Project design document form
(Version 11.0)

BASIC INFORMATION	
Title of the project activity	Salvador da Bahia Landfill Gas Management Project
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	16.0
Completion date of the PDD	22/01/2020
Project participants	Battre - Bahia Transferencia e Tratamento de Residuos Ltda. BELEKTRON d.o.o.
Host Party	Brazil
Applied methodologies and standardized baselines	ACM0001 - “Flaring or use of landfill gas” (version 19.0)
Sectoral scopes	13 - Waste handling and disposal
Estimated amount of annual average GHG emission reductions	612,777 tCO_2e per year

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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<u>*Summarized description of the project activity:*</u>

The registered CDM project activity “Salvador da Bahia Landfill Gas Management Project” promotes methane destruction through collection and combustion of landfill gas (LFG) at the Aterro Metropolitano Central landfill (AMC landfill)[1]. As per its current project design configuration, combustion of collected LFG occurs in the following methane destruction devices:

- Set of high temperature enclosed flares
- Set of 19 internal combustion gas engines (which since 01/01/2011 represents, at the same time, (i) additional/alternative methane destruction devices for the project activity and (ii) the major components for grid-connected electricity generation infrastructure which is entirely fuelled by LFG), has combined nameplate installed capacity of 20.1 MW and has been under operation within the geographical limits of the AMC landfill also since 01/01/2011).

LFG (rich in methane (CH_4)) has been historically generated at the AMC landfill as a result of anaerobic decomposition of municipal solid waste (MSW) disposed in this solid waste disposal site (SWDS). By promoting effective and efficient collection and combustion of LFG at the AMC landfill, the project activity thus promotes real and measureable greenhouse gas (GHG) emission reductions through destruction of methane in the project’s methane destruction devices.

It is assumed that, in the absence of the project activity, methane would otherwise be directly emitted into the atmosphere.

The AMC landfill is operated by the solid waste management company and host-country project participant Battre - Bahia Transferencia e Tratamento de Resíduos Ltda[2]. This landfill site is located in the Municipality of Lauro de Freitas, Bahia State, in the Northeast region of Brazil.

It is relevant to note that, due to the reasons and aspects further explained in Section A.3, the CDM project activity under its current design configuration does not encompass electricity generation (using LFG as renewable energy source) as an additional GHG abatement/mitigation measure despite the fact since 01/01/2011 the project design encompasses combustion of LFG in a set of 19 internal combustion gas engines (which represents major components of a electricity generation infrastructure located within the geographical limits of the AMC landfill). By taking into account the project design, no emission reductions associated to generation of electricity in such grid-connected 20.1 MW electricity generation infrastructure will be accounted as part of the operation of the project activity during its 3rd 7-year crediting period.

The only type of GHG abatement/mitigation action encompassed by the CDM project activity “Salvador da Bahia Landfill Gas Management Project” is destruction of methane. No emission reductions due to displacement of a more-GHG-intensive service (due to generation of electricity using collected LFG as fuel) are thus eligible or claimable for the project activity.

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[1] The landfill name “*Aterro Metropolitano Central*” is translated into English language as “*Central Metropolitan Landfill*”.

[2] The name of the host-country project participant was updated at UNFCCC in August/2019 from “Bahia Transferencia e Tratamento de Residuos S.A.” to “Battre - Bahia Transferencia e Tratamento de Resíduos Ltda.” as outlined in the updated version of the following documents valid for the project activity:

- completed Modalities of Communication (MoC) form

- Letter of Approval (LoA) issued by the DNA of Brazil

This occurred change correct reflects the previously occurred and required change in the registration name of the company as a result of occurred change in its statutory and shareholder organizational structure.

By encompassing methane destruction as its unique GHG abatement/mitigation measure, the project activity promotes real and measureable greenhouse gas (GHG) emission reductions through the following measures:

- Combustion of LFG rich in methane (CH_4) (that would otherwise be directly emitted into the atmosphere (in the absence of the project activity) in a set of high temperature enclosed flares and a set of 19 internal combustion gas engines (which represents the major components of a grid-connected 20.1 MW electricity generation infrastructure also located within the geographical limits of the AMC landfill).

The AMC landfill serves as final and permanent disposal site for all municipal solid waste (MSW) that is generated and collected in the city of Salvador (capital of Bahia State), Lauro de Freitas and Simões Filho.

The AMC landfill was built in 1997 and has employed *state-of-the-art* waste landfilling technics and operational management since its start of operations. In the absence of the CDM project activity (that was commissioned under its initial and not any longer valid design configuration in the late end of year 2003), no efficient management of LFG would occur[3].

The project activity encompasses the installation of all equipment and instruments that are required to promote LFG collection, LFG destruction (through controlled and efficient combustion in a set of 3 high temperature enclosed flares and a set 19 internal combustion gas engines) and related required measurement/monitoring at the AMC landfill.

LFG collection equipment currently installed as part of the project activity also includes a set of vertical LFG collecting wells (which are interconnected through a LFG pipeline network made of High Density Polyethylene (HDPE) pipes, manifolds and connecting parts). Through the LFG pipeline network, all collected LFG is directed to the project’s LFG flaring infrastructure (for combustion in enclosed a set of high temperature enclosed flares and set of 19 internal combustion gas engines) as part of the operation of the project activity.
Under normal circumstances the operation strategy for the project activity has prioritized the combustion of collected LFG under controlled and efficient conditions in the set of 19 internal combustion gas engines, with excess of collected LFG being sent to the set of flares.

As a result of the implementation of the project activity, the operation and management of the AMC landfill has not changed when compared to the situation prior to the implementation of the project activity and it is not expected to change during the time period encompassed by the 3rd 7-year renewable crediting period of the project activity either.

The scenario in the absence of the project activity (baseline scenario) represents largest share of LFG generated at the AMC landfill (with high content of methane) being freely emitted into the atmosphere without any treatment, collection, combustion or control. Under the baseline scenario, it is however assumed that a small share of generated LFG would be combusted in conventional

[3] As further explained and justified in Section B.6.1, it is acknowledged that a very small fraction of methane generated at the AMC landfill would need to be destroyed through combustion in the absence of project activity (baseline scenario). While no LFG collection and combustion infrastructure was ever built and put into operation at the AMC landfill prior of January 2004 (which is the date when the project activity was commissioned and started to operate), in order to have minor share of generated LFG (rich in methane) being combusted (under a level sufficient to meet the existing contractual requirement that defines the minimum level/share of methane required to be destroyed at the AMC landfill (as established by the Administration of Municipality of Salvador (competent municipal authority)), gradual implementation and use of conventional LFG venting/combustion drains is regarded as a need under the baseline scenario. By assuming such still valid contractual requirement as a requirement that in the absence of the project activity would be met as part of the operation of the AMC landfill along the baseline scenario, destruction a level/share of generated methane (that is defined as 5% of the total amount of LFG collected by the project activity) would thus occur in the absence of the project through the utilization of conventional LFG venting/combustion drains that would otherwise be gradually implemented and that would operate along the whole baseline scenario (within the expected landfill lifetime).

passive LFG venting/combustion drains that would otherwise be gradually[4] implemented at the AMC landfill and would be used for meeting the still valid contractual requirement that defines the minimum level/share of methane required to be destroyed at the landfill (as previously established by the Administration of the Municipality of Salvador (municipal authority)).

The AMC landfill was granted in 2009 with an operation license (environmental permit) valid until 30/12/2015. This permit was issued by the local environmental authority named Instituto do Meio Ambiente e Recusos Hídricos - INEMA (Bahia State Environmental Agency). On 09/08/2014 the AMC landfill was granted by INEMA with the renewal of the previously issued operational license (environmental permit). Like the previously issued environmental permit, the most recently issued environmental permit also encompasses the operation of the electricity generation infrastructure.

Box 1 – Pioneer design and implementation aspects of the project activity "Salvador da Bahia Landfill Gas Management Project" within the early stages of the CDM

The project activity "Salvador da Bahia Landfill Gas Management Project" was one of the first GHG emission reduction initiatives ever proposed under the framework of the CDM worldwide. The compilation of the initial version of the PDD for the "Salvador da Bahia Landfill Gas Management Project" valid for its already expired 1st 7-year renewable crediting period applying at that time the CDM baseline and monitoring methodology AM0002 represented one of the first initiatives worldwide related to the development of a PDD and a baseline methodology under the CDM. The originally applied CDM baseline and monitoring methodology AM0002 – "*Greenhouse Gas Emission Reductions through Landfill Gas Capture and Flaring where the Baseline is established by a Public Concession Contract*" was one of the first CDM methodologies ever proposed and submitted to UNFCCC as well as the second CDM methodology ever approved under the mechanism. This methodology was designed especially for the project activity "Salvador da Bahia Landfill Gas Management Project" and was applied in all versions of the registered PDD valid for its expired 1st 7-year crediting period (including the latest PDDs version 6 (dated 27/12/2013) and version 7 (dated 28/01/2015)). While representing the first CDM baseline and monitoring methodology for emission reduction determination from abatement of methane emissions in a landfill site, AM0002 was proposed to the UNFCCC as NM0004 and was later approved (as AM0002) on 26 September 2003. In summary, both AM0002 and the initial version of the registered PDD for the project activity "Salvador da Bahia Landfill Gas Management Project" valid for the expired 1st 7-year crediting period somehow reflect the "learning-by-doing" phase of the CDM during the years 2003 to 2005.

Equipment and infrastructure installed and/or monitored as part of the project activity (under its revised design configuration) thus encompasses the following:

- a LFG collection network comprising vertical LFG collection wells (with eventual implementation of horizontal LFG collection trenches being also considered[5]);

- a LFG flaring station (currently comprising 3 high temperature enclosed flares[6] and all

[4] Under the baseline scenario (absence of the project activity), conventional LFG venting/combustion drains would be gradually implemented (in line with the expected expansion of the MSW disposal area at the AMC landfill in accordance with its design and operational plan along its lifetime). This gradual implementation of conventional passive LFG venting/combustion drains would be in line with the existing contractual requirement for the minimum level/share of methane to be combusted at the AMC landfill.

[5] In November/2019, there was no horizontal LFG collection well/trench yet implemented as part of the project activity.

[6] The number of operational high temperature enclosed flares may permanently or temporarily change during the remaining lifetime of the project activity. In case of occurrence of permanent change of the number of installed flares, this will be opportunely addressed as per applicable guidance for addressing post-registration changes in the project design. Specification details for the installed high temperature enclosed flares are included in Section A.3.

required monitoring and control systems)[7];

- a set of 19 internal combustion gas engines (which since January/2011 represents, at the same time, (i) additional/alternative methane destruction devices for the project activity and (ii) major components of a grid-connected 20.1 MW electricity generation infrastructure fuelled uniquely by LFG and also located within the limits of the AMC landfill). Such electricity generation infrastructure encompasses total combined nameplate installed capacity of 20.1 MW;

- a captive off-grid backup electricity generator (fuelled by diesel). Such backup electricity generation source is expected to be used whenever the project's electricity demand cannot be met by imports of grid-sourced electricity[8] [9].

[7] The operation of one of the 3 previously gradually installed high temperature enclosed flares (Flare 1) is temporarily interrupted since March/2012 due to related equipment required maintenance and overhauling purposes (heavy required overhauling in Flare 1 and its ancillary components). In order to proceed with all required equipment heavy overhauling work, Flare 1 (incl. all related monitoring instruments and ancillary components) was completely disassembled, removed from the project site and sent to an appropriate service workshop in year 2012. Among required service, complete replacement of the flare's ceramic revetment material, significant welding work and complete painting in the flare external surface were diagnosticated as required. Due to cost and budgeting related issues, the required complete overhauling work in Flare has been systematically postponed and it is still pendent (not yet performed). Thus, in November/2019 (more than 7 years after its occurred temporary disassembly and removal from the project site), Flare 1 remains disassembled and with its overhauling work still pendent.

It is however relevant to note that, since in January/2011, the largest share of LFG collected as part of the operation of the project activity has been anyway sent for combustion in the set of 19 identical internal combustion gas engines. Thus, only a small fraction of collected LFG has been sent to the set of installed high temperature enclosed flares for combustion. In this context, by taking into account the nameplate flaring capacity of the previously installed 3 flares (Flare 1, Flare 2 and Flare 3), and the typical stream of collected LFG that has been sent to the set of flares since year 2011, it is demonstrable that flow of collected LFG as part of the project activity has not been sufficiently high to indeed require Flare 1 to be once again under continuous operation (even during temporary interruptions of operation of the set of 19 internal combustion gas engines).

In November/2019, it was still unclear when the above summarized required overhauling work in Flare 1 + ancillary equipment will be finally performed and concluded. If applicable, upon future occurrence of a final decision that Flare 1 (+ ancillary equipment) will indeed not be reinstalled in the project site, such decision (of having the project activity permanently encompassing only 2 high temperature enclosed flares (Flare 2 and Flare 3) + the set of 19 internal combustion engines as its methane destruction devices) will be opportunely addressed as per applicable CDM rules for addressing permanent post-registration changes in the project design.

[8] Specification details for the backup captive electricity generator (fuelled by diesel) are also included in Section A.3.

[9] As further explained in Sections B.6.1, B.7.1 and B.7.3, while the project activity does not encompass electricity generation as an additional GHG abatement/mitigation measure, all consumption by the project activity of electricity generated by the grid-connected 20.1 MW electricity generation infrastructure (fuelled by LFG, located within the geographical limits of the AMC landfill and of which the set of internal combustion gas engines represents the major components) will always be accounted as consumption of grid-sourced electricity (with related project emissions being determined ex-post).

Summarized description of the baseline scenario for the project activity during its 3rd 7-year crediting period:

For the 3rd 7-year renewable crediting period of the project activity, the baseline scenario for LFG management at the AMC landfill (which represents the baseline scenario for emission of methane at the site) remains being the same as the scenario existing prior to the implementation of the project activity:

- Largest share of LFG generated at the AMC landfill (with high content of methane) being freely emitted into the atmosphere without any treatment, collection, combustion or control through the surfaces of the landfill; with a small fraction of generated LFG (rich in methane) being destroyed in passive and conventional LFG venting/combustion drains (LFG collection and destruction system) (that would be otherwise implemented) in order have the still valid contractual requirement that defines the minimum level/share of methane required to be combusted at the AMC landfill being met[10].

GHG emission reductions to be achieved by the project activity during the 3rd 7-year crediting period:
By promoting permanent and real destruction of methane through combustion of collected LFG in high temperature enclosed flares and in a set of 19 internal combustion gas engines, the project activity is expected to promote total combined GHG emission reductions of 4,289,437 tCO_2e during its 3rd 7-year crediting period. This value is equivalent to average annual GHG emission reductions of 612,777 tCO_2e/year during the period.

Environmental aspects and other contribution of the project activity towards Sustainable Development locally and in the whole host-country Brazil:
The project activity promotes a significant positive impact towards sustainable development in Brazil.

At the time of the occurred project initial design conceptualization and CDM consideration, the project (yet under its previous design configuration) was regarded as consistent with criteria that were mentioned in a discussion paper dated April 2002 on the performance metrics for sustainable development for CDM projects in Brazil which was published by the Brazilian Ministry of Environment ("*Criterios de Elegibilidade e Indicadores de Sustentabilidade para Avaliacao de Projetos que Contribuam para a Mitigacao das Mundancas Climaticas e para a Promoção do Desenvolvimento Sustentável*." [11] [12]).

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[10] As further explained in Section B.6.1, under the baseline scenario (absence of the project activity) the still valid requirement that defines the minimum level/share methane required to be combusted at the AMC landfill (as established by the Administration of the Municipality of Salvador (public authority)) is assumed that would be met by the gradual implementation of a set of conventional and passive LFG venting/combustion drains in order to have such LFG combustion requirement being met along the remaining landfill lifetime. It is assumed that conventional LFG venting/combustion drains allowing methane to be combusted would be gradually implemented in line with the expected expansion of the MSW disposal area at the AMC landfill in accordance with its design and operational plan along its lifetime.

[11] The time period encompassing years 2002 and 2003 is when the initial design conceptualization of the project activity and its CDM consideration occurred. All data, information and details applicable in the context of such initial project design conceptualization period are referred in this updated version of the PDD with the reference "*at the time of the occurred project initial design conceptualization and CDM consideration*" and thus refer to information, data, figures and assumptions that were dated/valid at such time period.

In this particular context, the definition of "CDM consideration" is relevant: as per applicable CDM rules (i.e. CDM project standard for project activities (CDM-PS-PA)), "*the time of occurred CDM consideration*" refers to the time within the investment decision-making process for implementing the project when "*CDM benefits were considered necessary in the decision to undertake the project*" (i.e. "*(…) benefits of the CDM were a decisive factor in the decision to proceed with the project*"). In the particular case of the project activity "Salvador da Bahia Landfill Gas Management Project", CDM consideration thus occurred as part of the occurred project initial design conceptualization (prior to its implementation) within years 2002 and 2003.

Also at the time of the occurred project initial design conceptualization and CDM consideration, the implementation of the project activity (yet under its previous design configuration) was regarded as a real demonstration of the application of a world-class methane capture system in Brazil.

At that time, like its parent company SUEZ[13], Bahia Transferencia e Tratamento de Residuos S.A. (formerly "Vega Bahia Tratamento de Resíduos S.A.") already had a strong past record of demonstrating corporate social responsibility through social and environmentally friendly initiatives and visualized the implementation of the project activity as one more opportunity to illustrate the benefits of such activities. In the past, Bahia Transferencia e Tratamento de Residuos S.A. has previously contributed to the local community by financing a capacity-building course for young waste pickers from Salvador City and part of the construction of a sorting centre (operated by 80 ex-scavengers now organised as an independent co-operative). It would seek to build on these initiatives.

Besides climate change mitigation, the project activity has promoted important local environmental benefits. LFG contains trace amounts of volatile organic compounds, which are local air pollutants. Capturing of LFG using an active (forced) collection system and its controlled combustion (by flaring) greatly reduces such emissions, thereby contributing towards sustainable development. Furthermore, the implementation and operation of the project activity promotes strong reduction of LFG odors at the landfill and nearby regions.

In summary, the project provides the following additional important local environmental and social benefits, thus contributing towards sustainable development in Brazil:

- Reduction in emissions of other air pollutants such as hydrogen sulphide (that is present in trace quantities in LFG).
- Reduction of risk of occurrence of fire and/or explosions at the landfill due to improved LFG management.
- Reduction of odors at the landfill and nearby regions.
- Local job opportunities

Non-representing of CPA excluded from a previously registered PoA:
While registered under the CDM since 15/08/2005, the project activity does not represent a Component Project Activity (CPA) that has been excluded from a previously registered CDM Programme of Activities (CDM-PoA) as a result of erroneous inclusion of CPAs.

