed flare is determined as follows:

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

[19] For the considered monitoring period, Option C of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0) (where the gaseous stream the tool shall be applied to is the stream of collected LFG that is sent to the flares and to the electricity generation facility)[19] is the selected option for determination of values of $F_{CH4,sent\_flare,y}$ valid for each one of the installed 4 flares (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 $F_{CH4,sent\_flare,y,flare-4}$) and values of $F_{CH4,EL,y}$ valid for each one of the 21 internal combustion gas engines (based on the calculation of the sub-parameters $F_{CH4,EL,y,engine-1}$, $F_{CH4,EL,y,engine-2}$, (…) , $F_{CH4,EL,y,\ engine-21}$). This option represents one of the applicable calculation methods the PDD refers to. The PDD states the following regarding the calculation approach for values of $F_{CH4,sent\_flare,y}$ and $F_{CH4,EL,y}$:

> "*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.*"

Where:

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

$V_{t,n,wb,flare-n}$ 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 $V_{t,wb,flare-n}$ valid for each flare (calculation sub-parameters $V_{t,wb,flare-1}$, $V_{t,wb,flare-2}$, $V_{t,wb,flare-3}$ and $V_{t,wb,flare-4}$) are directly measured and reported (in Nm³ wet gas/h) in the monthly emission reduction calculation spreadsheets valid for the considered monitoring period (and enclosed to this Monitoring Report).

By taking into account that in the particular case of the project activity, during the considered monitoring period, measurements of volumetric flow of the gaseous stream (LFG) valid for each one of the 4 flares are already performed in Nm³ wet gas per hour (by considering standard temperature and pressure (STP) conditions), the following assumption is valid:

$V_{t,n,wb,flare-n}$ is equivalent 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), with monitoring details being presented in Section D.2

Note: in accordance with the PDD, since measurements of LFG flow to each one of the flares are automatically performed and recorded in normalized cubic meters (by considering standard temperature and pressure (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 to be considered for the determination of $V_{t,n,wb,flare-n}$.

$v_{CH4,t,wb}$ 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 m³ of $CH_4$ / m³ 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 PDD.

$T_n$ 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 PDD.

$MM_i$ 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 PDD.

$R_u$ 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 PDD.

$\rho_{CH4,n}$ is calculated as 0.7156650 kgCH$_4$ / m$^3$CH$_4$ 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 $F_{CH4,EL,y}$ (calculation sub-parameters $F_{CH4,EL,y,engine-1}$, $F_{CH4,EL,y,engine-2}$, (…), $F_{CH4,EL,y,engine-21}$):*

By also following calculation Option C of of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0), the mass flow of greenhouse gas *i* ($F_{i,t}$) (*i* = $CH_4$) to each individual internal combustion gas engine ($F_{CH4,EL,y,engine-1}$, $F_{CH4,EL,y,engine-2}$, (…), $F_{CH4,EL,y,engine-21}$) is determined as follows:

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

Where:

*n* Number of the installed internal combustion gas engines *n* (additional/alternative methane destruction devices for the project activity) = 1, 2, …, 21.

$V_{t,,wb,n,engine-n}$ Volumetric flow of the gaseous stream (LFG) to the internal combustion gas engine *n* in time interval *t* on a wet basis at normal conditions. For the considered monitoring period, every-minute values of $V_{t,wb,n.engine-n}$ (calculation sub-parameters $V_{t,wb,n,engine-1}$, $V_{t,wb,n,engine-2}$, (…), $V_{t,wb,n,engine-21}$) are reported (in Nm$^3$ wet gas/h) in the monthly emission reduction calculation spreadsheets valid for the considered monitoring period (and enclosed to the Monitoring Report).

While in the particular case of the project activity, during the considered monitoring period, measurements of volumetric flow of the gaseous stream (LFG) sent to each one of the 21 engines are not processed and recorded in $Nm^3$ of wet gas/h (normal conditions), values of values of $V_{t,wb,n,engine-n}$ (calculation sub-parameters $V_{t,wb,n,engine-1}$, $V_{t,wb,n,engine-2}$, (…), $V_{t,wb,n,engine-21}$) valid for each minute encompassed by the 181-day monitoring period are thus calculated in a separated spreadsheet[20] (that is also enclosed to this Monitoring Report) as follows:

Under conformance with related provisions of the PDD, the following equation is applied to convert every-minute records of measurements of volumetric flow of LFG sent to each one of the 21 internal combustion gas engines from actual conditions to normalized (standard) conditions of temperature and pressure:

$$V_{t,wb,n,engine-n} = V_{t,wb,engine-n} * (T_n / T_{t,engine-n}) * (P_{t,engine-n} * P_n)$$

Where:

| | |
|---|---|
| $V_{t,wb,engine-n}$ | Volumetric flow of the gaseous stream (LFG) to the engine *n* in time interval *t* on a wet basis at actual conditions. Every-minute measurement records of $V_{t,wb,engine-n}$ for each engine *n* (where *n* = 1, 2, (…), 21) valid for the whole considered monitoring period are reported (in $m^3$ wet gas/h) in a separated reduction calculation spreadsheet which is enclosed to the Monitoring Report. Measurement records are presented under sub-parameters $V_{t,wb,engine-1}$, $V_{t,wb,engine-2}$ , $V_{t,wb,engine-3}$, (…), $V_{t,wb,engine-21}$). Further monitoring details for the sub-parameters $V_{t,wb,engine-n}$ (*n* = 1, 2, 3, (…), 21) are included under details for the monitoring parameter $V_{t,wb,j,}$ in Section D.2. |
| $T_{t,engine-n}$ | Temperature of the gaseous stream in time interval *t*. Every-minute values of $T_{t,engine-n}$ for each engine *n* (where *n* = 1, 2, (…), 21) are reported (in Kelvin) in the monthly emission reduction calculation spreadsheets enclosed to the Monitoring Report. Further monitoring details about the sub-parameters $T_{t,engine-n}$ are included under details for the monitoring parameter $T_t$ in Section D.2. |
| $T_n$ | 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 PDD. |
| $P_{t,engine-n}$ | Pressure of the gaseous stream in time interval *t*. Every-minute values of $P_{t,engine-n}$ for each engine *n* are reported (in Pa) in the monthly emission reduction calculation spreadsheets enclosed to the Monitoring Report. Further monitoring details about the sub-parameters $P_{t,engine-n}$ are included under details for the monitoring parameter $P_t$ in Section D.2. |
| $P_n$ | 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 PDD. |

[20] In order to avoid having each one of the 6 MS-Excel monthly emission reduction spreadsheets with very high file size (i.e. exceeding 150 MB), the calculation of every-minute value of $V_{t,n,wb,engine-n}$ (under normalized (standard) conditions of temperature and pressure) valid for the whole considered monitoring period is made in a separated calculation spreadsheet. As part of the monitoring and emission reduction calculation procedure applied for the project activity, calculated values for $V_{t,n,wb,engine-n}$ (where n = 1, 2, (…), 21) (as reported in the separated calculation spreadsheet) are thus considered in the monthly emission reduction calculation spreadsheet.

*n* — Number of the installed internal combustion gas engines *n* (additional/alternative methane destruction devices for the project activity) = 1, 2, …, 21.

All related calculation are presented in the monthly emission reduction calculation spreadsheets that are enclosed to the Monitoring Report.

$v_{CH4,t,wb}$ — Volumetric fraction of $CH_4$ in the gaseous stream in time interval *t* on a wet basis. Further monitoring details about the monitoring parameter $v_{CH4,t,wb}$ are included above and in Section D.2.

$\rho_{CH4,n}$ — Density of $CH_4$ in the gaseous stream (LFG) at normal conditions. $\rho_{CH4,n}$ is calculated as 0.7156650 kgCH$_4$ / m$^3$CH$_4$ as reported in the monthly emission reduction calculation spreadsheet valid for the considered monitoring period. Details about the determination of $\rho_{CH4,n}$ are presented above.

It is relevant to note that, as established in the PDD and presented in the monthly emission reduction calculation spreadsheets, for each one of the 21 internal combustion gas engine, the calculated amount of methane destroyed for minute *m* for a particular gas engine is directly accounted as 0 (zero) if the such methane destruction device is monitored as "not working" in such minute *m* (on the basis of available every-minute records for the parameter $Op_{j,h}$ (sub-parameters $Op_{engine-1,h}$ , $Op_{engine-2,h}$ , (…), $Op_{engine-21,h}$ ).