A.2. Location of project activity

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The AMC landfill (that host the project activity) is located in a rural area of the municipality of Lauro de Freitas, Bahia State, Brazil.
The AMC landfill site and the project activity are thus located in the metropolitan area of Salvador (the Capital of Bahia State, which currently includes 10 municipalities). Although the total project area is 2,500,000 m^2, the area reserved for waste disposal is 600,000 m^2. At the time of the occurred project initial design conceptualization and CDM consideration, the AMC landfill had a designed total MSW disposal capacity of 18,000,000 m^3 and was expected to receive approximately 850,000 ton of MSW per year (with typical organic content of disposed MSW of approximately 65%).

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[12] The paper title is translated into English language as: "*Eligibility Criteria and Sustainable Development Indicators for Assessment of Projects Contributing Towards Mitigation of Climate Change and for Sustainable Development*"

[13]At the time of the occurred project initial design conceptualization and CDM consideration, SUEZ Environment was owner and operator of the AMC landfill. Operations of SUEZ Environment. In year 2006, through a management buy-out process, assets and operations of SUEZ Environment in Brazil are sold and "Solvi Group" is created. Solvi Group is the current main shareholder of Battre - Bahia Transferencia e Tratamento de Residuos Ltda.

At the time of the occurred project initial design conceptualization and CDM consideration, the geographic system boundaries of AMC landfill included plot of 72 hectares occupied by Bahia Transferencia e Tratamento de Residuos S.A. as well as a further 178 hectares to cover the landfill's expansion in subsequent phases as outlined in the concession agreement which was previously established between the project participant Battre - Bahia Transferencia e Tratamento de Residuos Ltda. and the Municipal Government of Salvador da Bahia.

The exact geographic coordinates of the project site (in decimal and in Degree, Minute, Second (DMS) formats) are as follows:

Format	Latitude	Longitude
DMS	12° 51' 45" S	38° 21' 59" W
Decimal	-12.8625	-38.3636

The following images show the location of the project activity:

Figure 1 - Project's location within Brazil
(as visible in November/2019 by using Google Earth PC application)

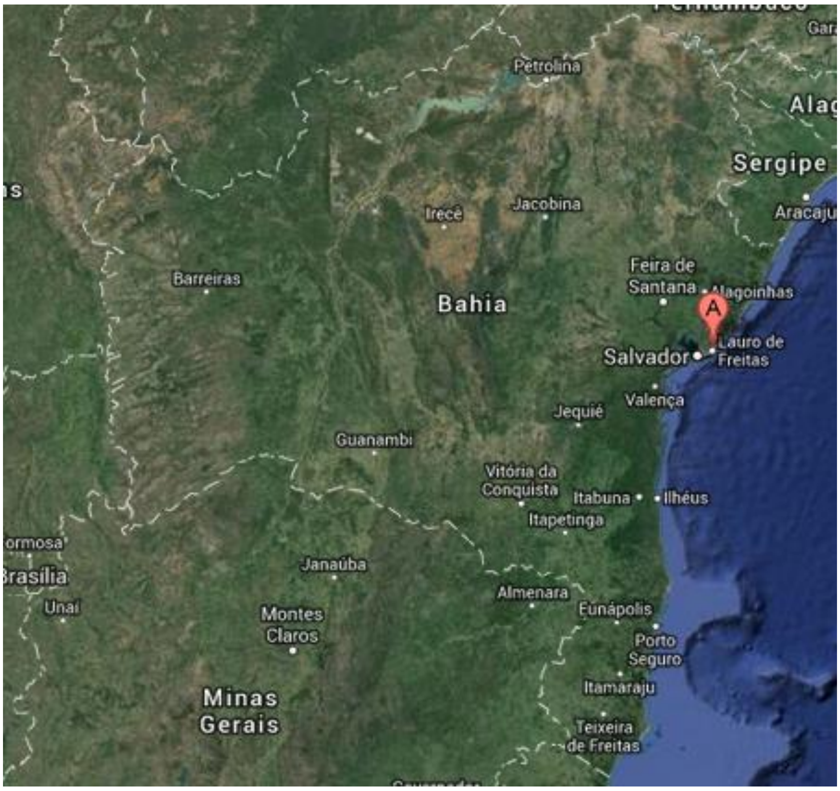

Figure 2 - Project’s location within Bahia State
(as visible in July/2015 by using Google Earth PC application)

Figure 3 - Project’s location within Lauro de Freitas municipality
(as visible in July/2015 by using Google Earth PC application)

Figure 4 – Aerial and zoom aerial views of the current location of the project activity within the AMC landfill (as visible in November/2019 by using Google Earth PC application)

A.3. Technologies/measures

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Pre-project and baseline situations at the AMC landfill in terms of LFG management:

The pre-project situation (situation prior to the implementation of the project activity) in the end of year 2003 represents the non-existence of any appropriate LFG management infrastructure and/or practice that would allow any methane emission migration through LFG collection and its combustion at the landfill site.

In the absence of the project activity (baseline scenario), it is assumed that a set of conventional LFG venting/combustion drains would be gradually[14] implemented and used at the AMC landfill in order to promote combustion of small share of generated LFG under a level that would be sufficient to meet the still valid contractual requirement that defines the minimum level/share of methane to be destroyed through combustion at the AMC landfill (as previously established by the Administration of the Municipality of Salvador (municipal authority)).

As part of the previously performed CDM validation for the project, it was demonstrated and confirmed that gradual implementation and use of conventional passive LFG venting/combustion drains at the AMC landfill (for meeting the yet valid contractual requirement for destruction of methane at the AMC landfill) represents the baseline scenario for the project activity.

It is thus assumed that within the time period encompassing the 3rd 7-year crediting period of the project activity, under the baseline scenario (absence of the proposed project activity), infrastructure promoting efficient LFG collection and destruction would still be non-existent at the AMC landfill since there are still no additional requirement/requisite that would require generated methane to be destroyed through combustion (under a rate higher than established by the still valid contractual requirement that defines the minimum level/share of methane required to be destroyed through combustion at the AMC landfill (as previously established by the Administration of the Municipality of Salvador)).

While currently there are still no additional or more recent legal municipal, state or national requirements in the city of Salvador, State of Bahia nor in Brazil (respectively) that would establish any requirement or guidance in terms of LFG management in new or existing landfills or waste dump sites, the baseline scenario for the project activity within its 3rd 7-year crediting period remains being the same as the scenario valid for its expired 1st crediting period.

As required by ACM0001 (version 19.0), the design, operation and management plan of the AMC landfill was not compromised or changed as a result of the implementation of the project activity. While no practice to deliberately increase methane generation in the landfill site has ever occurred prior to the implementation of the project activity, none of such practice (to deliberately increase methane generation on-site) has ever occurred after the implementation of the project activity either.
Furthermore, none of such practices are expected to occur during the time period to be encompassed by the 3rd 7-year renewable crediting period of the project activity either. As required by the applied baseline and monitoring methodology ACM0001 (version 19.0), the occurrence or planning of any change in the management of the AMC landfill during the time period to be encompassed by such 3rd 7-year renewable crediting period will be reported and will be justified by referring to applicable technical or regulatory specifications.

[14] Under the baseline scenario (absence of the project activity), conventional LFG venting/combustion drains that would be gradually implemented in line with the expected expansion of the MSW disposal area at the AMC landfill in accordance with its design and operational plan along its lifetime.

Technology and measures encompassed by the project design:
Employed technology encompasses deep improvements of LFG management at the AMC landfill through the installation and operation of an active LFG collection system composed by a LFG collection and transportation pipeline network plus the installation and operation of a LFG destruction devices.

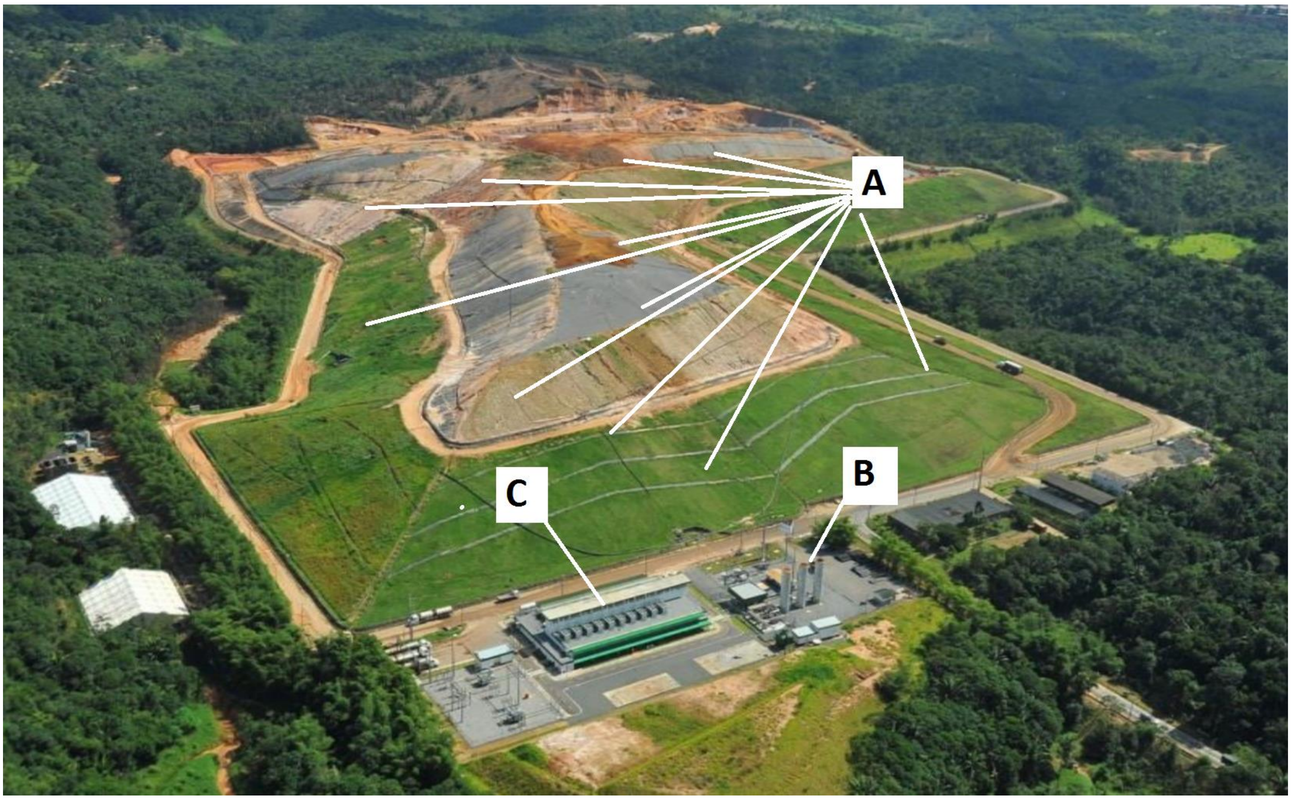

Figure 5 – Aerial view of the AMC landfill (A = MSW disposal area from which LFG is collected by the project's LFG collection system; B = project's LFG flaring infrastructure (by flaring); C = electricity generation infrastructure (for which the set of 19 internal combustion engines represents the major components)

LFG collection infrastructure:
The project's LFG collection infrastructure consists of a series of vertical extraction wells interconnected by header piping. LFG is extracted from the landfill using a vacuum system (controlled by centrifugal blowers powered by electric motors) and conducted both to high temperature enclosed flares and to the engine-generator sets of the electricity generation infrastructure.
The conversion of some of the pre-project existing passive conventional LFG venting/combustion drains into appropriate LFG collection wells represents a distinct advantage since such conventional drains were already installed in locations where most of the gas flows into the atmosphere. However, some physical barriers could interrupt the gas flow from the generation point to the well, so new wells needed to be drilled.
Also as part of the designed project's LFG collection system, collected LFG is sent both to the project's flaring station and to the electricity generation infrastructure through LFG High Density Polyethylene (HDPE) pipes and manifolds.

Figure 6 – View of a LFG collection well

Figure 7 – Partial view of the LFG pipeline

Destruction of methane through combustion of LFG in high temperature enclosed flares:

As per the currently valid project design configuration, share of collected LFG is to be combusted through flaring, thus mitigating methane emissions. While ACM0001 (version 19.0) requires ex-post monitoring whether enclosed flaring equipment combusting LFG operates under compliance with operational requirements and/or recommendations (as set by equipment manufacturer), the main operational characteristics and specifications of the set of 3 high temperature enclosed flares[15] [16] are defined as follows:

Installed LFG flaring equipment	Characteristics/specifications
High temperature enclosed flares	*Flares 1, Flare 2 and Flare 3[17]:* Manufacturer: BTS Termodinâmica de Sistemas Ltda. Max. LFG flaring capacity (for continuous operation) for each flare: 5,360 Nm^3/h Required min. temperature of the exhaust gas of the flare (to ensure LFG destruction under high CH_4 destruction efficiency): 500 ^oC Required max. temperature of the exhaust gas of the flare (to ensure LFG destruction under high CH_4 destruction efficiency): 1,200 ^oC Required frequency for inspection service (incl. inspection in the conditions of the flare's isolation ceramics revetment material): every 10 (ten) years

Source: Equipment technical declarations made available by the respective equipment's manufacturers

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[15] While the 3 high temperature enclosed flares and the engine–generator sets of the grid-connected 20.1 MW electricity generation infrastructure represent equipment combusting LFG through flaring that are encompassed by the project activity, compliance of such stationary combustion sources with specifications and operational recommendations from equipment manufacturer should be monitored as per applicable guidance of ACM0001 (version 19.0) + applicable methodological tools.

Specifications and characteristic of the 3 high temperature enclosed flares encompassed by the project activity are reported in this Section. The specifications of other ancillary equipment for the project's LFG collection and flaring component (e.g. centrifugal blowers, valves, flow meters, gas analyzer, etc.) as well as specifications of other ancillary equipment for the set of 19 internal combustion gas engines (additional centrifugal blowers, LFG treatment/cooling system, etc.) are not detailed in this updated version of the PDD. However, specifications of all major equipment and instruments (incl. monitoring instruments) are expected to be regularly reported in the Monitoring Reports valid for the 3rd 7-year crediting period which are yet to be issued (like occurred in the previously issued Monitoring Reports valid for the currently expired 2nd 7-year crediting). This is in accordance with applicable guidelines for completing the CDM-PDD form and also in accordance with applicable methodological and monitoring requirements as set by ACM0001 (version 19.0) + applicable methodological tools.

[16] The project participant Battre - Bahia Transferencia e Tratamento de Residuos Ltda. acknowledges that additional high temperature enclosed flare(s) may eventually be installed from the project site during the 3rd 7-year crediting period in order to fully accommodate projected/potential increase in the amount of LFG to be collected by the project activity. Other additional ancillary equipment may also be installed (e.g. additional centrifugal blower(s)) along the whole project remaining lifetime in order to address eventual increase in LFG collection by the project activity or replaced worn/damaged units. In case of installation of additional flare(s) be indeed confirmed/occurred, information made available in different sections of this PDD (which outline specifications and/or operational requirements and conditions for the flares) will be updated accordingly by applying applicable CDM procedure for addressing post-registration changes (e.g. correction in information that does not affect the project design).

In summary, this revised version of the PDD does not include detailed specifications and maintenance requirements for other equipment which are part of the project activity (e.g. centrifugal blowers, CH_4 content gas analyzer unit, LFG pressure and temperature sensors, thermocouples for measuring temperature of the exhaust gas of the flares, etc.). While, differently than the case of the high temperature enclosed flares, compliance of maintenance requirements and specifications for such additional equipment of the project's LFG collection and destruction component are not required to be monitored through dedicated monitoring parameters, it is important to note that such equipment (i.e. centrifugal blowers, thermocouples, flow meters) may be changed during the 3rd crediting period (due to malfunction, maintenance schedules, calibration events, etc.). The non-inclusion of specification and maintenance details of such additional equipment in the PDD is in accordance with applicable CDM rules and requirements (incl. requirements of ACM0001 (version 19.0) and applicable guidelines for completing the PDD for a CDM project activity). Details about such additional ancillary equipment (incl. monitoring instruments/equipment) will be made available in the Monitoring Reports for regular monitoring periods for the project activity.

[17] Section A.1 includes details about the still on-going temporarily interruption of the operation of one of the 3 previously gradually installed high temperature enclosed flares (Flare 1).

Figure 8: View of the project's LFG collection and destruction station equipped with 3 high temperature enclosed flares (picture dated February/2011)

Destruction of methane through combustion of collected LFG in a set of 19 internal combustion gas engines (since January/2011):

Since January/2011, besides of having methane being destroyed through combustion of collected LFG in the set of high temperature enclosed flares, destruction of CH_4 has also been promoted through combustion of collected LFG in a set of identical 19 internal combustion gas engines. This set of 19 gas engines represents, at the same time, (i) additional/alternative methane destruction devices for the project activity and (ii) major components of a grid-connected 20.1 MW electricity generation infrastructure fuelled uniquely by LFG and located within the geographical limits of the AMC landfill since January/2011.

Each one of the 19 internal combustion gas engines is part of an individual state-of-the-art engine-generators set type 3, model/series JMS 320-GS manufactured in Austria by GE Jenbacher GmbH & Co OHG and with individual nameplate power generation capacity of 1.059 MW each[18].

[18] Depending on construction and assembly aspects of each individual engine-generator sets Jenbacher, type 3 model/series JMS 320-GS (e.g. selection of supplier of alternator and other electrical components), the nameplate installed capacity for assembled units (that includes the internal combustion gas engines) may be slightly higher or lower than 1.059 MW (1,059 kW). In the particular case of the so far installed 19 container-based modular engine-generator packages, all alternators of the unit indicate nameplate power generation capacity of 1,059 kW (1.059 MW). Nevertheless, it is crucial to note that under typical operational conditions, an individual set will never operate under working conditions able to reach exactly 100% of its nameplate power generator capacity (even when operated under full load and under favourable electricity grid conditions). In fact, under typical operational conditions (even under full load), power generation by each individual engine-generator set may be slightly below 1.059 MW.

Figure 9: View of the internal combustion gas engine (regarded as additional/alternative methane destruction devices for the project activity). This engine is the major component of each one of the type 3, JMS 320-GS series engine-generator set manufactured by GE Jenbacher GmbH & Co OHG

The GE Jenbacher lean-burn gas engines fuelled by LFG (such as the engine that is part of the type 3, JMS-320 series engine-generator set) have CH_4 destruction efficiency in the range of 99.5%[19]. Such typical very high CH_4 destruction efficiency expected for set the internal combustion gas engines is in line with GHG calculation approach of ACM0001 (version 19.0) for the determination of baseline emissions for destruction of CH_4 in such additional/alternative methane destruction devices as presented in Section B.6.1.

Each one of the currently installed 19 engine-generator sets includes an internal combustion gas engine + ancillary equipment that are all part of a grid-connected 20.1 MW electricity generation infrastructure located within the geographical limits of the AMC landfill. The installed engine-generator sets are each one connected to an individual power transformer (one power 440 V/13.8 kV power transformer for each engine-generator set). All installed engine-generator sets are controlled by a common power generation control infrastructure (incl. a shared main supervisory control and data acquisition system for the whole infrastructure (SCADA)). Each individual power transformer is connected to a shared power substation through a dedicated power transmission line. Through such power substation (that is connected to the National Electricity Grid of Brazil) net generated electricity by such power generation infrastructure has been exported by the grid-connected 20.1 MW electricity generation infrastructure located within the geographical limits of the AMC landfill through the national electricity grid.

The electricity generation infrastructure located within the geographical limits of the AMC landfill also encompasses the installation and continuous operation of a new LFG treatment and cooling infrastructure where all LFG is filtered/cleaned (removal of SOx, siloxanes and other impurities) in an activated carbon filtering system. Furthermore, in order to meet operational requirements of the engine-generator sets, LFG is also cooled (in a chiller) prior to be sent to the engine-generator sets.

[19] Source: Publicly available declaration from GE Power & Water Jenbacher Gas Engines – USA. Available online: file:///C:/Users/Samsung/Downloads/GE-Power-Water%20(3).pdf

Figure 10: Aerial view of the grid-connected 20.1 MW electricity generation infrastructure located within the geographical limits of the AMC landfill (for which the set of 19 internal combustion gas engines represents the major components) + project's LFG flaring infrastructure (picture dated February/2011)

Figure 11 – Aerial view of the grid-connected 20.1 MW electricity generation infrastructure located within the geographical limits of the AMC landfill (picture dated February/2011).

Figure 12 – View of the infrastructure for treatment/cooling of LFG used for the electricity generation (picture dated February/2011)

Figure 13 – internal view of the electricity generation infrastructure
(view of the 19 (nineteen) *state-of-the-art* GE-Jenbacher JMS 320-GS engine-generator sets)
(picture dated February/2011)

Box 2 – Approved non-inclusion of electricity generation as additional GHG abatement/mitigation measure as part of the project activity + approved non-accounting of emission reductions associated to displacement of a more-GHG-intensive service (i.e. CO_2 emission reductions due to generation of electricity using collected LFG as renewable energy source)[20]

Under its current design configuration, as previously approved by the CDM Executive Board in December/2018, the project activity encompasses only methane destruction GHG abatement measure. Despite of the occurrence of combustion of collected LFG in a set of internal combustion gas engines (that represents the major components of an electricity generation infrastructure) since January/2011, the project activity does not include any additional project component and/or extension of technology/measures. That means that the project activity does not encompass electricity generation as an additional GHG abatement/mitigation measure since January/2011 and it thus remains having methane destruction as its unique GHG abatement/mitigation measure. Therefore, like also valid for its currently expired 2nd 7-year crediting period, no emission reductions associated to generation of electricity using collected LFG as renewable energy source will be accounted and/or claimed by project activity during its 3rd 7-year crediting period either.

Timeline with the most relevant facts and events related to the occurred implementation of the grid-connected 20.1 MW electricity generation infrastructure (entirely fuelled by LFG and located within the geographical limits of the AMC landfill) and its starting of operations in January/2011:

The table below includes a timeline with the most relevant facts and events related to the occurred implementation of the grid-connected 20.1 MW electricity generation infrastructure fuelled by LFG (for which the set of 19 internal combustion gas engines, as additional/alternative methane destruction devices for the project activity, represents major components) and its starting of operations on 01/01/2011.

Timeline with the most relevant facts and events related to the occurred implementation of the grid-connected 20.1 MW electricity generation infrastructure powered by collected LFG and located within the geographical limits of the AMC landfill.

Time	Description
Period within years 2002 and 2003 (when the project initial design conceptualization and CDM consideration occurred)	Although utilization of LFG as gaseous fuel for electricity generation was indeed previously examined as part of the occurred project initial design conceptualization within years 2002 and 2003 (at the time when CDM consideration occurred), that time it was however effectively decided at that time to implement the project activity by not including utilization of LFG as fuel for electricity generation. This is highlighted in previous version of the PDD valid for the 1st 7-year crediting period (PDD version 5, dated March/2005). The decision of not including the examined/analyzed utilization of collected LFG as gaseous fuel for electricity generation at that time (encompassing the occurred project initial design conceptualization (within years 2002 and 2003) and only later including such utilization as a change in the design of the project activity) is indeed in line with of a very relevant set of recommendations made available in a set of independent technical evaluations performed by the Energy Sector Management Assistance Program (ESMAP) from the World Bank (WB) for utilization of LFG for

[20] The non-inclusion of electricity generation as additional GHG abatement/mitigation measure (as part of the project activity) + non-accounting of emission reductions associated to displacement of a more-GHG-intensive service (i.e. CO_2 emission reductions due to generation of electricity using collected LFG as renewable energy source) were approved by the CDM Executive Board (CDM-EB) in December/2018 in the context of the approval process of post-registration changes for the project activity addressed under PRC-0052-005. Related details are available online:

https://cdm.unfccc.int/PRCContainer/DB/prcp885665585/view

	electricity generation that were held within 2004 and 2005: the initiative "*Landfill Gas-to-Energy (LFGTE) Initiative for Latin America and the Caribbean*" was undertaken as a pioneer and credible independent technical investigation study performed by ESMAP/WB. This particular and pioneer technical investigation initiative was carried out by experts charted by the World Bank's ESMAP (of which content/tasks involved inter alia the collection of inputs and perceptions from practioners of LFG collection and destruction/utilization initiatives in South America as well as inputs from technical staff from Municipal Solid Waste (MSW) management companies). The initiative intended promoting and disseminating the potential for development of environmentally sound non-conventional energy sources such as landfill gas (LFG) and mitigation of GHG emissions. The declared objectives of the Landfill Gas-to-Energy (LFGTE) Initiative in Latin America and the Caribbean were as follows: *"1) contribute to the maximization of methane emissions reductions and the development of carbon trading opportunities;* *2) promote LFGTE investment in Latin America and the Caribbean to improve solid waste management practices in the* *region;* *3) create awareness of LFGTE opportunities;* *4) document and disseminate LFGTE experience; and* *5) establish knowledge sharing mechanisms to increase cooperation."* The second phase of the "*LFGTE Initiative for Latin America and the Caribbean*" initiative was initiated in year 2004 and included the complete development (by reputable LFG-to-electricity professionals chartered by ESMAP) of 10 pre-feasibility studies for the effective promotion of LFG destruction and utilization (as gaseous fuel for electricity) in different landfill sites located in Brazil, Colombia, Mexico, Peru, and Uruguay (landfills not hosting any LFG collection and destruction/utilization initiative). As part of such performed pre-feasibility studies, chartered experts evaluated *inter alia* the technical and economic feasibility of the development of LFG collection and utilization initiatives in the selected 10 landfill sites (of which 3 are located in Brazil): the Gramacho Landfill, the Muribeca Landfill and the Santa Tecla Landfill. Of these 3 landfill sites analyzed in Brazil, only the Gramacho landfill in Rio de Janeiro, RJ has indeed the size (scale) and projected potential installed capacity in terms of electricity generation using LFG as fuel that was comparable to the project activity and/or to the AMC landfill. It is relevant to note that the technical report/publication "*The Landfill Gas-to-Energy Initiative for Latin America and the Caribbean*" issued by ESMAP at that time with the findings including the following very relevant disclaimer regarding the implementation of electricity generation infrastructure in the context of all performed 10 pre-feasibility studies for the promotion of LFG destruction and utilization (as gaseous fuel for electricity): *"(…)* *The results showed that in most cases combined revenues from CERs and energy generation could make the projects feasible. The reports recommended* ***developing effective projects in two stages. First, a reliable and constant LFG capture and flaring system should be implemented to ensure that the landfill operator is acquainted with the technology and that landfill operation practices do not interfere with the system. Second, the energy generation plant should be added once the***

> ***landfill gas capture system is stable and well calibrated and the methane flow has proven to be as predicted. This two-stage approach will greatly reduce the risk of sub-utilizing energy plants as a result of problems not anticipated during prefeasibility studies.***
> *(…)"* [21]

The above-quoted disclaimer is indeed in line with the decision/approach previously applied by BATTRE of NOT implementing any infrastructure promoting utilization of collected LFG as gaseous fuel for electricity generation in the context of the initial construction and operation of the project activity (at the time of occurred project initial design conceptualization and CDM consideration within year 2002 and 2003); but later building the grid-connected 20.1 MW electricity generation infrastructure within the geographical limits of the AMC landfill.

The technical report "*Pre-Feasibility Study for Landfill gas recovery and energy production at the Gramacho Landfill Rio de Janeiro, Brazil"* issued by the part of the initiative in June/2005 also includes the following conclusions/findings that also sufficient reflect the particular situation at the AMC landfill (at the time of the occurred initial design conceptualization + CDM consideration for the project activity):

> *"This Pre-Feasibility Study Report addresses the potential implementation of a landfill gas (LFG) collection, control and utilization project at the Gramacho Landfill in Rio de Janeiro, Brazil. (…) The general objective of this effort is to evaluate the technical and economic feasibility of developing landfill gas-to-energy (LFGTE) projects at the selected sites, and project the environmental benefits (by way of carbon emission reductions) and other environmental impacts of doing so. These evaluations consider the project development within the framework of current international carbon markets such as the Clean Development Mechanism (CDM) of the Kyoto Protocol."*
> *(…)*
> ***"A flaring only project also is feasible and appears more favorable economically than the LFGTE project under all CER pricing, financing and project duration scenarios analyzed."*** [SIC]
>
> > (*Note:* this assumption is indicated in the report by taking into account CDM revenues due to commercialization of CERs (by accounting price of USD 5.00 per commercialized CER) as well as revenues due to commercialization of generated electricity (by accounting electricity sale price of USD 0.029/kWh (USD 29.00 per

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[21] As outlined in the Report "*The Landfill Gas-to-Energy Initiative for Latin America and the Caribbean*", technical assessment activities performed as part of the conducted pre-feasibility studies included inter alia:

(i) evaluation of existent and future trends in the electricity sector in the country (including assessment of their potential impacts on an LFG-to-electricity generation project being implemented in the underlying country);
(ii) (ii) preparation of a detailed and realistic conceptual design for the LFG collection and utilization system (to be used as a tool for evaluating the capital costs required for implementing and operation LFG collection at the landfills and estimating the costs of implementing and operating electricity generation initiatives using LFG as fuel);
(iii) (iii) estimation of the cost of implementing and operating both LFG collection and destruction initiatives as well as electricity generation infrastructure promoting utilization of LFG (incl. capital and operational costs breakdowns);
(iv) (iv) assessment of sources of revenue (commercialization of generated electricity) and (v) the development of plans for the implementation of LFG recovery and utilization projects at the 10 landfills (including steps involved and a identification of schedule for project implementation).

The LFGTE initiative included the creation of a web site in English, Spanish, and Portuguese (http://www.bancomundial.org.ar/lfg/default.htm) where details about the conducted 10 pre-feasibility studies were made available. The Report "The Landfill Gas-to-Energy Initiative for Latin America and the Caribbean" is available online: https://openknowledge.worldbank.org/handle/10986/17972
Details about the initiative and copy of the Technical report "*The Landfill Gas-to-Energy (LFGTE) Initiative for Latin America and the Caribbean"* are available online: https://openknowledge.worldbank.org/handle/10986/17972

	MWh = BRL 64.00 per MWh when taking into account the BRL / USD exchange rate valid in Nov. 2005))[22] It is also relevant to note that at the time of occurred project initial design conceptualization + CDM consideration (within years 2002 and 2003), CDM rules were not as flexible and defined as currently valid CDM rules and procedures in terms of addressing of changes in the project design for a typical project activity under the CDM and/or in terms of implementation of elements/phases for a registered CDM project activity (eventually not under full conformance with forecasts/time plan included in the PDD of the underlying project activity). These concerns were especially relevant for the particular case of project activities with gradual/phased implementation. Thus, the decision of the project participant BATTRE[23] of not explicitly including in the PDD for 1st 7-year crediting period of the project activity an electricity generation component using LFG as gaseous fuel also reflects a willingness, at that time, of avoiding any potential risk for future issuance of CERs by the project activity (i.e. due to eventual mismatching of project design information as made available in the PDD vs. implementation and operation of the project activity).
Period encompassing years 2007 and 2008	After the operation of the project activity as a LFG collection and destruction initiative for more than 3 years, the project participant BATTRE and the company Solvi Valorização Energética (SVE)[24] initiated the development of further internal field studies and investigations related to promotion of the utilization of LFG collected by project activity as gaseous fuel for electricity generation (as a more rational and environmentally friendly solution than flaring all LFG collected). A complete set of further (complementary) technical, economical and commercial evaluations were thus performed by BATTRE and SVE during the period encompassing years 2007 and 2008. Such internal investigations resulted in incurrence (in year 2009) of major capital expenditures for implementing the grid-connected electricity 20.1 MW generation infrastructure, thus finally promoting a more sustainable, environmentally friendlier and more rational use for LFG (as fuel for the generation of electricity). The following technical aspects and conditions *inter-alia* represented at that time crucial aspects in the context in incurrence of major capital expenditures for implementing the electricity generation infrastructure: - Reduced uncertainties about the quantity and quality for collected LFG at the AMC landfill (after the project activity being operated as a LFG collection and destruction initiative for more than 4 years (since Jan. 2004).

[22] The findings from the technical report "*Pre-Feasibility Study for Landfill gas recovery and energy production at the Gramacho Landfill Rio de Janeiro, Brazil"* are in line with the decision of BATTRE of not including in the initially conceived and approved project design an electricity generation infrastructure fuelled by LFG. This technical report is available online: http://s3.amazonaws.com/zanran_storage/www.bancomundial.org.ar/ContentPages/2469259978.pdf

[23] As further explained in Section A.1., the name of the host-country project participant was updated in August/2019 from "Bahia Transferencia e Tratamento de Residuos S.A." to "Battre - Bahia Transferencia e Tratamento de Resíduos Ltda." Reflecting the previously occurred and required change in the registration name of the company as a result of occurred change in its statutory and shareholder organizational structure.

[24] Solvi Valorização Energética Ltda. is a registered company that is owned by Solvi Group (www.solvi.com). Solvi Group is also the main owner of BATTRE.

	- Development by BATTRE of real field expertise and competence with collection of LFG (after the project activity being operated as a LFG collection and destruction initiative for about 5 years) - Technological developments involving utilization of LFG as gaseous fuel for electricity generation (incl. occurred real improvements in terms of conversion efficiency of engine-generator units, use of advanced electronics for dealing with usual fluctuations in CH_4 content/fraction in LFG, reduction of problems of synchronization of engine-generator sets within the electricity grids, etc.) - More attractive sale price for generated electricity in Brazil (when compared to sale price previously considered at the time of the occurred project initial design conceptualization and CDM consideration within years 2002 and 2003). - Reduction in policy and market uncertainties within the Brazilian power market (when compared to the situation at the time of the occurred project initial design conceptualization and CDM consideration within years 2002 and 2003) - Overall slight improvement in macroeconomic conditions in Brazil (when compared to the situation at the time of the occurred project initial design conceptualization and CDM consideration within years 2002 and 2003)
17/03/2008	A decision of going ahead with the process of further evaluating the potential implementation of the electricity generation infrastructure (from both technical and economical perspectives) was formally taken by the Board of Directors BATTRE and SVE on 17/03/2008 with the establishing of the enterprise/company "Usina Termelétrica SVE Salvador S.A." (also denominated "Termoverde"). "Termoverde" is established as joint-venture between BATTRE and SVE.
30/04/2008	As part of the further technical and economical investigations for the implementation of the grid-connected 20.1 MW electricity generation infrastructure powered by LFG, a technical solution involving the installation of engine-generator sets manufactured/supplied by the American/Austrian power generation equipment manufacturer GE Jenbacher GmbH & Co OHG was regarded as the most suitable technical alternative/solution for electricity generation using LFG (among other evaluated options/alternatives).
26/08/2008	An Engineering, Procurement and Commission (EPC) agreement was established/signed between Termoverde and the Brazil based company STEMAC Energia Ltda. (at the time acting as representative in Brazil for the power generation equipment manufacturer and supplier GE-Jenbacher GmbH & Co OHG) in the context the incurrence (in year 2009) of major capital expenditures for implementing the electricity generation infrastructure[25]. Such technical EPC agreement encompassed design,

[25] As previously outlined in the previous version of the PDD for the currently expired 1st 7-year crediting period of the project activity (PDD version 5, dated March 2005), electricity generation using LFG as part of the project design has been previously examined to eventually be part of the project design at the time of the occurred project initial design conceptualization and CDM consideration (within years 2002 and 2003). The incurrence of major capital expenditures for implementing the grid-connected 20.1 MW electricity generation infrastructure located within the geographical limits of

	construction, commissioning and initial operation (under a "turn-key" business model) of the state-of-the-art electricity generation infrastructure with about 20.1 MW of installed capacity (using an expandable number of 19 (nineteen) engine-generator sets model GE-Jenbacher, JMS 320-GS with installed capacity of 1,059 kW each). It is noteworthy that at that time, no GE-Jenbacher engine-generator set had ever been previously installed in the whole South America.
October/2008	Approval of the starting of the construction work for the new electricity generation infrastructure in an area in the AMC landfill next to the project's LFG flaring infrastructure and initial of minor construction work (access, topography work, etc.).
January/2009	Starting of construction and assembly of the main components of the electricity generation infrastructure, with major capital expenditures being incurred. Upon the publication of the Resolution no. 1,797 dated 03/02/2009 issued by the Brazilian Electricity Regulatory Agency (ANEEL), the entity Usina Termelétrica – UTE SVE Salvador S.A. was established as an Independent Power Producer through the implementation and operation of the electricity generation infrastructure (of which starting of operations was forecasted to occur on 01/12/2009 as outlined on Resolution 1.797 from ANEEL).
Period within year 2009 and year 2010	The latest version of the time plan for the electricity generation infrastructure (Nov./2010) summarizes the milestone for the construction and commissioning of the electricity generation infrastructure as follows: Civil construction: - Foundations for the power house and foundations for the 19 engine-generator sets: from Jan./2009 to Jul./2009 - Construction of the power house (incl. firefighting equipment): from Jun./2009 to Sep./2010 Electrical and power control system: - Installation of the 19 engine-generator sets (without testing/commissioning): from Jul./2009 to Jan./2010 - Installation of ancillary and control system for the 19 engine-generator sets (without testing/commissioning): from Jun./2009 to Sep./2010 Power substation and transmission line: - Construction of power station: from April/2009 to March/2010 - Construction of transmission line: from April/2009 to November/2010 (interruption during the period from September/2009 to March/2010) Testing and commissioning for the whole infrastructure: from November/2010 to December/2010. On 19/04/2010, based on the outcome of its performed surveillance, ANEEL has issued a Notification Report highlighting the status of the implementation electricity generation infrastructure (final construction status) and also highlighting the relative implementation delay for such infrastructure.

the AMC landfill occurred years later (in year 2009). Such incurrence of major capital expenditures for implementation of grid-connected power generation infrastructure thus occurred in later period in the context of the project activity already registered under the CDM.