<u>*Determination of $PE_{flare,y}$:*</u>

$PE_{flare,y}$ 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). For the considered monitoring period, 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 actually 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 ($\eta_{flare,m}$) for each one of the flares as follows:

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

Where:

$\eta_{flare,m}$ — Flare efficiency in minute m. Details for the determination of applicable values of $\eta_{flare,m}$ during the considered monitoring period are presented below under "*Determination of every-minute values of* $\eta_{flare,m,flare-1}$, $\eta_{flare,m,flare-2}$, $\eta_{flare,m,flare-3}$ and $\eta_{flare,m,flare-4}$ *(Flare 1, Flare 2, Flare 3 and Flare 4)".*

$F_{CH4,RG,m}$ — 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 $F_{CH4,sent\_flare,y,flare-4}$)).

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 methodological tool "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) at normal conditions. As per Option B of the applicable methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0), the volumetric flow of the gaseous stream on a dry basis for each flare at normal conditions (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 "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 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 "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 "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 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 "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 [21]:

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

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 PDD.

$P_t$ Absolute pressure of the gaseous stream in time interval

[21] 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.

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

*Determination of every-minute values of* $\eta_{flare,m,flare-1}$, $\eta_{flare,m,flare-2}$, $\eta_{flare,m,flare-3}$ and $\eta_{flare,m,flare-4}$ *(Flare 1, Flare 2, Flare 3 and Flare 4):*

*Flare 2 and Flare 4:*

For the particular case of Flare 2 and Flare 4, values of $\eta_{flare,m}$ valid for each flare are calculated based on performed measurements of methane in the exhaust gas of the flare in question 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 Flare 2 and Flare 4 by directly 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 for Flare 2 and Flare 4 ($\eta_{flare,calc,m,flare-2}$ and $\eta_{flare,calc,m,flare-4}$), 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 for Flare 2 and Flare 4, 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 for Flare 2 and Flare 4 as per appropriate national or international standard during 2 sets of measurement events. 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 for each flare by the third party inspection service company "Merieux NutriSciences" / "Bioagri Ambiental Ltda.", which is an inspection service company 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.

$F_{CH4,RG,t}$ 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 for Flare 2 and Flare 4 (calculation sub-parameters $F_{CH4,RG,t,flare-1}$, $F_{CH4,RG,t,flare-2}$ 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 = 2 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 flares 2 and 4 (calculation sub-parameters $V_{t,db,n,flare-2}$ and $V_{t,db,n,flare-3}$) 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 [22]:

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

Where:

[22] 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.

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

<u>*Flare 1 and Flare 3:*</u>

For the particular case of Flare 1 and Flare 3, the reference default value of $\eta_{flare,m}$ is directly considered as per Option A (Default value) of the methodological tool "Project emissions from flaring" from which the following related guidance of the PDD is applied:

> *"(…)*
> *Option A: Default value*
> *For each one of the high temperature enclosed flares installed as part of the project activity, the flare efficiency for each minute m ($\eta_{flare,m}$) is 90% when the following two operational conditions/requirements are simultaneously met (in order to demonstrate that the flare is operating as per the recommendations and requirements set by the equipment manufacturer for the minute m in question):*
>
> *(1) The temperature of the exhaust gases o the flare (monitoring parameter $T_{EG.m}$) and the flow rate of LFG to the flare (monitoring parameter $F_{RG,m}$) is within the manufacturer's specification/requirements for the flare (monitoring parameter $SPEC_{flare}$) in minute m;*
>
> *(2) Flame is detected in the flare in minute m (monitoring parameter $Flame_m$).*
>
> *If for the minute m, conditions (1) and/or (2) are not met, $\eta_{flare,m}$ is set as 0% for the minute in question.*
> *(…)"*

In applying Option A, for every minute *m* within the considered monitoring period, $\eta_{flare,m}$ = 0.90 (90%) (upon demonstration of full compliance with operational and maintenance requirements for the flare) or 0% (in case full compliance with operational and maintenance requirements for the flare in question is not demonstrated). As defined by the *ex-ante*

determined parameter “Manufacturer’s flare specifications for temperature, flow rate and maintenance schedule interval” ($SPEC_{flare}$), compliance with operational temperature range, flow rate range and required maintenance schedule interval is considered for the determination of the selected default value of $\eta_{flare,m}$ for the determination of $F_{CH4,flared,y}$ and its application along every minute *m* the considered monitoring period. The selection and application of the default value for $\eta_{flare,m}$ (90% or 0%) for each minute *m* of the considered monitoring period is presented in the monthly emission reduction calculation spreadsheets. Since Flare 1 and Flare 3 were not under operational status during the whole considered monitoring period [23], no collected LFG was combusted by these particular flares, compliance with operational and maintenance requirements for the flares in question is thus directly assumed/derived as not demonstrated and $\eta_{flare,m}$ is thus selected as 0% for all every-minute time instants within the considered monitoring period.