	As per a communication issued by BATTRE on 10/05/2010 (and submitted/registered within ANEEL on 12/05/2010) the status of the electricity generation infrastructure was as follows at such date: - About 86% of total required work for the simultaneous construction and assembly of the 19 engine-generation sets were concluded. - About 80% of total required work for the construction of the power transmission line connecting the electricity generation infrastructure to the electricity grid were concluded. As per a communication issued by BATTRE on 12/09/2010 (and submitted/registered within ANEEL) the status of the electricity generation infrastructure was as follows at such date: - About 95% of total required work for the simultaneous construction and assembly of the 19 engine-generation sets were concluded. - About 95% of total required work for the construction of the power transmission line connecting the electricity generation infrastructure to the electricity grid were concluded. Upon difficulties of the conclusion of the transmission line construction work (that were caused by delays in the licensing/permit for its implementation within the limits of a local community) and also due to the heavy rains during the raining season, the simultaneous construction and assembly of the 19 engine-generation sets for the facility as well as the construction of the power transmission line connecting the electricity generation infrastructure to the electricity grid were further delayed[26]. As outlined in official communications issued by the local electricity distribution company COELBA on 01/10/2010 and 22/11/2010, upon performance of its surveillance to the grid-connected 20.1 MW electricity generation infrastructure as established by applicable rules and regulations of the Brazilian power market, CELBA declared that all 19 engine-generator sets were under appropriate installation conditions for the performance of testing work as part of their commissioning[27]. As outlined in an official communication issued by the Brazil's national grid operator is termed *Operador Nacional do Sistema* (ONS) [28] dated 15/12/2010, upon positive outcome of performance surveillance in the electricity generation infrastructure, all its 19 engine-generator sets were regarded as under conformance with applicable requisites for connection to the National Electricity Grid of Brazil. As outlined in a communication issued by BATTRE on 15/12/2010 (and submitted/registered within ANEEL), simultaneous release/approval of all 19 engine generator-sets of the electricity generation infrastructure for starting operating as power generation sources connected to the National

[26] Copies of the versions of the master time plan for the implementation of the electricity generation infrastructure valid in Feb./2009 and Nov./2010 were made available to the to the DOE in charge of the validation of the revised version of the PDD valid for the currently expired 2nd 7-year crediting period addressing post-registration changes. The comparison of these different versions of the time plan allows confirmation of the previously unforeseen/unexpected delay on conclusion of the construction and commissioning work for the electricity generation infrastructure.

[27] A complete commissioning report for the grid-connected 20.1 MW electricity generation infrastructure was later issued by STEMAC S/A Grupo Geradores on 05/01/2011. Copy of this Commissioning Report was made available to the DOE in charge of the validation of this revised version of the PDD.

[28] Brazil's national grid operator is termed *Operador Nacional do Sistema* (ONS) and it is a government agency responsible for the coordination and monitoring of electric power generation and transmission facilities connected to Brazil's national grid (SIN). The agency operates under the supervision and regulation of the country's national power regulator Aneel.

	Electricity Grid of Brazil was request. As published in the Diario Oficial da União (DOU) of 22/12/2010 (Issue 244, Section 1)[29] , all 19 engine-generator sets of the electricity generation infrastructure were simultaneously released/approved for starting operating as power generation sources connected to the National Electricity Grid of Brazil.
01/01/2011	Starting of operation of the electricity generation infrastructure (of which the set of 19 internal combustion gas engines represents the major components). On 01/01/2011, the grid-connected 20.1 MW electricity generation infrastructure started operating with its total combined nameplate installed capacity been significantly limited in terms of utilization. Unfortunately, after more than 6 years of continuous operation, the electricity generation infrastructure remains operating with its total combined nameplate installed capacity not being fully utilized. Since the starting of operations of the electricity generation infrastructure, its 19 engine-generator sets have operated alternately (never simultaneously). *Note: Unforeseen/unexpected delay on conclusion of the construction and commissioning work for the grid-connected 20.1 MW electricity generation infrastructure located within the geographical limits of the AMC landfill:* Due to difficulties and problems during the construction phase of the electricity generation infrastructure (that could not be previously unforeseen/unexpected), its start of operations was significantly delayed when compared to previously available forecasts: while the electricity generation infrastructure was forecasted to start operating in the beginning of year 2010, its operations were initiated on 01/01/2011 (about 1 year of delay). By taking into account the unforeseen/unexpected delay in the conclusion of all related construction and commissioning work for the electricity generation infrastructure, and by also taking into account CDM rules and procedures valid at that time, the project participant BATTRE thus took the strategic decision to only permanently connect the new LFG powered electricity generation infrastructure to the project activity (connection to the existent project's LFG pipeline (pipeline deviation between the blowers, main LFG flow meter and the installed flares)) on 01/01/2011, thus ensuring that the such electricity infrastructure started to operate right on the beginning of the second 7-year crediting period. Appendix 3 includes details about the relatively poor performance of the project activity in terms of collection of LFG resulting in limited utilization of available total combined nameplate installed capacity of its electricity generation infrastructure during the period from year 2011 to year 2017. Tables summarizing the evolution of the performance of the project activity within year 2011 (1st year with the electricity generation infrastructure under operation) and the evolution of annual average of LFG supply to such infrastructure + annual achieved average of combined capacity factor for the whole infrastructure during the period from 01/01/2011 to 31/12/2017

[29] The *Diário Oficial da União* (DOU) is the official journal of the federal government of Brazil. DOU issue 244, Section 1 dated 22/12/2010 is retrievable online: http://www.imprensanacional.gov.br/

	are included in Appendix 3.
Period within year 2015 and 2016	After years facing very unfavorable conditions and difficulties for commercialization of the CERs under the global carbon market, in year 2015 BATTRE was one of winners for the first auction from the Pilot Auction Facility for Methane and Climate Change Mitigation (PAF) from the World Bank. The need of sourcing CERs under the initiative triggered the decision of BATTRE to renew of the 7-year crediting period of the project activity (expired on 31/12/2010) and also address the occurred starting of combustion of collected LFG in the set of 19 internal combustion gas engines of the electricity generation infrastructure as a post-registration change in its design as per applicable CDM rules and procedures.
06/12/2018	The occurred permanent change in the project design encompassing combustion of collected LFG also occurring since 01/01/2011 in the set of 19 internal combustion engines (which represent the major components of the grid-connected 20.1 MW electricity generation infrastructure powered by collected LFG and located within the geographical limits of the AMC landfill) were finally approved by the CDM-EB (in the context of the approval process of post-registration changes for the project activity which were successfully addressed under PRC-0052-005).
22/08/2019	CERs for a monitoring period within the 2nd 7-year crediting period of the project activity (under its current design configuration) were finally issued.
November/2019	Related efforts for the renewal of the 7-year crediting period were initiated (e.g. completion of the PDD for the 3rd 7-year crediting period, selection of DOE for performance of related validation assessment).

Consumption of electricity by the project activity:
During the period from the starting of operation of the project activity (in March/2004) until 31/12/2010, all of its electricity demand has been entirely met by consumption of grid-sourced electricity. Within such period encompassing more than 6-years, the operation of the project activity had to be completely interrupted during events of temporary interruption of supply of grid-sourced electricity to the project activity.
A backup captive off-grid electricity generator (fuelled by diesel and with 700 kVA of nameplate installed capacity) was installed and was put under operational conditions on 01/01/2011. Such captive off-grid electricity generator is planned to be used along the remaining lifetime of the project activity whenever the project's electricity demand cannot be met by imports of grid-sourced electricity.

The main specifications of the backup captive off-grid electricity generator (fuelled by diesel) are summarized below:

Specification for the backup captive off-grid electricity generator (fuelled by diesel)	
Manufacturer	STEMAC Grupos Geradores (Brazil)
Model/product	G – GMC
Power	700 kVA (560 kW by considering a power factor of 0.8) (480 V voltage, 60 Hz frequency)
Main components	Diesel engine: Scania DC1649A Generator: WEG GTA 1005322944

In summary, the project's electricity demand is to be met by one of the following sources/approaches:

- Imports of grid-sourced electricity[30]
- Electricity supply by the installed backup captive off-grid electricity generator (fuelled by diesel) (expected to occur only during temporary planned or unplanned circumstances when supply of grid-sourced electricity is temporarily interrupted).

Consumption of Liquefied Petroleum Gas (LPG) by the project activity:
In accordance to the project design, since the start of operation of the project activity, LPG has been used as a start-up fuel to ignite the high temperature enclosed flare whenever it is required to re-start the operation of the flares (e.g. after maintenance/repair events, after temporary planned or unplanned interruptions in grid electricity supply to the project activity, etc.)[31].

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[30] Since the project activity does not encompass electricity generation as a GHG abatement/mitigation measure and no emission reductions due to displacement of a more-GHG-intensive service (due to generation of electricity using collected LFG as fuel) are thus eligible and/or claimable; any consumption by the project activity of electricity sourced/generated by the grid-connected 20.1 MW electricity generation infrastructure within the geographical limits of the AMC landfill (of which the set of 19 internal combustion gas engines represents the major components) will always be regarded and accounted as consumption of grid-sourced electricity (with related project emissions being accounted and determined ex-post). This represents a conservative approach.

[31] In each one of the operational flares, the main fuel line for the auxiliary flame-based system that supports/allow the flare burner ignition includes a manually selectable switching valve from which an upstream thin supply line (tube/pipeline) or an upstream thin LFG supply line (tube/pipeline) can be alternately selected as the start-up fuel line for flare burner ignition (as part of each event of flare operation starting). In each flare, both the thin LPG supply line and the thin LFG supply line include appropriate pressure reduction valves and other elements which allow the selected start-up fuel (LPG or LFG) being combusted in auxiliary flame-based system under pressure and very flow which are required for the starting-up process of the flare (under conformance with its functioning design). Upon the occurred replacement in June/2011 of the previously installed pressure reduction valve in the thin LFG supply line by a new valve (with improved/appropriate functioning and design), it finally became more reliable and safer to use LFG as primary start-up fuel, thus potentially displacing the so far occurred use of LPG as start-up fuel for the flares. The use of very low amount of collected LFG as start-up fuel in high temperature enclosed flares is indeed a common practice in well-designed LFG collection and destruction initiatives across the world (incl. project-based initiatives under the CDM). In the particular case of the flares of the project activity, in each individual flare operation starting event, the thin LFG supply line (or the thin LPG supply line as an alternative) supply relatively small amount of LFG for keeping the small flame of the auxiliary flame-based system lid (typically about 5 minutes). Moreover, it is relevant to note that, for each operational flare, LFG is injected in the thin LPG supply line for the auxiliary flame-based system used for flare ignition from a LFG supply points within the project's main LFG pipeline which is located upstream to the location within the pipeline where the installed LFG flow meter sets for measuring amount of LFG sent to the project's methane destruction devices are located. Thus, under normal operation conditions, no emission reduction associated with such relatively very low consumption of LFG in each individual flare starting process is accounted. This is conservative. It is also important to note that the use of LPG as start-up fuel is still being available as a backup alternative (e.g. in case of any required planned or unplanned maintenance/repair work in the LFG supply line for igniting the flare).

Technology transfer due to the implementation and operation of the project activity:
By taking into account the pioneer nature of the project activity, at the time of its initial design conceptualization, it was assumed that the applied technology were to be transferred to Brazil through the following actions:

- Partnership with universities: Federal University of Bahia (UFBA), CEPEA/ESALQ from São Paulo University (USP), FEA from São Paulo University (USP)
- Partnership with public agency: CETESB, São Paulo
- Development of local equipment's suppliers: flares, blowers, measurement equipment's, gas capture network equipment and eventually gas to energy plant
- Involvement of Brazilian engineering consultants' firms that would then be able to replicate the project

While most of operation and monitoring equipment installed as part of the implementation of the project activity is imported material, some relevant local content in terms of equipment are installed. By taking into account the pioneer aspect of the implementation of the project activity at the time of its initial design conceptualization within years 2002 and 2003, it indeed promoted significant expertise and competence development in LFG management & design and operation of LFG collection and destruction system in Brazil.

Battre - Bahia Transferencia e Tratamento de Residuos Ltda. (which at the time of the occurred project initial design conceptualization and CDM consideration was a subsidiary of the multinational company SUEZ Environment) has operated and managed the AMC landfill. At that time, SUEZ Environment was operating 237 landfills throughout the world (of which 206 were located in Europe) with a total of 32.8 million ton of Municipal Solid Waste being treated waste in 2001. At that time, most of the landfills operated by SUEZ Environment were equipped with active (forced) or passive LFG capture and treatment system (particularly those requiring compliance with European waste management regulations). As par data of 2000, 16 of these landfills were equipped with power generation units (use of collected LFG as gaseous fuel for electricity generation) and were collectively generating up to 212,000 MWh of electricity per year with a total constant LFG consumption of about 115,000 m^3 per hour in average.

No change in the design and operational conditions of the AMC landfill:
As required by ACM0001 (version 19.0), the design and operational conditions of the AMC landfill has not changed after the implementation of the project activity and no change is expected to occur within its 3rd 7-year renewable crediting period under its revised design configuration. While the volume covered with disposed MSW at the AMC landfill has increased as part of the normal operational dynamics of such large landfill, the landfill design and operational requirements in place are still being the same since the start of operations of the landfill in year 1997 regardless of the implementation (in year 2003) and constant operation of the project activity (since January 2004) and/or its occurred permanent design change.

The AMC landfill is thus expected to remain being operated with the application of the same and previously applied MSW landfilling technics and procedures. Bahia Transferencia e Tratamento de Residuos S.A. has designed and has managed and operated the AMC landfill in accordance with its design, construction, operational and management requirements as required and established in the environmental permits and licenses applicable for the AMC landfill and best practices for landfill construction and operations in Brazil. All this aspects and requirements are completely independent from having a CDM project activity implemented at the AMC landfill

Expected operational lifetime for the project activity:
The expected operational lifetime for the project activity is at least 20 years. Lifetime for the project related equipment may even exceed 20 years if required service and maintenance is performed correctly and in case equipment are always operated as per recommendation and requirements set by manufacturers of related equipment/instruments.

Project monitoring system:
The project activity also includes all needed monitoring system (instruments, equipment and procedures) required to ensure that all applicable monitoring activities are performed as established in the monitoring plan and under conformity with ACM0001 (version 19.0) and applicable methodological tools. Such measurements and monitoring include continuous measurements of LFG flow sent to the flares and to the electricity generation unities, continuous measurements of methane content in collected LFG, etc. ACM0001 (version 19.0) requires ex-post monitoring whether equipment destroying LFG through flaring operates under compliance with operational requirements and/or recommendations as set by flaring equipment manufacturer. Moreover, consumption of electricity and fossil fuel by the project activity (+ related emission factors) are also monitored in order to have project emissions being determined.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	Battre - Bahia Transferencia e Tratamento de Resíduos Ltda.	No
Switzerland	BELEKTRON d.o.o.	No

A.5. Public funding of project activity

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No public funding is involved for the implementation and operation of this project activity.

A.6. History of project activity

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The project activity “Salvador da Bahia Landfill Gas Management Project” is registered as under the CDM and it (and/or the infrastructure/components it encompasses) was not previously included as a component project activity (CPA) in a registered CDM programme of activities (PoA). Prior of being registered under the CDM, the project activity (and/or the infrastructure/components it encompasses) did not represent any part or a whole previously registered CDM project activity that had been deregistered. Prior of being registered under the CDM, the project activity (and/or the infrastructure/components it encompasses) were not part of a previous CPA that has been excluded from a previously registered CDM PoA either.

The project activity (and/or the infrastructure/components it encompasses) does not represent or part of a previously registered CDM project activity or a CPA under a previously registered CDM PoA whose crediting period has or has not expired (hereinafter referred to as former project) which existed within the same or other geographical location as the CDM project activity.

A.7. Debundling

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Not applicable.

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

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The following CDM baseline and monitoring methodology is applied:

- CDM baseline and monitoring methodology ACM0001 - “Flaring or use of landfill gas” (version 19.0) (https://cdm.unfccc.int/methodologies/DB/JPYB4DYQUXQPZLBDVPHA87479EMY9M);

The following methodological tools are also applied:

- Emissions from solid waste disposal sites (version 08.0) (http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v8.pdf);

- Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0) (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v3.0.pdf);

- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (version 03), (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v3.pdf)

- Project emissions from flaring (version 03.0) (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v3.0.pdf);

- Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0) (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v3.0.pdf);

- Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period (version 03.0.1) (http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v3.0.1.pdf).

- Combined tool to identify the baseline scenario and demonstrate additionality (version 07.0) (https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v7.0.pdf)

B.2. Applicability of methodologies and standardized baselines

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The approved baseline and monitoring methodology ACM0001 (version 19.0) is applied. In addition, the above-listed methodological tools (which are referred by this consolidated baseline and monitoring methodology) are also applied. Demonstration of applicability conditions for ACM0001 (version 19.0) and all above-referred methodological tools are included in the tables below:

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 19.0)	**Justification**
"*The methodology is applicable under the following conditions:* *(a) Install a new LFG capture system in a new or existing SWDS*[32] *where no LFG capture system was installed prior to the implementation of the project activity; or* *(b) Make an investment into an existing LFG capture system to increase the recovery rate or change the use of the captured LFG, provided that:* *(i) The captured LFG was vented or flared and not used prior to the implementation of the project activity; and* *(ii) In the case of an existing active LFG capture system for which the amount of LFG cannot be collected separately from the project system after the implementation of the project activity and its efficiency is not impacted on*	As per the latest version of the CDM project standard for project activities (CDM-PS-PA), in the context of the renewal of crediting period for a previously registered CDM project activity, the PDD valid for the additional 3rd 7-year crediting period should be completed by applying the latest version of the CDM baseline and monitoring methodology which was previously applied or, if applicable, the latest version of the CDM baseline and monitoring methodology of which the previously applied CDM methodology was consolidated into. The project activity was previously registered as a CDM project activity by applying the CDM baseline and monitoring methodology AM0002 (version 1.0) and had its 1st 7-year crediting period previously renewed with a PDD applying ACM0001 (version 15.0). While ACM0001 (version 19.0) currently represents the latest valid version of the ACM0001 baseline and monitoring methodology (which has replaced AM0002 and other previous methodologies applicable for landfill gas projects), it was thus the one to be applied in the context of the renewal of crediting period for the registered CDM project activity. The project design encompasses the installation of an active (forced) LFG capture system in an existing SWDS where no LFG collection system was installed under the pre-project scenario[33]. The project was

[32] SWDS = Solid Waste Disposal Site. In the particular case of the project activity, the considered SWDS is the AMC landfill.