In summary, for the considered monitoring period, the values of $\eta_{flare,m}$ obtained for Flare 1, Flare 2, Flare 3 and Flare 4 are summarized below:

| Determined (calculated) reference values for $\eta_{flare,m}$ for the considered monitoring period | Flare 1 ($\eta_{flare,m,flare-1}$) | Flare 2 ($\eta_{flare,m,flare-2}$) | Flare 3 ($\eta_{flare,m,flare-3}$) | Flare 4 ($\eta_{flare,m,flare-4}$) |
|---|---|---|---|---|
| | 0 | 0.9996001 | 0 [24] | 0.9999613 |

*Confirmation/validation of the application of determined values of $\eta_{flare,m,flare-1}$, $\eta_{flare,m,flare-2}$, $\eta_{flare,m,flare-3}$ and $\eta_{flare,m,flare-4}$ for every minute of the considered monitoring period:*

It is relevant to note that, as data records for the monitoring parameter “Flame detection of flare in the minute *m*” ($Flame_m$) are also considered for the confirmation of the application of the reference values of $\eta_{flare,m}$ for the determination of values of $F_{CH4,flared,y}$ along the considered monitoring period for every minute “*m*” of the considered monitoring period. For each installed flare, the time the flare has operated is determined by monitoring for every single minute “*m*” the flame combustion status/condition in each flare through status records of individual UV flame detectors installed in each flare (of which status signal (flame status “*on*” or “*off*”) is continuously recorded and reported). It is also relevant to note that 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 effectively considered in the context of the application of the reference values for $\eta_{flare,m}$ for Flare 1, Flare 2, Flare

[23] The non-operation of Flare 1 and Flare 3 during the whole considered monitoring period is demonstrated inter alia through available data records for the monitoring parameter “Flame detection of flare in the minute *m*” ($Flame_m$). As explained in Section D.2, “off” value based on performed measurements for $Flame_{m,flare-1}$ and $Flame_{m,flare-3}$ are reported for every single minute of the whole monitoring period in the set of monthly emission reduction spreadsheets valid for the considered monitoring period.

[24] Since Flare 1 and Flare 3 were not under operational status under the whole considered monitoring period, there is not a single minute within the considered monitoring period in which the reference 90% default value for $\eta_{flare,m}$ was applied.

3 and Flare 4 for every minute *"m"* of the considered monitoring period. As outlined in the monthly emission reduction spreadsheets, for each minute *"m"* of the considered monitoring period in which the given flare has combusted LFG by not operating in accordance with all 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), the 0% value is directly applied for $\eta_{flare,m}$ and no destruction of methane is therefore accounted for the flare in question during the minute *m* as part of the calculation value of $F_{CH4,flared,y}$.

For the considered monitoring period, the accumulated value for $F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$ is calculated as 31,331 $tCH_4$.

For the considered monitoring period, baseline emissions of methane from the SWDS ($BE_y = BE_{CH4,y}$) are calculated as 743,648 $tCO_2e$. 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 removals

>>

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

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

Where:

| | |
|---|---|
| $PE_{EC,y}$ | Project emissions from consumption of electricity due to the project activity ($tCO_2$/yr) |
| $PE_{FC,y}$ | Project emissions from consumption of fossil fuels due to the project activity (for purpose other than electricity generation) ($tCO_2$/yr). |

*Project emissions due to the consumption of electricity by the project activity ($PE_{EC,y}$):*

During the considered monitoring period, the electricity demand of the project activity was entirely met by electricity which is regarded as grid-sourced electricity[25].