[33] While the installed active (forced) LFG capture system as part of the project activity encompasses entirely new equipment (centrifugal blowers, flares, etc.), by assuming that the project activity completely replaces the previously existent pre-project passive LFG venting and combustion system (using conventional passive LFG venting/combustion drains), in the particular context of the demonstration of meeting of applicability criteria for ACM0001 (version 19.0), it is assumed that condition (a) is not applicable and condition (b – i) is applicable. As previously assessed as part of the validation assessment for the currently registered CDM project activity, in the absence of the project (baseline scenario), while a share of generated LFG would be captured and vented through conventional venting/combustion drains that would otherwise be installed, a minor share of collected LFG would thus be combusted in a non-systematic or controlled manner in order to meet safety and odor requirements and also meet the contractual requirement that defines the minimum level/share of methane required to be destroyed at the AMC landfill. Such conventional LFG venting/combustion drains would be installed and would operate without any forced negative pressure gradient. No

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 19.0)	**Justification**
by the project system: historical data on the amount of LFG capture and flared is available. (c) *Flare the LFG and/or use the captured LFG in any (combination) of the following ways:* (i) *Generating electricity;* (ii) *Generating heat in a boiler, air heater or kiln (brick firing only) or glass melting furnace; and/or* (iii) *Supplying the LFG to consumers through a natural gas distribution network.* (iv) *Supplying compressed/liquefied LFG to consumers using trucks* (v) *Supplying the LFG to consumers through a dedicated pipeline* (d) *Do not reduce the amount of organic waste that would be recycled in the absence of the project activity."*	implemented in year 2003. In this sense, condition (a) of the quoted applicability criteria is met. In the absence of the project activity, a set of conventional LFG venting/combustion drains would be installed in order to meet the still existing/valid contractual requirement for the minimum rate of destruction of methane at the AMC landfill. Under its current configuration, the project design encompasses collection of LFG, destruction of methane through combustion of collected LFG in flares and in internal combustion gas engines. Thus, the project activity meets condition (c). *The implementation and operation of the project activity does not reduce the amount of organic waste that would be recycled in the absence of the project activity:* As a result of the previously occurred implementation of the project activity, there were no quantitative, qualitative, procedural or regulatory change occurred or triggered in terms of MSW management activities and policies valid for the AMC landfill and/or valid for any other existing solid waste treatment or solid waste disposal facility under the area of influence of this landfill that would be promoted or triggered by the project activity in comparison with what would occur in the absence of the project activity (baseline scenario). The situation is expected to remain the same during the 3rd 7-year crediting period of the project activity. It is crucial to note that, mainly by taking into consideration the nature of the project activity and aspects related to recycling of organic fraction of MSW in the region of landfill and in the rest of Brazil, both the implementation and operation of the project activity *per se* are not expected to promote any quantitative or qualitative change in terms of waste disposal activities historically undertaken at the AMC landfill. Furthermore, no quantitative or qualitative changes in terms of waste management practices are expected to occur in any other existent or potential solid waste disposal site (SWDS) or solid waste treatment facility (located or to be located in the region under influence by the AMC landfill) as a direct outcome or consequence of the implementation and operation of the CDM project activity during its 3rd 7-

collected LFG would be used for electricity or heat generation in the baseline scenario. No collected LFG would be supplied to consumers through a natural gas distribution network either. As a conclusion, no systematic or continuous monitoring of LFG (under a quantitative or qualitative perspective) has occurred prior to the implementation of the project activity at the AMC landfill. Under the initial project implementation phase, capital investments were made in new equipment (as part of the implementation of the project activity) thus promoting LFG recovery at the landfill without any pre-project LFG management infrastructure and thus allowing systematic and controlled combustion/flaring for captured LFG.

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 19.0)	Justification
	year crediting period. Thus, the mere previously occurred implementation of the project and its continuous operation as a methane destruction initiative under the CDM have not promoted and are not expected to promote or trigger any reduction (or prevention) of the amount of organic type of MSW (or any other type of solid waste) that would eventually be recycled or utilized in the region (e.g. no prevention by the project activity of the implementation or and non-promotion of any reduction of activity in an existent or hypothetical waste composting facility that would promote utilization/recycling of waste in the region (for example)). As demonstrated in applicable construction, design and operational documented requirements valid for the AMC landfill (as previously defined by Bahia Transferencia e Tratamento de Residuos S.A. and later confirmed in the environmental permits valid for the construction and operation of this landfill), the AMC landfill is not expected to include any activity or initiative promoting recycling or utilization of organic fraction of waste disposed in this landfill (such as implementation of a large scale waste sorting or waste composting facility for example). Thus, without any organic waste recycling activity being under operation within the limits of the AMC landfill, it is clearly not expected that the mere implementation of the project activity promoting collection and destruction/utilization of LFG could eventually promote any reduction in the amount of organic waste recycling activities in the AMC landfill and/or in any other site located in region under influence of the AMC landfill. The design, construction and operational aspects for the AMC landfill were previously defined in accordance with the commercial agreements that the project participant Battre - Bahia Transferencia e Tratamento de Resíduos Ltda holds and is expected to hold in the position of the owner of the AMC landfill and also in the position of a private regional waste management company (service provider) acting as a player in market and providing MSW disposal services for the city of Salvador and other municipalities located within its Metropolitan Region. Furthermore, it is also crucial to take into account that currently there is not even any existent or planned large-scale MSW sorting, recycling or utilization facility for organic fraction of MSW (e.g. a large-scale waste composting plant) with comparable size/capacity and located in the region of influence of

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 19.0)	Justification
	the AMC landfill. In fact, recycling and utilization of organic fraction of MSW is not a common practice in the whole country of Brazil. In this sense, the implementation and operation of the project activity thus clearly does not represent any perverse incentive or driver for the promotion of any quantitative or qualitative reduction or even prevention of waste recycling related activities or initiatives for any type of organic fraction of solid waste or solid residues that would occur in the absence of the project activity at the AMC landfill or in the region of influence of this landfill. The same is actually also applicable for recycling of inert waste material. Furthermore, regardless of the non-existence of any MSW recycling or utilization facility with comparable capacity that could eventually somehow compete with the AMC landfill in terms of processing of organic fraction of MSW waste, aspects and actions related to promotion of recycling or utilization of organic fraction of solid waste are to be seen as fully dependent on public service policies in the case of Brazil (including policies, laws, regulations and programmes) and are to be defined/triggered by competent governmental authorities (under a regional and national level) and/or to be eventually implemented/operated by practitioners of waste recycling. In Brazil, the administrations of municipalities are the entities responsible for all MSW management services. Waste management companies such as Battre - Bahia Transferencia e Tratamento de Resíduos Ltda. normally acts as service providers, providing MSW collection and disposal services as per directives and contractual requirements which are set by the municipalities from where generated MSW are to be managed. In this sense, in the position of a MSW management company operating a methane destruction initiative under the CDM, Battre - Bahia Transferencia e Tratamento de Resíduos Ltda. is not under a position to trigger, establish or promote any promotion of reduction or prevention of organic waste recycling in the region where it operates. Finally, the implementation and operation of the project activity has never represented any incentive or driver for involved municipalities, any other public entity or any other relevant recycling practitioner for the promotion of changes in the policies and practices related to recycling of inert or organic solid waste in the region (or even outside the region) of influence of the AMC landfill. No change in this sense is expected

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 19.0)	Justification
	to occur during the 3rd 7-year crediting period of the project activity either. As outlined in Section B.6.1, so far, there is still no legal restriction or requirement for LFG gas collection and its destruction or even utilization using high temperature enclosed flares or any other device/equipment in Brazil. Actually, there is no applicable regulation that deals with LFG management in Brazil at all. Thus, the implementation of more appropriate and environmentally safe management of LFG at the AMC landfill (as a direct outcome of the implementation and operation of the project activity) *per se* does not represent any driver or incentive to dispose incremental amount of MSW in the AMC landfill (when compared to the situation that would occur in the absence of the project). In this sense, under no circumstance the project activity *per se* potentially promote any displacement of volumes of organic waste stream from eventual treatments/utilization in an existent or hypothetical MSW recycling/utilization facilities (e.g. a MSW composting plant for example) to be disposed at the AMC landfill because of the implementation and continuous operation of the project activity. Therefore, applicability condition (d) is also satisfied[34].

[34] As per the Brazilian Federal Law 12.305/10, waste recycling is defined as a process of transformation of waste material and residues through promotion of changes in their physical, chemical or biological properties in order to allow and promote use of such materials as raw material or even as new products. Although waste recycling is being regarded in the national sector directives for waste management as a priority goal, solid waste recycling initiatives in Brazil are still being quite limited (especially in the case of organic fraction of MSW). As outlined in the publication "*Panorama dos Resíduos Sólidos no Brasil – 2018/2019*" (tittle translated into English language as "*Outlook of Solid Waste Sector in Brazil – years 2018/2019"* and available online at: http://abrelpe.org.br/download-panorama-2018-2019/), solid waste recycling initiatives in Brazil have encompassed mainly the following by-products/waste types with higher economic value:

- aluminum (mainly beverage aluminum cans),
- pre-separated/sorted clean (not contaminated) paper,
- pre-separated/sorted (not contaminated) plastic material (mainly PET beverage bottles),
- glass material.

The "*Panorama dos Resíduos Sólidos no Brasil*" is a publication annually published by the Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais – ABRELPE (translated into English language as "Brazilian Association for Municipal Solid Waste and Special Waste") and represents one of the most credible annual outlook and statistics source for the solid waste management in Brazil. The most recent Greenhouse Gases Emissions National Inventory (published by the Brazilian Ministry of Technology and Science in 2010 and available online at: http://www.mct.gov.br/upd_blob/0213/213909.pdf) also confirms that non-conventional MSW treatment alternatives (such as composting of organic fraction of MSW and waste incineration) are not meaningful practices in Brazil (including the region where the project activity was implemented).
In fact, in year 2012 the Brazilian Ministry of City Infrastructure (through its National Secretary of Sanitation) has published the year 2010 edition of a very comprehensive and detailed sectoral analysis/diagnostic about the whole MSW sector in Brazil: the publication "*Diagnóstico do Manejo de Resíduos Sólidos Urbanos – 2017*" (tittle translated into English language as "Diagnostics of Urban Solid Waste Management - 2017" and available online at: http://www.snis.gov.br/diagnostico-residuos-solidos/diagnostico-rs-2017). Like the Report "*Panorama dos Resíduos Sólidos no Brasil – 2018/2019*", this Government official publication also includes relevant and detailed statistics for

MSW management for the main municipalities, States and regions in Brazil. Available statistics includes prevailing practices in terms of waste management practices (collection, disposal and re-use/recycle).

In the particular case of the region under potential influence of the AMC landfill (city of Salvador, Lauro de Freitas e Simões Filho), all solid waste materials (organic or inert) to be eventually/potentially recycled (very small share of collected MSW) are normally previously sorted in the waste generation sources (prior to be mixed with other types of MSW to be disposed in landfills or waste dump sites in the region). In the particular case of recycling of organic fraction of waste material to be disposed in landfills or dump sites, the current *status quo* is also expected to be the prevailing situation valid in the future: paper waste streams (mixed with other MSW types), food residues, textile, wood waste etc. when ready to be disposed in landfills/dump sites or already disposed in a particular landfill or dump site) are not even regarded as recyclable material (and thus not even accounted in the available statistics for recyclable material).
Under the category "*organic MSW fraction*" only clean (not contaminated) and previously sorted pulp/paper/cardboard waste materials has actually been considered as recyclable material (as per both available statistics and available recycling practices). Besides some particular inert waste materials with commercial value (e.g. aluminum, clean plastic material and glass), no other waste materials have been collected from stream of MSW to be disposed in landfills in order to be recycled in the region where the project activity is implemented or transported to be recycled in other region. This has also been the common recycling scenario in other regions of Brazil.
Thus, in the particular case of the AMC landfill, both under the baseline and project scenarios (with or without the implementation of the project activity), no organic fraction of solid waste stream that has been directed to this landfill would be expected to be collected and directed to any type of recycling facility (e.g. composting facility) after or prior its disposal in the landfill site. This situation is expected to remain being the practice in the future. In fact, as established by related construction and design documents for the AMC landfill, no waste pickers or waste sorting teams have ever operated in the landfill area. No composting plant for organic waste (or any other type of alternative management for MSW organic content) was ever implemented or is expected to be implemented in the area in the future either.

That confirms that no relevant sorting and collection of recyclable organic material from MSW already disposed in the AMC landfill are expected to occur regardless of the implementation of the project activity (under both baseline and project scenarios). Thus, recycling or alternative use from organic fraction of waste already disposed in the landfill are not expected to occur either (regardless of the implementation of the project activity).
In summary, based on information and data included in the "*Diagnóstico do Manejo de Resíduos Sólidos Urbanos – 2017*"; information and data available in the "*Panorama dos Resíduos Sólidos no Brasil – 2018/2019*" and also based on common practice for waste collection, disposal e recycling in the region of the project activity and even in other regions in Brazil, and by also taking into account the local situation at the region of the project site, the following assertions are valid for potential of recycling of organic fraction of MSW in the region of influence of the AMC landfill:

- The current MSW management practice in Brazil (and its trend for the future) represents disposal of collected MSW in existing and new landfills (and still existing open dump sites). This practice currently represents almost all undertaken management for all stream of MSW which is actually collected (in mass basis); with very reduced share of collected MSW in Brazil being currently treated under non-conventional methods such as waste incineration (0.03%) and composting (0.11%) (in mass basis as per data of year 2017 (data organized and published in year 2019)).
- It is important to note that in all regions in Brazil with existing MSW disposal activities using landfilling techniques (in existing landfill or existing dump sites) significant quality improvements in terms of MSW disposal services and techniques are still required especially for cases where solid waste is disposed in existing dump sites and in existing not well designed/managed landfills. Such required improvements include construction of better-designed landfills, use of more appropriated technics for waste compacting and covering, etc. In this sense, the AMC landfill represents a very well designed and managed landfill. The main barrier for improving MSW management in Brazil is still being lack of capital and investment capacity from municipalities to face high associated costs for implementing environmentally friendly MSW management operations. Under the region of influence of the AMC landfill, organic fraction of solid waste material that is collected as MSW has been historically disposed by applying landfilling techniques.
- In all geographical regions in Brazil, relative low share of previously sorted pulp/paper/cardboard (clean and not contaminated) waste materials have been used as recycling material in the region. Materials under such conditions are termed in the available statistics as "dry recyclable material" and are normally not mixed with MSW stream to be sent to landfills or dump sites. It is important to note that the initiatives and businesses involving recycling of previously sorted dry pulp/paper/cardboard materials (clean and not contaminated materials) have their particular dynamics and characteristics and with not so detailed statistics in some cases. However, under no circumstance such activities are to be affected or even influenced by change, improvements or aspects related to MSW disposal activities employing good landfilling technics (for example: in most of the well managed landfills in Brazil, the landfill is implemented in a closed and controlled area without waste pickers collecting waste from the landfill as a way or living). By taking into consideration the dynamics of initiatives promoting recycling of paper material, it is correct to assume that, differently than for MSW disposal activities; policies, planning and practices related to MSW collection and sorting could indeed under a certain limit play a role such initiatives.
- By merely promoting efficient collection and destruction/utilization of LFG in a landfill (where LFG is generated due to anaerobic degradation of organic fraction of MSW which is to be disposed in the landfill under the framework of contracts for MSW disposal signed with municipalities in the region), the implementation of the project activity and its continuous operation *per-se* clearly does not represent any driver or incentive for

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – “Flaring or use of landfill gas” (version 19.0)	Justification
“*The methodology is only applicable if the application of the procedure to identify the baseline scenario confirms that the most plausible baseline scenario is* *(a) Atmospheric release of LFG or capture of LFG and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons; and* *(b) In the case that the LFG is used in the project activity for generating electricity and/or generating heat in a boiler, air heater, glass melting furnace or kiln;*	As further demonstrated in Section B.4, the most plausible baseline scenario for methane emissions remains being the release of LFG from the SWDS into the atmosphere (with minor share of generated LFG being partially destroyed in conventional LFG passive venting/combustion drains). The application of the procedure to identify the baseline scenario thus falls into (a). While the project activity does not encompass supply of LFG to the end-user(s) through natural gas distribution network, trucks or the dedicated pipeline, (c) is thus not applicable. While the AMC landfill does not represent a Greenfield SWDS, (d) is not applicable either. The quoted applicability condition is thus

promoting any change in the MSW management situation in the region where it is implemented (including waste recycling practices or initiatives for organic content of MSW to be disposed in landfills or dump sites).

By taking into account (i) the institutional and regulatory framework for the public service of MSW management; (ii) the dynamics of MSW sector in the region where the project activity is to be implemented and in Brazil, and (iii) magnitude of average costs for existing MSW management options (which could be regarded as alternatives to disposal of MSW in landfills (e.g employment of MSW composting techniques)), (iv) the available related statistics, the following aspects are to be noted:

- it is clear that promotion or even disincentive of recycling of organic fraction of MSW are not waste policy aspects that would be under any influence or willingness of the project participant BATTRE (owner and operator of the AMC landfill). Aspects and actions related to promotion of any increase or even reduction of recycling of organic fraction of waste (and/or recycling of any other type of solid waste material) in the region where the project activity is implemented, are to be seen as dependent in a last instance on public service policies (including policies, laws, regulations and programmes) to be set by competent governmental authorities (under a regional and national level) and by practitioners of recycling. In Brazil, the administrations of municipalities are responsible for addressing all MSW management services. Furthermore, there are federal directives and laws to be considered by Municipalities for the implementation and operation of their local waste management policies. This is the case in the geographical region of the project site. Waste collection and disposal services are normally performed by the municipality and/or are performed by private companies hired and paid by one or more municipalities (under contractual commercial agreements for provision of public service on behalf of such municipality (ies)) for the provision of MSW collection and/or MSW disposal services by completely following directives and requirements established by the municipalities in signed contracts. In this context, both under the baseline and project scenarios (with or without the implementation of the project activity), the project participant Battre – Bahia Transferencia e Tratamento de Resíduos Ltda. is not under a position to design or plan the implementation of any initiative promoting recycling or use of organic waste (e.g. operation of a solid waste composting plant) at the AMC landfill or at other location in the region.
- The implementation of the project-based initiative promoting collection of LFG and its destruction in high temperature flare and utilization as fuel for electricity generation in the AMC landfill *per se* would not trigger any change in the regional policies and practices for MSW management in the region or outside its region of influence either. As further discussed in Section B.6.1, so far, there is still no legal restriction neither requirement for LFG gas collection and its destruction using high temperature enclosed flares in Brazil. Moreover, there is still no legal restriction neither requirement for passive venting of LFG or its combustion in conventional LFG destruction systems either. Actually, regardless of the existing contractual requirement that defines the minimum level/share of methane required to be destroyed at the AMC landfill (as established by the Administration of the Municipality of Salvador (public authority)) there is no applicable regulation/law that deals with LFG management in Brazil. Thus, the implementation (and operation) of more appropriate and environmentally safe management of LFG at the AMC landfill as part of the project activity does not represent a driver or incentive to promote incremental disposal of organic waste stream at this landfill thus displacing or preventing such waste stream from being treated under an existent or potential (hypothetical) MSW recycling/utilization facilities (e.g. a hypothetical waste composting plant) instead.

In summary, by taking into consideration the nature of project activity and all aspects and information above-presented, the project activity does not pose any risk or potential to promote any relative decrease of the amount of organic fraction of MSW that would be otherwise recycled or utilized or prevention of any mean of waste recycling or utilization.

Applicability Condition of CDM baseline and monitoring methodology ACM0001 – "Flaring or use of landfill gas" (version 19.0)	**Justification**
(i) For electricity generation: that electricity would be generated in the grid or in captive fossil fuel fired power plants; and/or *(ii) For heat generation: that heat would be generated using fossil fuels in equipment located within the project boundary."* *(c) In the case of LFG supplied to the end-user(s) through natural gas distribution network, trucks or the dedicated pipeline, the baseline scenario is assumed to be displacement of natural gas.* *(d) In the case of LFG from a Greenfield SWDS, the identified baseline scenario is atmospheric release of the LFG or capture of LFG in a managed SWDS and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons.*	satisfactory met.

Non applicability conditions	**Justification**
"This methodology is not applicable: *(a) In combination with other approved methodologies. For instance, ACM0001 cannot be used to claim emission reductions for the displacement of fossil fuels in a kiln or glass melting furnace, where the purpose of the CDM project activity is to implement energy efficiency measures at a kiln or glass melting furnace;* (b) *If the management of the SWDS in the project activity is deliberately changed during the crediting in order to increase methane generation compared to the situation prior to the implementation of the project activity.*	Neither options (a) and/or (b) occur. Under the revised project design configuration, the only GHG emission reductions claimed are due to destruction of methane through combustion (in high temperature enclosed flares an in the set of internal combustion gas engines). After the implementation of the project activity in year 2003, the landfill operator has continued with MSW disposal activities at the AMC landfill as per its normal and previously planned/defined operation conditions and practices (as per the practice prior to the implementation of the project activity). MSW disposal practices and management at the AMC landfill are not expected to change during the 3rd 7-year crediting period of the project activity either. The quoted applicability condition is thus satisfactory met.

Regarding the applied methodological tools, the table below summarizes how the project activity meets their applicability conditions:

Methodological tool	Version	Applicability conditions	Comments
"Project emissions from flaring"	03.0	*"This tool provides procedures to calculate project emissions from flaring of a residual gas. The tool is applicable to enclosed or open flares and project participants should document in the CDM-PDD the type of flare used in the project activity.* *This tool is applicable to the flaring of flammable greenhouse gases where:* *o Methane is the component with the highest concentration in the flammable residual gas; and* *o The source of the residual gas is coal mine methane or a gas from a biogenic source (e.g. biogas, landfill gas or wastewater treatment gas).* *The tool is not applicable to the use of auxiliary fuels and therefore the residual gas must have sufficient flammable gas present to sustain combustion. For the case of an enclosed flare, there shall be operating specifications provided by the manufacturer of the flare.* *This methodology refers to the latest approved version of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream". The applicability conditions of this tool also apply."*	As part of the project activity, share of collected LFG (whose component with the highest concentration is methane) is combusted in high temperature enclosed flares with other share being combusted in a set of internal combustion gas engines (which represents the major components of a grid-connected 20.1 MW electricity generation infrastructure fuelled by LFG and located within the geographical limits of the AMC landfill). LFG is a flammable gas generated from the anaerobic decomposition of organic waste material disposed in the AMC landfill. LFG is thus a gas from a biogenic source. Methane is the component with the highest concentration in LFG. No auxiliary fuel is required to make the flammability of LFG sufficiently enough to be combusted in the project flares[35]. As demonstrated above, the applicability conditions for the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"

[35] In accordance with the design of the currently installed high temperature enclosed flares, Liquefied Petroleum Gas (LPG) is to be potentially used during short time periods for igniting the flares. For starting the flare, LPG may be directed to the fuel injectors of the flare and once the flame is sufficiently stable, collected LFG is thus directed to the flare and supply of LPG to the injectors is thus immediately interrupted. By taking into account the type/purpose of the potential use of LPG by the project activity, it is deemed correct to assume that LPG does not represent any auxiliary fuel (which would be required to make the flammability of LFG sufficiently enough to be combusted in the project's flare). It is important to note that during the short time LPG may be combusted during the flare ignition process, no measurements of LFG directed to the installed flare are performed with the flare meeting the operational requirements (as set by equipment manufacturer (e.g. min. flow, min. temperature of exhaust gas of the flare, etc.)). Thus, whenever the minor quantity of LPG is being combusted in the flare, no emission reductions due to methane combustion are claimed. It is important to note that, as outlined in Section B.6.1, all consumption of LPG by the project activity to ignite the flares are to be accounted as project emissions.

Methodological tool	Version	Applicability conditions	Comments
			are also sufficiently met. Thus, the quoted applicability criteria defined in the methodological tool are sufficiently met.
"Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"	03.0	*"This tool provides procedures to estimate the baseline, project and/or leakage emissions associated with the consumption of electricity.* *(…)* *The tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption:* *<u>Scenario A:</u> Electricity consumption from the grid. The electricity is purchased from the grid only. Either no captive power plant is installed at the site of electricity consumption or, if any on-site captive power plant exits, it is not operating or it can physically not provide electricity to the source of electricity consumption.* *<u>Scenario B:</u> Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumption source and supply the source with electricity. The captive power plant(s) is/are not connected to the electricity grid.* *<u>Scenario C:</u> Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumption source. The captive power plant(s) can provide electricity to the electricity consumption source.*	The electricity demand of the project activity configuration has been met by imports of grid-sourced electricity [36]. In cases of impossibility of meeting the project's electricity demand through imports of grid-sourced electricity, electricity generated by the backup captive off-grid electricity generator (fuelled by diesel) will be consumed by the project activity [37]. Thus, Scenario C of the tool is applicable. In summary, the quoted applicability criteria defined in the methodological tool are sufficiently met. It is important to note that, as further explained in Section A.3, emission reductions associated to generation of electricity by the grid-connected 20.1 MW electricity generation infrastructure fuelled by LFG and located within the geographical limits of the AMC landfill will not be accounted during the 3rd 7-year crediting period of the project activity. As further

[36] It is relevant to note that in the particular case of the project activity, all electricity sourced by the grid-connected 20.1 MW electricity generation infrastructure fuelled by LFG and located within the geographical limits of the AMC landfill is regarded and accounted as consumption of grid-sourced electricity as justified in Box 2 in Section A.3.

[37] Since 01/01/2011, the project's electricity demand is to be met by one of the following sources/approaches:

- Imports of grid-sourced electricity (with electricity sourced by the grid-connected 20.1 MW electricity generation infrastructure fuelled by LFG and located within the geographical limits of the AMC landfill being always regarded and accounted as consumption of grid-sourced electricity as justified in Box 2 in Section A.3).
- Electricity supply by the installed backup captive off-grid electricity generator (fuelled by diesel) (expected to occur only during temporary planned or unplanned circumstances when supply of grid-sourced electricity is also interrupted).

Methodological tool	Version	Applicability conditions	Comments
		The captive power plant(s) is/are also connected to the electricity grid."	explained in Sections B.6.1, B.7.1 and B.7.3, 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 AMC landfill will be accounted as consumption of grid-sourced electricity (with related project emissions being ex-post determined).
"Emissions from solid waste disposal sites"	08.0	*"This tool provides procedures to calculate baseline, project or leakage emissions of methane from solid waste disposed or prevented from disposal at a solid waste disposal site (SWDS)."* *"The tool can be used to determine emissions for the following types of applications:* *(a) Application A: The CDM project activity mitigates methane emissions from a specific existing SWDS. Methane emissions are mitigated by capturing and flaring or combusting the methane (e.g. "ACM0001: Flaring or use of landfill gas"). The methane is generated from waste disposed in the past, including prior to the start of the CDM project activity. In these cases, the tool is only applied for an ex ante estimation of emissions in the project design document (CDM-PDD). The emissions will then be monitored during the crediting period using the applicable approaches in the relevant methodologies (e.g. measuring the amount of methane captured from the SWDS);*	The project activity mitigates methane emissions from a landfill. The applicability of the methodological tool is thus met. Application A in the methodological tool is selected and applied in the context of calculations of ex-ante estimates of emission reductions to be achieved by the project activity during its 3rd 7-year crediting period as established by ACM0001 (version 19.0).
"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"	03.0	*"This tool provides procedure to determine and calculate project and/or leakage CO_2 emissions from the combustion of fossil fuels. It is used in cases where CO_2 emissions from fossil fuel combustion (for use other than for electricity generation)*	As established by ACM0001 (version 19.0), this methodological tool is applied for the determination of project emissions due to the consumption of fossil fuel by

Methodological tool	Version	Applicability conditions	Comments
		are calculated based on the quantity of fuel combusted and its properties.”	the project activity (with fossil fuel being used for purposes other than for electricity generation). In the particular case of the project activity, Liquefied Petroleum Gas (LPG) is to be potentially used to ignite the installed/operational flare (after events of planned or unplanned interruptions of operation of the flare). The applicability condition of the methodological tool is thus met.
“Tool to determine the mass flow of a greenhouse gas in a gaseous stream”	03.0	“*This tool is used to determine the mass flow of greenhouse gas i (CO_2, CH_4, N_2O, SF_6 or a PFC) in the time interval t.”* *This tool provides procedures to determine $F_{i,t}$ (kg/h). The mass flow of a greenhouse gas (CO_2, CH_4, N_2O, SF_6 or a PFC) in the gaseous stream in time interval t. based on measurements of:* *(a) the total volume flow or mass flow of the gas stream,* *(b) the volumetric fraction of the gas in the gas stream and* *(c) the gas composition and water content.* *Typical applications of this tool are methodologies where the flow and composition of residual or flared gases or exhaust gases are measured for the determination of baseline or project emissions, which is the case of the present project activity”.*	As established by ACM0001 (version 19.0), this tool is applied as per the methodology for determining the mass flow of CH_4 which is sent to the flares. The applicability condition of the methodological tool is thus met.
Methodological tool “Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period”	03.0.1	“*This tool provides a stepwise procedure to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period, as required by paragraph 49 (a) of the modalities and procedures of the clean development mechanism. The tool consists of two steps. The first step provides an approach to evaluate whether the current baseline is still valid for the next crediting period. The second step provides an approach to update the baseline in case that the current baseline is not valid anymore*	The application of this tool in the context of the renewal of the 7-year crediting period is required as per the CDM project standard for project activities (CDM-PS-PA). The applicability condition of the methodological tool is thus met.

Methodological tool	Version	Applicability conditions	Comments
		for the next crediting period."	
"Combined tool to identify the baseline scenario and demonstrate additionality"	07.0	*"This tool provides a step-wise approach to identify the baseline scenario and simultaneously demonstrate additionality."* *"The tool is applicable to all types of proposed project activities. However, in some cases, methodologies referring to this tool may require adjustments or additional explanations as per the guidance in the respective methodologies. This could include, inter alia, a listing of relevant alternative scenarios that should be considered in Step 1, any relevant types of barriers other than those presented in this tool and guidance on how common practice should be established."*	As established by ACM0001 (version 19.0), this methodological tool is applied for determining both the baseline scenario for a proposed CDM project activity as well for assessing and demonstrating the additionality of a proposed CDM project activity.

B.3. Project boundary, sources and greenhouse gases (GHGs)

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The boundary of the project activity includes the landfill site where LFG rich in methane is captured and destroyed (through combustion of LFG in a set of enclosed high temperature flares and in a set of internal combustion gas engines (collectively regarded as methane destruction devices for the project activity)). The electricity grid to which the project activity is connected to[38] is the National Electricity Grid of Brazil. The table below provides a summary of the delineation of greenhouse gases (GHG) and sources included and excluded from the project boundary:

[38] Since 01/01/2011, the project's electricity demand is to be met by one of the following sources/approaches:

- Imports of grid-sourced electricity (with electricity sourced by the grid-connected 20.1 MW electricity generation infrastructure fuelled by LFG and located within the geographical limits of the AMC landfill being always regarded and accounted as consumption of grid-sourced electricity as justified in Box 2 in Section A.3). This represents a conservative approach.
- Electricity supply by the installed backup captive off-grid electricity generator (fuelled by diesel) (expected to occur only during temporary planned or unplanned circumstances when supply of grid-sourced electricity is also interrupted).

	Source	GHG	Included?	Justification/Explanation
Baseline	Emissions from decomposition of waste at the SWDS site.	CO_2	No	CO_2 emissions from decomposition of organic waste are not accounted since the CO_2 is also released under the project activity.
		CH_4	Yes	The major source of emissions in the baseline.
		N_2O	No	N_2O emissions are very small when compared to CH_4 emissions from SWDS (in tCO_2e). This is conservative.
Project activity	Emissions from consumption of fossil fuel LPG by the project activity	CO_2	Yes	May be an important emission source.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from consumption of grid-sourced electricity by the project activity	CO_2	Yes	May be an important emission source.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from consumption of electricity sourced by the backup captive off-grid electricity generator (fueled by diesel)	CO_2	Yes	May be an important emission source.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.

The schematic flow diagram below summarizes the project boundary and delineates the project activity (equipment, parameters to be monitored, and GHG included in the project boundary).

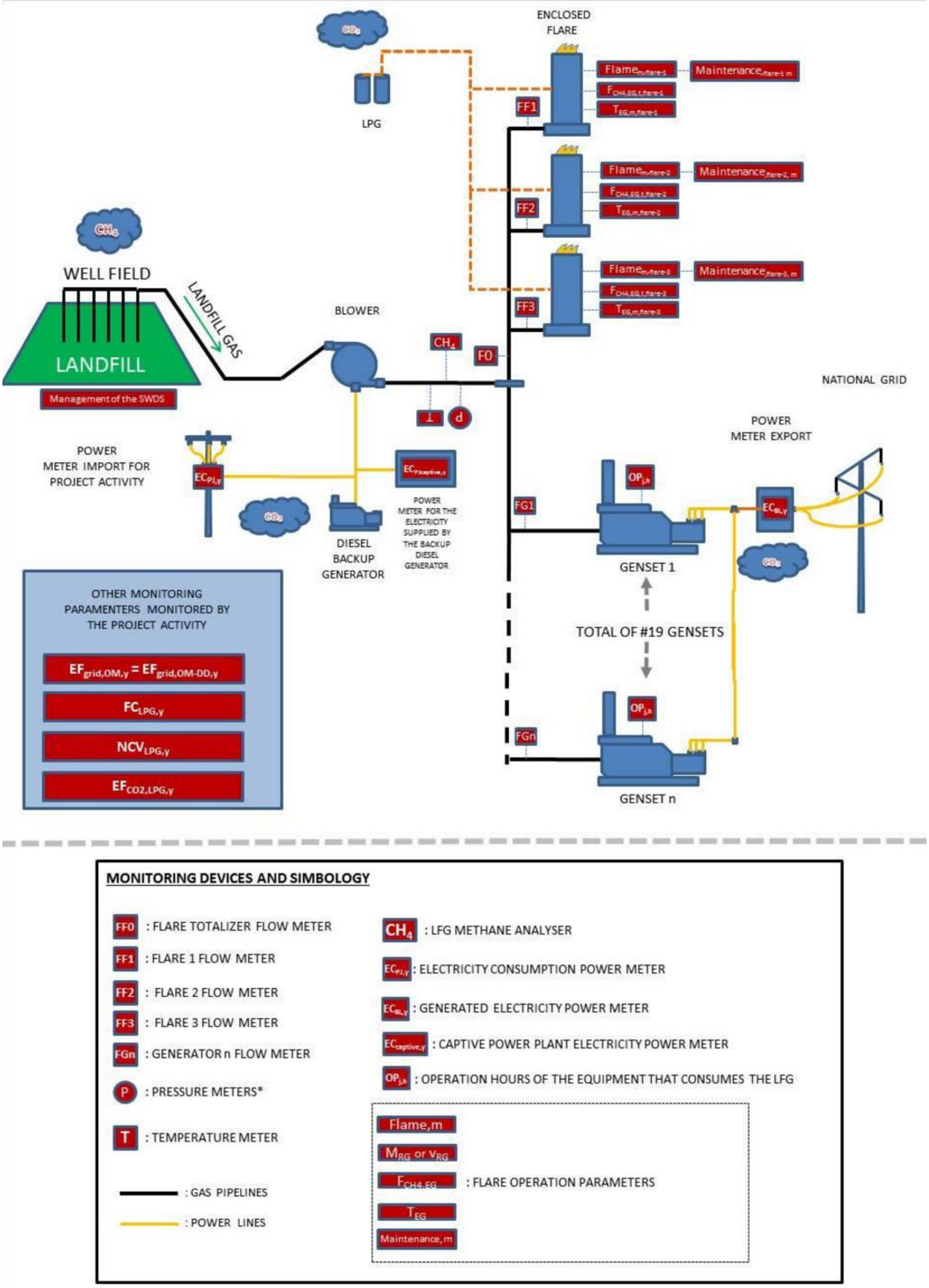

Figure 14 - Schematic flow diagram: delineation of the project boundary for the project activity (under its revised design configuration)

B.4. Establishment and description of baseline scenario

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This Section includes the application of the stepwise approach of the latest version of methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" in order to confirm the identification of the baseline scenario for the project activity within its 3rd 7-year crediting period.

<u>Application of the stepwise approach of the methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period":</u>

As per applicable guidance of the CDM project cycle procedure for project activities (CDM-PCP-PA), the stepwise approach of the methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" (version 03.0.1) is to be applied in order to confirm the validity of the previously determined baseline scenario of the project activity for methane emissions.

Step 1: Assess the validity of the current baseline for the next crediting period

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies

<u>Baseline for emissions of methane:</u>

As further explained in Section B.6.1, prior to the registration of the project as a CDM, regardless of the existence of a still valid contractual requirement defining the minimum level of methane to be combusted at the AMC landfill (as established by the Administration of the Municipality of Salvador (public authority)), there was indeed no legal obligation to capture and destroy the LFG (by using active (forced) collection systems and high temperature enclosed flares) at the AMC landfill and/or in any other existing (under operation or not) landfill in Brazil.