While grid-sourced electricity and electricity generated by the backup captive off-grid electricity generator (fuelled by diesel) represent the sources of electricity consumed by the project activity, $PE_{EC,y}$ is thus calculated as follows:

[25] Under conformance with project design description outlined in the PDD, during the considered monitoring period, the project activity consumed only electricity sourced by the grid-connected electricity generation infrastructure fuelled by LFG (of which the set of 21 internal combustion engines (project's methane destruction devices) represents major components) and grid-sourced electricity (during periods when the grid-connected electricity generation was not under operation, but supply of grid-sourced electricity was normal). As defined in the PDD, since emission reductions due to displacement of a more-GHG-intensive service (due to generation of electricity using collected LFG as fuel) are not eligible and/or claimable for the project activity, all consumption by the project activity of electricity generated by the grid-connected electricity generation infrastructure fuelled by LFG located within the geographical limits of the UVS – Caieiras landfill is to be regarded and accounted as consumption of grid-sourced electricity (with related project emissions being determined ex-post) as a conservative approach.

$PE_{EC,y} = PE_{EC,grid,y} + PE_{EC,captive,y}$

Where:

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

$PE_{EC,captive,y}$ Project emissions from consumption of electricity generated by a captive off-grid electricity generator fuelled by fossil fuel (diesel)

For the considered monitoring period, $PE_{EC,grid,y}$ and $PE_{EC,captive,y}$ are determined as follows:

*(i) <u>Project emissions due to the consumption of grid-sourced electricity by the project activity ($PE_{EC,grid,y}$):</u>*

By directly applying applicable guidance of the methodological tool “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01), project emissions due to the consumption of grid-sourced electricity by the project activity ($PE_{EC,grid,y}$) are calculated as follows:

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

Where:

$TDL_{grid,y}$ Average technical transmission and distribution losses for grid-sourced electricity consumed by the project activity in year *y.* As per applied monitoring procedure, the value for $TDL_{grid,y}$ is determined 20%. Further details about the ex-post determination of the value for $TDL_{grid,y}$ are included in Section D.2.

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

| Month | Amount of electricity regarded as supplied by the grid consumed by the project activity (MWh) |
|---|---|
| Jul./2019 | 265 |
| Aug./2019 | 199 |
| Sep./2019 | 274 |
| Oct./2019 | 332 |
| Nov./2019 | 255 |
| Dec./2019 | 219 |

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

$EF_{EL,grid,y}$ Emission factor for grid sourced electricity in year *y.* By taking into account the source of electricity to be consumed by the project activity (gird-sourced electricity and electricity sourced by backup captive off-grid electricity generator (fuelled by diesel)), the PDD defines that the project activity fits under Scenario C with Case C.III of the methodological tool “Tool to calculate baseline, project and/or leakage emissions from electricity consumption” (version 01) and the following generic approach is thus defined as applicable for the determination of $EF_{EL,grid}$:

> *"Where case C.III has been identified, as a conservative simple approach, the emission factor for electricity generation should be the more conservative value between the emission factor determined as per guidance for scenario A and B respectively. This means that the more conservative value should be chosen between a) the result of applying either option A1 or A2 and b) the result of applying either option B1 or B2."*

The PDD also includes the following disclaimer:

> *"(…) Within a specific monitoring period along the 2nd 7-year crediting period, in case it is confirmed that the installed backup captive off-grid electricity generator (fuelled by diesel) was not used during the period in question, project emissions due to the consumption of electricity from such backup captive generator will thus directly be determined as null/zero and, under this circumstance, Case C.I (Grid Electricity) may be considered as an alternative for the ex-post determination of project emissions due to consumption of grid-sourced electricity by the project activity within such period under Scenario C (with direct application of option A1 or A2 of the methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 1) for the ex-post determination of $EF_{EL,grid,y}$ as established by guidance of tool for Case C.I)."*

While the installed backup captive off-grid electricity generator (fuelled by diesel) was not used during the considered monitoring period, the above-quoted guidance is regarded as applicable and Option A1 and Option A2 are thus directly selected and applied for the determination of $EF_{EL,grid,y}$ as follows with the most conservative (higher) value being chosen:

*Determination of $EF_{EL,grid,y}$ as per Option A1:*
Under Option A1, $EF_{EL,grid,y}$ is selected as the combined margin (CM) emission factor ($EF_{grid,CM,y}$) for year 2019 which is calculated as per applicable guidance of the methodological tool "Tool to calculate the emission factor for an electricity system" (version 04.0) as the weighted average of the operating margin and build margin emission factors. To weight these two factors, the default values applicable to both weighting factor as valid 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 PDD. |
| $w_{BM}$ | 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 PDD. |
| $EF_{grid,OM,y}$ | Operating margin $CO_2$ emission factor in year *y*. $EF_{grid,OM,y}$ is ex-post determined as 0.5181 $tCO_2$/MWh.The selected value for the monitoring parameter $EF_{grid,OM,y}$ represents the official average monthly values for year 2019 as calculated and published by the |

DNA of Brazil. Further details about the monitoring parameter $EF_{grid,OM,y}$ are included in Section D.2.

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

As presented in the summarized emission reduction calculation spreadsheet which is also enclosed to this Monitoring Report, under Option A1, for the considered monitoring period, $EF_{grid,CM,y}$ is calculated as 0.5181 $tCO_2/MWh$.

*Determination of $EF_{EL,grid,y}$ as per Option A2:*
Under Option A2, $EF_{EL,grid,y}$ is directly determined as 1.3 $tCO_2/MWh$ (applicable conservative default value as per methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"). Further details for the ex-ante selected value of $EF_{EL,grid,y}$ under Option A2 is made available in Section D.1 and in the PDD.

Since 1.3 $tCO_2/MWh$ represents the most conservative (higher) value for $EF_{EL,grid,y}$ under Option A1 (when compared to all the annual average value for year 2018) and value selected under Option A2, this value is thus selected as the applicable value of $EF_{EL,grid,y}$ for the whole considered monitoring period.

For the considered monitoring period, the accumulated value of $PE_{EC,grid,y}$ is thus calculated as follows:

$PE_{EC,grid,y}$ = 1,544 MWh * 1.3 * (1 + 20%) = 2,409 $tCO_2$ (rounded value)

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

*(ii)* *<u>Project emissions due to the consumption of electricity sourced by backup captive off-grid electricity generator (fuelled by diesel) ($PE_{EC,captive,y}$):</u>*

While the installed backup captive off-grid electricity generator (fuelled by diesel) was not used during the considered monitoring period and no consumption by the project activity of electricity sourced by such captive power generation source thus occurred, $PE_{EC,captive,y}$ is thus directly determined as being null (zero). Further details are included in Section D.2 under monitoring details for the parameter "Quantity of electricity generated in captive diesel backup generator during the year y" ($EC_{PJ,captive,y}$) = Quantity of electricity generated in captive diesel backup generator during the year y ($EG_{Diesel-Generator,y}$) and under monitoring details for the parameter "Quantity of fuel diesel combusted by the captive off-grid electricity generator" ($FC_{Diesel,y}$).

Total project emissions due to the consumption of electricity by the project activity ($PE_{EC,y}$) for the considered monitoring period are calculated as $PE_{EC,grid,y}$ + $PE_{EC,captive,y}$ and represents 1,955 $tCO_2$ (rounded value).

*<u>Project emissions from consumption of fossil fuels due to the project activity (for purpose other than electricity generation) ($PE_{FC,y}$):</u>*

During the considered monitoring period relatively low amount of Liquefied Petroleum Gas (LPG) was consumed for igniting project's high temperature enclosed flares. By following related provisions in the PDD, project emissions associated with consumption of fossil fuel (for purposes other than electricity generation) ($PE_{EC,y}$) are determined as follows:

$PE_{FC,y} = PE_{LPG,y}$

Where:

$PE_{LPG,y}$ Project emissions due to the consumption of Liquefied Petroleum Gas by the project activity in year y (in $tCO_2$/year). By directly applying valid guidance of the methodological tool "Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion" (version 02) and under conformance with the PDD, $PE_{LPG,y}$ is determined 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 180 kg (0.180 ton) of LPG. Additional monitoring details for the monitoring parameter $FC_{LPG,y}$ are included in Section D.2.

$COEF_{LPG,y}$ $CO_2$ emission coefficient for LPG. As established in the PDD, $COEF_{LPG,y}$ is determined by following applicable guidance of Option B of the methodological tool "Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion" (version 02) as follows:

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

Where:

$NCV_{LPG,y}$ Net calorific value of the fuel LPG (in GJ/ton LPG)

$EF_{CO2,LPG,y}$ $CO_2$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 determination of 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:

$PE_{LPG,y}$ = 0.180 ton LPG * 3.05 $tCO_2$/ton LPG = 1 $tCO_2$ (rounded value).