This situation currently prevails[39].

Although there is still no regional or national legal requirement in Brazil establishing LFG to be collected and destroyed in landfills located in Brazil, in the particular case of the AMC landfill, in order to meet the still existing/valid requirement establishing for the minimum level of methane to be combusted at the AMC landfill (as established by the Administration of the Municipality of Salvador (municipal authority)), it is assumed that in the absence of the project (baseline scenario) a set of conventional passive LFG venting/combustion drains would be gradually implemented and used as a LFG management measure in place for meeting the requirement. The demonstration of validity of the previously determined baseline scenario for the project activity is thus under full compliance with existing/valid applicable mandatory national, regional and/or sectorial policies and requirements.

The demonstration of validity of the previously identified baseline scenario for emissions of methane at the AMC landfill for the project activity is thus under full compliance with mandatory national, regional and/or sectorial policies and requirements.

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[39] By November/2019, there was still no legal requirement for LFG gas collection and its destruction using active or passive high temperature enclosed flares in Solid Waste Disposals Sites (SWDS's) in Brazil (from open waste dumpsites to well-managed landfills). Moreover, by November/2019 there was still no legal restriction neither legal requirement for passive venting of LFG or combustion of LFG in conventional LFG destruction systems (e.g. passive flares) valid for SWDS's located in the country either. Actually, there is still no applicable regulation that deals with LFG management in Brazil.

The Brazilian National Policy on Waste Management: After years of studies and negotiations, the Brazilian Regulation termed National Policy on Waste Management, established by Decree No. 7,404/10 (the Decree) was finally published on 23/12/2010. In force since its publication and with no modifications/complementation since its issuance, this decree regulates the National Policy on Waste Management (PNRS) as established by Federal Law No. 12,305 (the LPNRS), and creates the Steering Committee for the Implementation of Reverse Logistics Systems (Steering Committee) and the PNRS Interministerial Committee. This most recent Brazilian Regulation of the National Policy on Waste Management does not establish any requirement, obligation or recommendation related to LFG management at landfills in Brazil. The following about the *Regulation of the National Policy on Waste Management* is pointed out by the law firm "Tauil & Chequer Advogados" in an articles published in year 2011:

> *"(...) The Regulation of the National Policy on Waste Management, established by Decree No. 7,404/10 (the Decree), was published on December 23, 2010. In force since its publication, the Decree regulates the National Policy on Waste Management (PNRS), established by Federal Law No. 12,305/10 (the LPNRS), and creates the Steering Committee for the Implementation of Reverse Logistics Systems (Steering Committee) and the PNRS Interministerial Committee. The main purpose of the PNRS Interministerial Committee is to support the PNRS structuring and implementation, in order to enable the accomplishment of the provisions and goals set forth by the LPNRS. The Steering Committee has the basic function of guiding the implementation of reverse logistics. Among the instruments regulated by the Decree are the Reverse Logistics Systems, the Waste Management Plans (PGRS) and the National Registry for Hazardous Waste Operators. The Decree lists three specific instruments for the implementation and operation of the reverse logistic systems: (i) sectorial agreements, executed between public authorities and the industry; (ii) regulations, issued by the executive branch; and (iii) commitment agreements—which are to be adopted in the absence of sectorial agreements and regulations and when specific circumstances require more restrictive obligations—to be approved by the competent environmental agency. Regarding the obligation to prepare a PGRS, which should be required within environmental permitting proceedings, the Decree mentions the possibility of jointly submitting the PGRS under specific conditions and in cases where activities are conducted in the same condominium, municipality, micro-region or metropolitan/urban areas. Additionally, the Decree establishes that small companies that generate household waste, as provided for by article 30 of the LPNRS, are not required to submit a PGRS. Regarding the National Registry for Hazardous Waste Operators, which must be integrated to the already existing Federal Technical Registry of IBAMA, the Decree establishes a registration obligation for companies that manipulate or operate hazardous waste. The Decree also describes those who are considered generators or operators of hazardous waste, establishing several requirements for their authorization or permitting. These include the preparation of hazardous waste management plan, the demonstration of technical and economic capacity and the obtaining of civil liability insurance for environmental damages."*

Determination of plausible alternative(s) for generation of electricity in the absence of the project activity:

As presented in the next steps, as explicitly established by ACM0001 (version 19.0), the baseline for generation of electricity is directly defined as follows:

"*Electricity generation in existing and/or new grid-connected power plants*"

The baseline scenario for electricity generation is thus directly regarded as under full compliance with mandatory national, regional and/or sectorial policies and requirements.

Step 1.2: Assess the impact of circumstances

Baseline for emissions of methane:

The previously identified baseline scenario for emissions of methane at AMC landfill for the project activity was previously demonstrated as not changed at the time of requesting renewal of the crediting period[40]. While this baseline scenario for methane emissions identified at the validation stage of the project activity was "*the continuation of the current practice without any investment*", an assessment of the changes in market characteristics was thus required for the renewal of the crediting period. This is required by the methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" (version 03.0.1).

As an outcome of such analysis, it is was previously confirmed the following:

- The conditions and circumstances considered or taken into account to determine the baseline emissions in the previous crediting period are still valid. LFG (rich in CH_4) generated at the AMC landfill would still being freely emitted into the atmosphere (with minor share of generated LFG being destroyed in conventional passive LFG venting/combustion drains in order to meet the contractual requirement) in the absence of the project activity.
- There is no change in market or regulatory characteristics/aspects (incl. legal requirements) or new market or regulatory circumstances that would demand any type of re-assessment or re-evaluation for the determination of the baseline scenario for the 3rd 7-year renewable crediting period.

[40] By taking into account the non-inclusion of electricity generation as additional GHG abatement/mitigation measure as part of the project activity + non-accounting of emission reductions associated to displacement of a more-GHG-intensive service (i.e. CO_2 emission reductions due to generation of electricity using collected LFG as renewable energy source) and by also noting that the previously identified baseline scenario for the project activity in terms of methane emissions remains the same, baseline emissions and ex-ante estimations of emission reductions to be achieved by the project activity during the 3rd 7-year renewable crediting period have thus not changed when compared assumptions as presented in the latest version of the PDD (and related emission reduction spreadsheet) valid for the 1st 7-year crediting period (PDD version 7, dated 28/01/2015).

While the baseline and monitoring methodology which was previously applied in the PDD for the 1st crediting period (AM0002, version 1) includes a methodological approach for determining the baseline emissions due to methane destruction which is based in specific set of methodological assumptions and approaches, the methodological assumptions (incl. default values) applicable as per both ACM0001 (version 15.0) and as per ACM0001 (version 19.0) are slightly different. Such differences promote a relative difference in estimations of ex-ante estimations of baseline emissions to be achieved by the project activity along the 2nd and 3rd 7-year crediting period. Furthermore, it is also noteworthy that the ex-ante selected value for Global Warming Potential (GWP) for methane (CH_4) which is valid for the largest share of the 2nd 7 year crediting period (period from 01/01/2013 onwards) and for the 3rd 7-year crediting period (value valid for the 2nd commitment period of the Kyoto Protocol) is higher than the one previously applied (value of 25 instead of 21 values previously applied).

Remaining baseline alternative for generation of electricity:

While the baseline scenario for generation of electricity is demonstrated/confirmed as being directly defined as being "*Electricity generation in existing and/or new grid-connected power plants*"; there are no conditions and/or circumstances and/or changes in market regulatory characteristics/aspects to be considered/assessed.

Step 1.3: Assess whether the continuation of the use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewable is requested.

While the baseline scenario identified at the previously performed validation stage of the project activity was not selected at that time as "*the continuation of use of the current equipment(s) without any investment and, the projects proponents or third party (or parties) would undertake an investment later due, for example, to the end of the technical lifetime of the equipment(s) before the end of the crediting period or the availability of a new technology*", this step is thus not applicable. This is applicable both in the context of baseline for emissions of methane and baseline for generation of electricity.

Step 1.4: Assessment of the validity of the data and parameters

It is relevant to note that selected methodological requirements, ex-ante selected data and parameters which were determined in year 2003 (prior to the start of the 1st 7-year crediting period of the project activity) as per the applicable requirements of the previously applied CDM baseline and monitoring methodology (AM0002 (version 1)) are not any longer valid/applicable for the 2nd and 3rd 7-year crediting period (since other/more recent CDM baseline and monitoring methodology (ACM0001 (version 15.0)) and ACM0001 (version 19.0) are applied for the 2nd and 3rd 7-year crediting periods of the project activity respectively).

As per the applied version of the valid CDM baseline and monitoring methodology (ACM0001 (version 19.0)) and related methodological tools, there are differentiated applicable methodological approaches that are considered (when compared to the previously applied AM0002 (version 1)) (incl. some of the ex-ante determined parameters, other default values and even other assumptions). Due to that, new data and ex-ante determined parameters were previously applied in the context of the demonstration of the validity of the previously derived baseline scenario and also applied in the determination of baseline emissions for the 3rd 7-year crediting period. Thus, some of data and parameters as presented in the latest version of the PDD valid for the 1st crediting period are not any longer valid. Furthermore, it is also relevant to note that values for new/additional ex-ante determined parameters also selected in this revised version of the PDD in order to address previously approved occurred changes in the project design.

As a conclusion, since (i) the demonstration of validity of the previously derived baseline scenario, (ii) determination of baseline emissions for the 3rd 7-year crediting period and (iii) ex-ante determined parameters and default values are all determined/calculated as per applicable guidance of ACM0001 (version 19.0) + applicable methodological tools, the validity of most of the previously defined ex-ante determined parameters is thus limited for the project activity. The methodological approaches for the demonstration of validity of the previously derived baseline scenario, baseline emissions of methane during the 3rd 7-year crediting period, ex-ante determined parameters and monitored parameters for the project activity are all presented and justified in this Section, in Section B.6.1, Section B.6.2 and Section B.7.1 respectively.

Step 2: Update the current baseline and the data and parameters

Step 2.1: Update the current baseline

The determination of the baseline scenario for the project activity (as per applicable guidance of ACM0001 (version 19.0) + applicable methodological tools) is included below under "*Determination of the baseline scenario*".

It is important to note that while the baseline scenario (in terms of emissions of methane) for the project activity is not changed for the 3rd 7-year renewable crediting period (when compared to the baseline scenario assumed for its 1st and 2nd 7-year crediting periods), the applied methodological approaches for the determination of baseline scenario and baseline emissions (as per ACM0001 (version 19.0) + applicable methodological tools) are indeed different than the ones required by the previously applied methodology AM0002 (version 1) in the PDD valid for the currently expired 1st 7-year crediting period of the project activity.

Moreover, identification of baseline for generation of electricity was previously assumed as relevant for the demonstration of non-undermining of the previously assessed additionality of the project activity by the previously approved permanent changes in the project design. Thus, for completeness reasons, this revised version of the PDD includes the determination of the baseline scenario and baseline emissions both for methane emissions and for electricity generation as per the applicable guidance and requirements and stepwise approaches of ACM0001 (version 19.0) regardless the fact baseline scenario (in terms of methane emissions) remains being the same as the one valid for its currently expired 1st and 2nd 7-year crediting periods and that emission reductions associated to displacement of a more-GHG-intensive service (i.e. CO_2 emission reductions due to generation of electricity using collected LFG as renewable energy source) are not accounted.

The determination of baseline emissions of methane (by following all applicable guidance and requirements of ACM0001 (version 19.0) and applicable related methodological tools) is presented in Section B.6.1 (under "*Determination of* $F_{CH4,BL,y}$"). Related ex-ante estimations of baseline emissions for the 3rd 7-year crediting period are summarized in Section B.6.3.

Determination of the baseline scenario *(in order to demonstrate the continuation of earlier identified baseline scenario)*
(By following applicable stepwise procedure of the "Combined tool to identify the baseline scenario and demonstrate additionality" as required by ACM0001 (version 19.0)):

On the next steps, the validity of the previously identified project's baseline scenario for methane emissions is confirmed through the application of the stepwise approach for determining baseline scenario as per the "Combined tool to identify the baseline scenario and demonstrate additionality" (version 07.0) as required by ACM0001 (version 19.0).

Application of the stepwise approach for determining baseline scenario for both emissions of methane at the AMC landfill as per the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality":

STEP 0: Demonstration whether the proposed project activity is the *First-of-its-kind*

This optional step is not applied for the renewal of the crediting period of a registered CDM project activity.

STEP 1: Identification of alternative scenarios

SUB-STEP 1a: Define alternatives to the proposed CDM project activity

Identification of alternatives for the destruction of LFG:

In this step, the following baseline alternatives for the destruction of LFG are taken into consideration:

LFG1: The project activity undertaken without being registered as a CDM project activity. (i.e. capture and landfill or use of LFG). This is a plausible alternative scenario, however involves significant investment and operation & maintenance costs.

LFG2: Atmospheric release of the LFG or capture of LFG in a managed SWDS and destruction through flaring to comply with regulations or contractual requirements, or to address safety and odour concerns or for other reasons. This scenario corresponds to the continuation of the current situation (the proposed project activity or any other alternatives are not implemented).

LFG3: Atmospheric release of the LFG or capture of LFG in an unmanaged SWDS and destruction through flaring to comply with regulations or contractual requirements, to address safety and odour concerns, or for other reasons. While the AMC landfill is a well-managed SWDS, this alternative is not applicable.

LFG4: LFG is partially not generated because part of the organic fraction of the solid waste is recycled and not disposed in the SWDS;

LFG5: LFG is partially not generated because part of the organic fraction of the solid waste is treated aerobically and not disposed in the SWDS;

LFG6: LFG is partially not generated because part of the organic fraction of the solid waste is incinerated and not disposed in the SWDS.

The project activity was developed and it is currently implemented at the AMC landfill site, which is a well-managed landfill site. This particular SWDS has been under continuous operation since 1997. The purpose of the AMC landfill is the final disposal of municipal solid waste through adopting of appropriate landfilling practices and techniques. The design, construction and operation of the AMC landfill do not encompass any recycling of the organic fraction of waste and its design is not expected to change in the future. Furthermore, as further explained in Section B.2, the project activity has not previously promoted and is not expect to promote any change in waste recycling activities in the region where the AMC landfill is located. In this context, it is crucial to note that with or without the project activity being implemented, no recycling of the organic fraction of waste disposed at the AMC landfill, neither aerobic treatment, neither incineration of disposed waste streams have occurred or have prevented (or would have occurred or would have prevented) at this particular landfill and/or in any other landfill, or recycling station located in the region where the AMC landfill is located.

Thus, alternative scenarios LFG3, LFG4, LFG5 and LFG6 are hereby automatically excluded from the determination of baseline alternatives. Such exclusions is in accordance with applicable guidance of ACM0001 (version 19.0).

In fact, recycling of organic matter, aerobic treatment and incineration of Municipal Solid Waste (MS) has not been common practice in Brazil[41]. The implementation and operation of project activity has never promoted and is not expected to promote any quantitative change (including reduction) in the amount of organic solid waste that could or would be eventually recycled. This is an applicability condition/criteria of ACM0001 (version 19.0) of which compliance is further explained in Section B.2.

Identification of alternatives for electricity generation:

While the project activity (under its current design configuration) includes methane destruction as its unique measure, identification of alternatives for electricity generation is thus not applicable in the particular context of the application of the stepwise procedure of the methodological tool for the identification of baseline scenario.

Box 2a – Previously occurred identification of remaining alternative for electricity generation being effectively considered in previous version of the PDD (version 14.1 dated 02/11/2018) in the particular context of the assessment/demonstration of non-undermining of previously demonstrated additionality of the project activity.

Regardless of the non-inclusion of electricity generation as an additional GHG abatement/mitigation measure for the project activity and non-accounting of emission reductions associated to displacement of a more-GHG-intensive service (i.e. CO_2 emission reductions due to generation of electricity using collected LFG as renewable energy source), alternative(s) for electricity generation were anyway previously identified as part of application of STEP 1 in the previous version of the PDD (version 14.1 dated 02/11/2018) valid for the currently expired 2[nd] 7-year crediting period addressing occurred permanent changes in the project design inter alia encompassing methane destruction through combustion of collected LFG also in set of 19 internal combustion gas engines (which are the major components of an electricity generation

[41] In fact, organic content of generated Municipal Solid Waste MWS in Brazil has been historically managed through disposal on solid waste dump sites or landfills (either controlled or uncontrolled). This is outlined in Figure 4.1.3.1 on page 46 of the publication "*Panorama dos Resíduos Sólidos no Brasil – 2018/2019*". Available online:

http://www.abrelpe.org.br/panorama_apresentacao.cfm

infrastructure fuelled uniquely by LFG, located within the geographical limits of the AMC landfill and under operation since 01/01/2011)[42].

As part of the assessment/demonstration of non-undermining by the occurred post-registration changes in the project design of the previously demonstrated additionality of the project activity, economic/financial aspects of the whole power generation infrastructure were thus taken into account in the previous version of the PDD (version 14.1 dated 02/11/2018) addressing such changes through performance of investment analysis (STEP 3 of the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality"). Such aspects includes effective consideration of (i) investment capital expenditures (CAPEX), (ii) operation and maintenance expenditures (OPEX), (iii) revenues, (iv) depreciation, etc. associated to the whole electricity generation infrastructure (for which the set of 19 internal combustions gas engines represent major components).

Thus, realistic alternative for electricity generation using collected LFG were thus identified solely for making the investment analysis performed in Section B.5 of the previous version of the PDD (version 14.1 dated 02/11/2018) deemed credible and realistic (where the content of Section B.5 complements the content of Section B.4 in such previous version of the PDD).

It is however important to note that even in such previous version of the PDD, the performance of the stepwise procedures of the "Combined tool to identify the baseline scenario and demonstrate additionality" (version 07.0) for the confirmation of the previously identified baseline scenario for the project activity does not include electricity generation alternative. In this particular context, while being previously considered in the previous version of the PDD in the particular context of the performed investment analysis (under STEP 3 (Investment analysis) of the stepwise procedure of such methodological tool), the identified remaining alternative for electricity generation is effectively not considered for the determination of the baseline scenario for the project activity[43].

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[42] While electricity generation is not included as additional GHG abatement/mitigation measure as part of the project activity and emission reductions associated to displacement of a more-GHG-intensive service (i.e. CO_2 emission reductions due to generation of electricity using collected LFG as renewable energy source) are not accounted, baseline emissions and alternatives for electricity generation are thus not considered/accounted in the particular case of confirming the previously derived baseline scenario for the project activity. However, financial/economic aspects related to power generation using the generation infrastructure (of which the set of 19 internal combustion gas engines represents major components) were previously considered/accounted in the particular context of the demonstration of non-undermining of the previously assessed additionality of the project activity by its permanent design changes (as outlined in the previous version of the PDD (version 14.1 dated 02/11/2018).