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 the accumulated value of $PE_{LPG,y}$ for the considered monitoring period.

In summary, total project emissions ($PE_y$) for the considered monitoring period are calculated as $PE_{EC,y}$ + $PE_{LPG,y}$ and represents 2,410 $tCO_2$ (rounded value).

### E.3. Calculation of leakage emissions

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Not applicable.

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

Emission reductions achieved by the project activity during the considered monitoring period are determined as the difference between accumulated total values for baseline emissions ($BE_y$) and project emissions ($PE_y$) which are determined for such period as presented in Section E.1 and E.2 respectively.

During the considered monitoring period, achieved emission reductions are calculated and reported as follows:

| | Baseline GHG emissions or baseline net GHG removals (t $CO_2$e) | Project GHG emissions or actual net GHG removals (t $CO_2$e) | Leakage GHG emissions (t $CO_2$e) | GHG emission reductions or net anthropogenic GHG removals (t $CO_2$e) | | |
|---|---|---|---|---|---|---|
| | | | | Before 01/01/2013 | From 01/01/2013 | Total amount |
| **Total** | 743,648 | 2,410 | - | - | 741,238 | 741,238 |

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

| Amount achieved during this monitoring period (t $CO_2$e) | Amount estimated ex ante for this monitoring period in the PDD (t $CO_2$e) |
|---|---|
| 741,238 | 683,801 |

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

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The 683,801 $tCO_2$e value is calculated as the share of the previously determined ex-ante estimates of emission reductions valid for year 2019 which is equivalent to the considered monitoring period encompassing 184-day length within year 2019. The value of ex-ante estimation of emission reductions as per the PDD that is valid/equivalent for the considered monitoring period is calculated as 1,356,453 $tCO_2$e * 184 / 365.

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

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Achieved emission reductions by the project activity during the considered monitoring period are about ~8% higher than the calculated equivalent value of ex-ante estimation of emission reductions valid for the same period (encompassing 184 days within year 2019) as per the PDD.

The following aspect justifies and explains the relative difference between the value for ex-ante estimation of emission reductions as per the PDD (calculated as valid/equivalent for the considered monitoring period) and emission reductions actually achieved by the project activity during the considered monitoring period:

<u>Aspect/condition which represents an increase 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:</u>

- *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 UVS - Caieiras landfill and collected by the project activity was derived by applying the First Order Decay (FOD) model as per the methodological tool “Emissions from Solid Waste Disposal Sites” (version 08.0) in the context of the determination of ex-ante estimated emission reductions to be achieved during the 2$^{nd}$ 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 slightly underestimated the amount of LFG to be actually generated and collected by the project activity.

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

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Not applicable.

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## Document information

| *Version* | *Date* | *Description* |
|---|---|---|
| 07.0 | 31 May 2019 | Revision to:<br>• Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN);<br>• Add a section on remarks on the observance of the scale limit of small-scale project activity during the crediting period;<br>• Add "changes specific to afforestation or reforestation project activity" as a possible post-registration changes;<br>• Clarify the reporting of net anthropogenic GHG removals for A/R project activities between two commitment periods;<br>• Make editorial improvements. |
| 06.0 | 7 June 2017 | Revision to:<br>• Ensure consistency with version 01.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN);<br>• Make editorial improvements. |
| 05.1 | 4 May 2015 | Editorial revision to correct version numbering. |
| 05.0 | 1 April 2015 | Revisions to:<br>• Include provisions related to delayed submission of a monitoring plan;<br>• Provisions related to the Host Party;<br>• Remove reference to programme of activities;<br>• Overall editorial improvement. |
| 04.0 | 25 June 2014 | Revisions to:<br>• Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0));<br>• Include provisions related to standardized baselines;<br>• Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1;<br>• Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*;<br>• Editorial improvement. |
| 03.2 | 5 November 2013 | Editorial revision to correct table in page 1. |
| 03.1 | 2 January 2013 | Editorial revision to correct table in section E.5. |
| 03.0 | 3 December 2012 | Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, Annex 11). |
| 02.0 | 13 March 2012 | Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20). |

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

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