[43] The previous version of the PDD (version 14.1 dated 02/11/2018) valid for the currently expired 2nd 7-year crediting period and addressing occurred permanent changes in the project design includes the following related details (which are not valid/applicable in the context of the determination of the baseline scenario for the project activity - that includes methane destruction as it unique measure):

"Realistic and credible alternative(s) for electricity generation may include (relevant only in the context of demonstration of non-undermining of the previously assessed additionality of project activity by its post-registration design changes):

E1: Electricity generation from LFG, undertaken without being registered as CDM project activity;
E2: Electricity generation in existing or new renewable or fossil fuel based captive power plant(s);
E3: Electricity generation in existing and/or new grid-connected power plants.

Scenario E2 is directly excluded. Since all electricity demand of the AMC landfill has been historically met by a reliable supply of grid-sourced electricity, the utilization of a captive electricity generator to supply electricity for the landfill site (using renewable or fossil energy sources) never occurred and it would not be expected to occur in the absence of the project activity either.

It is relevant to note that, as further explained in Section A.3, a backup captive off-grid electricity generator fuelled by diesel is indeed also implemented as a permanent post-registration change in the project design. Thus, it is relevant to consider that; like the current situation of other landfill sites without a CDM project activities promoting collection and destruction/utilization of LFG being implemented and like the pre-project situation at the AMC landfill; no backup captive off-grid electricity generator fuelled by diesel or by any other fuel

Identification of alternatives for heat generation:

Heat generation scenarios using LFG collected at the landfill as fuel are not part of the project activity either, as there are no heat requirements at the landfill and the project activity does not encompass use of collected LFG for heating or thermal purposes (i.e. use of collected LFG as gaseous fuel in boiler, air heater, glass melting furnace(s) and/or kiln).

Therefore, scenarios H1 trough H7 are not considered either. This is also in accordance with ACM0001 (version 19.0).

Identification of alternatives for supply of LFG to a natural gas distribution network and/or distribution of compressed/liquefied LFG by using trucks:

Supply of LFG to a natural gas distribution network and/or distribution of compressed/liquefied LFG by using trucks are currently not considered as part of the project activity either. Therefore, this option is not considered on the present analysis.

Outcome of SUB-STEP 1a: The only alternatives to be taken into consideration, after STEP 1a) are LFG1, LFG2 (in the particular context of identification of the baseline scenario for the project activity – that includes methane destruction as its unique measure).

SUB-STEP 1b: Consistency with mandatory applicable laws and regulations:

So far, there are still no legal restrictions or requirements/obligations for LFG collection and destruction in Brazil. Moreover, there are still no legal restrictions or requirements/obligations for utilizing collected LFG for generation of electricity (or any other type of LFG utilization) in Brazil either. Therefore alternative LFG1 and LFG2 are thus under compliance with applicable mandatory laws and regulations.

Outcome of SUB-STEP 1b: the only remaining alternatives to be taken into consideration after SUB-STEP 1b) are identified as LFG1 and LFG2 (in the particular context of identification of the baseline scenario for the project activity – that includes methane destruction as its unique measure).

would be expected to be implemented at the landfill site in the absence of the project activity (baseline scenario).”

Application of STEP 2: Barrier analysis + STEP 3: Investment analysis + STEP 4: Common practice analysis:

Differently than the previous version of the PDD (version 14.1 dated 02/11/2018) valid for the currently expired 2nd 7-year crediting period and addressing occurred permanent changes in the project design, the application of the following subsequent steps of the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality" (version 07.0) are not included/presented in Section B.5:

- STEP 2: Barrier analysis
- STEP 3: Investment analysis
- STEP 4: Common practice analysis

The main reason for such non-inclusion of content in Section B.5 of this PDD is that demonstration of additionality is not applicable/required for the renewal of the crediting period of a registered CDM project activity[44].

<u>*Conclusion of the confirmation of the previously identified baseline scenario for the project:*</u>

In summary, by taking into account the content of this section (Section B.4) and the content of the Section (Section B.5) in the previous version of the PDD (version 14.1 dated 02/11/2018), it is demonstrated the following:

Alternative LFG1 (*"The project activity undertaken without being registered as a CDM project activity"*) does not represent baseline alternative.

Thus, the baseline alternative for the project activity is confirmed as being as follows:

- LFG2 ("*Atmospheric release of the LFG or partial capture of LFG and destruction to comply with regulations or contractual requirements, or to address safety and odors concerns*").

[44] It is relevant to note that as per the applicable methodological guidance of both ACM0001 (versions 15.0 and 19.0) and the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality" (version 07.0), determining baseline scenario for a LFG collection and destruction/utilization under the CDM is a task which is somehow combined with the assessment and demonstration of additionality for such project activity.
In terms of demonstration of additionality of the project activity, as outlined in the previous version of the PDD (version 14.1 dated 02/11/2018), the subsequent application of the stepwise approach of the methodological tool aimed to demonstrate that the previously assessed of additionality of the project activity (under its initial and not any longer valid design configuration) was not undermined by the occurred permanent post-registration changes in the project design.
Such demonstration is performed by assessment of additionality of the project activity as per the currently valid approaches for demonstration of additionality.
While in the particular case of the renewal of the 7-year crediting period of the project activity, it is not required/necessary to re-assess and re-demonstrate the additionality neither demonstrating the validity of the previously assessed/demonstrated additionality, the application of STEP 2, STEP 3 and STEP 4 of the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality" (version 07.0) are thus regarded as not applicable / not required in the particular context of the demonstration of the continuation of the previously identified baseline scenario for emissions of methane at the AMC landfill for the project activity during its 3rd 7-year crediting period. This is in accordance with the methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" and other applicable CDM guidelines and rules.

In this particular context, B.4 and B.5 are thus complementary sections since both sections deal with the identification of the baseline scenario and demonstration of additionality of the project activity (under its revised project design). Thus, the application of the steps of the "Combined tool to identify the baseline scenario and demonstrate additionality" as undertaken in Section B.4 are also directly applicable in the context of the demonstration of additionality of the project activity. On the other hand, as established by such methodological tool, steps of this tool to be normally undertaken in Section B.5 are thus also applicable in the context of the confirmation of the previously identified baseline scenario for the project activity.

Procedure for estimating the end of the remaining lifetime of existing equipment:

While remaining lifetime of existing equipment and prior consideration of CDM are also aspects that, if applicable, are required to be considered in the context of the determination of the baseline scenario, the following details are also relevant in the particular context of the demonstration of validity of the previously derived baseline scenario for the project activity:

As per ACM0001 (version 19.0), this procedure is only applicable (in the context of the determination of baseline scenario for the project activity) if LFG has been ever utilized in existing equipment that was in operation prior to the implementation of the project activity.

The project activity started to operate in late 2003 in a landfill of which previous starting of operations is dated year 1997. No type of LFG destruction and/or LFG utilization equipment was ever in place prior to the implementation of the project activity as there was no LFG management at all prior of the implementation of the project activity.

This step of ACM0001 (version 19.0) is thus not required in the context of the demonstration of the continuation of the baseline scenario for the project activity.

Conclusion about the demonstration of the continuation of validity of the previously identified baseline scenario):

As an outcome of the application of the applicable guidance of the “Combined tool to identify the baseline scenario and demonstrate additionality” (version 07.0) and ACM0001 (version 19.0), it is demonstrated the following:

-The baseline scenario for the project activity (in terms of emissions of methane) remains being identified as the atmospheric release of the LFG with minor share of generated LFG being partially collected and destroyed in conventional passive LFG venting/combustion drains that would otherwise be installed in the absence of the project activity in order to address the still existent contractual requirement for the minimum level/share of methane to be destroyed at the AMC landfill (as established by the Administration of the Municipality of Salvador (Municipal authority)).

Step 2.2: Update the data and parameters

All applicable and required ex-ante determined parameters valid for the project activity along the 3rd 7-year renewable crediting period are presented in Sections B.6.1 and B.6.2.
While some of the ex-ante determined parameters (which are summarized in Sections B.6.1.and B.6.2) are applied only in the context of ex-ante estimations of emission reductions to be achieved by the project activity along the 3rd crediting period, other ex-ante determined parameters will however be used for the calculation/determination of emission reductions in an ex-post basis (in conjunction with parameters determined ex-post) along the 3rd 7-year crediting period.

It is also important to consider that ACM0001 (version 19.0) and applicable methodological tools include set of parameters (ex-ante or ex-post determined) which were not previously applied/considered in the PDD valid for the 1st 7-year crediting period (as this PDD was completed in accordance requirements and guidance of the baseline and monitoring methodology AM0002 (version 1)). Furthermore, as also outlined in Section B.6.2 the value for the Global Warming Potential (GWP) for the GHG methane is also changed for the share of the 2nd crediting period (from 01/012013 onwards) and for the 3rd crediting period when compared to the GWP value previously applied during the 1st crediting period. This is 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".

B.5. Demonstration of additionality

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As also indicated in Section B.4, demonstration of additionality is not applicable/required for the renewal of the crediting period of a registered CDM project activity. Due to that, this Section is not completed[45].

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

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In accordance with ACM0001 (version 19.0) and applicable methodological tools, emission reductions (ER_y) to be achieved by the project activity during the 3rd 7-year crediting period are determined (in tCO_2e) as the difference between baseline emissions (BE_y) and project emissions (PE_y) as follows:

$$ER_y = BE_y - PE_y \quad \textbf{(0)}$$

Where:

BE_y Baseline emissions in year *y* (in tCO_{2e}/yr)

PE_y Project emissions in year *y* (in tCO_{2e}/yr)

Determination of Baseline Emissions (BE_y):

As per ACM0001 (version 19.0), baseline emissions (BE_y) for the project activity during its 3rd 7-year renewable crediting period are determined according to equation (1) and comprises the following emission sources:

a) Baseline methane emissions from the SWDS[46] in the absence of the project activity;

b) Baseline emissions for electricity generation using fossil fuels or supplied by the grid in the absence of the project activity;

c) Baseline emission for heat generation using fossil fuels in the absence of the project activity; and

d) Baseline emissions for natural gas use from existing natural gas network in the absence of the project activity.

[45] The previous version of the PDD (version 14.1 dated 02/11/2018) valid for the currently expired 2nd 7-year crediting period and addressing occurred permanent changes in the project design includes the whole assessment/demonstration of the non-undermining by the occurred post-registration changes in the project design of the previously demonstrated additionality of the project activity. Such demonstration demonstrates that the project activity is still regarded as additional when the post-registration changes in the project design are considered, thus meeting applicable CDM requirement for addressing post-registration changes in the project design.

[46] As established by the methodological tool "Emissions from solid waste disposal sites" (version 08.0), "SWDS" refers to Solid Waste Disposal Site.

$$BE_y = BE_{CH4,y} + BE_{EC,y} + BE_{HG,y} + BE_{NG,y} \quad (1)$$

Where:

BE_y Baseline emissions in year *y* (in tCO_2e/yr)

$BE_{CH4,y}$ Baseline emissions of methane from the SWDS in year *y* (in tCO_2e/yr)

$BE_{EC,y}$ Baseline emissions associated with electricity generation in year *y* (in tCO_2e/yr)

$BE_{HG,y}$ Baseline emissions associated with heat generation in year *y* (in tCO_2e/yr)

$BE_{NG,y}$ Baseline emissions associated with natural gas use in year *y* (in tCO_2e/yr)

In the particular case of the project activity, no collected LFG is currently expected to be used as gaseous fuel for heat generation purposes; and no LFG collected by the project activity is expected to be injected in a natural gas distribution pipeline or even displace/complement the use of natural gas either. Due to that, $BE_{HG,y}$ and $BE_{NG,y}$ are not applicable in the context of the determination of baseline emissions for the project activity during its 3rd 7-year renewable crediting period and are thus regarded as null. Furthermore, since electricity generation using LFG as fuel is not considered/regarded as an additional GHG abatement/mitigation measure for the project activity, $BE_{EC,y}$ is not applicable in the context of the determination of baseline emissions for the project activity during its 3rd 7-year renewable crediting period either. Thus, $BE_{EC,y}$ is also regarded as null.

Thus, the determination approach for baseline emissions is summarized as follows:

$$BE_y = BE_{CH4,y} \quad (2)$$

Baseline methane emissions ($BE_{CH4,y}$) is calculated in conformance with ACM0001 (version 19.0) + applicable methodological tools respectively by following the approaches presented below:

Baseline emissions of methane from the SWDS ($BE_{CH4,y}$)

Baseline methane emissions from the anaerobic waste decomposition in the considered SWDS ($BE_{CH4,y}$) are determined (in tCO_2e/yr) as per the formulas presented below. The determination of $BE_{CH4,y}$ is based on the amount of methane that is actually captured and combusted by the project activity (in the set of high temperature enclosed flares and/or set of internal combustion gas engines) and also by taking in account the amount of methane that would be captured and destroyed in the landfill in the absence of the project activity (baseline scenario).

In addition, the effect of methane oxidation (that is assumed as existing in the baseline and not in the project scenario) is also taken into account as also required by ACM0001 (version 19.0)[47]:

[47] As established by ACM0001 (version 19.0), the ex-ante determined parameter $OX_{top-layer}$ is the fraction of the methane that would be oxidized in the top layer of the considered SWDS (AMC landfill) in the absence of the project activity (baseline scenario). As per ACM0001 (version 19.0), it is assumed that for a typical landfill hosting a LFG collection and destruction and/or utilization CDM project activity, this effect is reduced as part of the LFG which is captured does not pass through the top layer of the considered SWDS. This oxidation effect is also accounted for in the methodological tool "Emissions from solid waste disposal sites" (version 08.0). In addition to this effect, the installation of a LFG capture system under the project activity may result in the suction of additional air into the considered SWDS. In some cases, such as project activities where the LFG collection is based on high suction pressure, the suction effort may decrease the amount of methane that is generated in the landfill under the project scenario. However, in most circumstances where the LFG is captured and used this effect was considered to be very small, as the operators of landfills have, in most cases, an incentive to main a high methane concentration in the LFG. For this reason, this effect is neglected as a conservative assumption.

$$BE_{CH4,y} = \left(\left(1 - OX_{top\_layer}\right) * F_{CH4,PJ,y} - F_{CH4,BL,y}\right) * GWP_{CH4} \quad (3)$$

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 (dimensionless)

$F_{CH4,PJ,y}$ Amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year *y* (in tCH_4/yr)

$F_{CH4,BL,y}$ Amount of methane that would be destroyed through flaring of LFG in the baseline scenario (absence of project activity) in year *y* (in tCH_4/yr)

GWP_{CH4} Global warming potential of CH_4 (in tCO_2e/tCH_4)

Ex post determination of $F_{CH4,PJ,y}$

As per ACM0001 (version 19.0), the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices (in tCH_4/yr) during the 3rd 7-year renewable crediting period is to be ex-post determined as the sum of quantities of methane destroyed through combustion of collected LFG in flare(s), power plant(s), boiler(s), air heater(s), glass melting furnace(s), kiln(s) (methane destruction devices) and/or by supply of collected LFG to consumer(s) through natural gas distribution network based on ex-post measurements, as follows:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} + F_{CH4,HG,y} + F_{CH4,NG,y} \quad (4)$$

Where:

$F_{CH4,flared,y}$ Amount of methane which is destroyed through combustion of collected LFG in the flares in year *y* (in tCH_4).

$F_{CH4,EL,y}$ Amount of methane which is destroyed through combustion of collected LFG in the internal combustion gas engines in year *y* (in tCH_4).

$F_{CH4,HG,y}$ Amount of methane which is destroyed through combustion of collected LFG in heat generation device(s) in year *y* (in tCH_4/yr). The project design currently does not encompass combustion of collected LFG in heat generation device(s). Thus, $F_{CH4,HG,y}$ is assumed as null (zero).

$F_{CH4,NG,y}$ Amount of methane which is destroyed by supply of collected LFG to consumer(s) through natural gas distribution network in year *y* (in tCH_4/yr). The project design currently does not encompass supply of collected LFG to consumer(s) through natural gas distribution network. Thus, $F_{CH4,NG,y}$ is assumed as null (zero).

As also established by ACM0001 (version 19.0), $F_{CH4,EL,y}$, $F_{CH4,HG,y}$ and $F_{CH4,NG,y}$ are to be determined by using the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0), and by monitoring the working hours of the power plant(s), boiler(s), air heater(s), glass melting furnace(s) and/or kiln(s) (if applicable), so that no emission reduction are claimed for methane destruction during non-working hours of the methane destruction device(s) in question. This is taken into account by monitoring the hours *h* that the equipment/device *j* promoting destruction of methane is operating in year *y* ($Op_{j,h,y}$).

In summary, the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices will be ex-post determined as follows:

$$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y} \quad \textbf{(5)}$$

Determination of the amount of methane which is destroyed through combustion of collected LFG in the flares ($F_{CH4,flared,y}$)

$F_{CH4,flared,y}$ is determined as the difference between the amount of methane supplied to the flares and any methane emissions from the flares, as follows:

$F_{CH4,flared,y}$ is determined as the difference between the amount of methane supplied to each individual flare and methane emissions from the flare in question, as follows:

$$F_{CH4,flared,y} = F_{CH4,sent\_flare,y} - \frac{PE_{flare,y}}{GWP_{CH4}} \quad \textbf{(6)}$$

Where:

$F_{CH4,flared,y}$	Amount of methane which is destroyed through combustion of collected LFG in the flares in year *y* (in tCH_4/yr)
$F_{CH4,sent\_flare,y}$	Amount of methane in collected LFG which is sent to the flare(s) in year *y* (in tCH_4/yr)
$PE_{flare,y}$	Project emissions from flaring of the residual gas stream in year *y* (in tCO_2e/yr)
GWP_{CH4}	Global warming potential of CH_4 (in tCO_2e/tCH_4)

For each individual high temperature enclosed flare, $F_{CH4,sent\_flare,y}$ is determined by following applicable guidance of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0). As per the ACM0001 (version 19.0), the following requirements apply for the determination of $F_{CH4,sent\_flare,y}$:

- The gaseous stream that shall be considered in the application of the methodological tool is the stream of collected LFG which is sent for combustion in the flares
- CH_4 is the greenhouse gas for which the mass flow is determined;;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 or 17 in the methodological tool); and
- The mass flow should be calculated at least on a an hourly basis for each hour *h* in year *y*;

Determination of the amount of amount of methane which is destroyed through combustion of collected LFG in the internal combustion gas engines ($F_{CH4,EL,y}$):

$F_{CH4,EL,y}$ is directly determined by following applicable guidance of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) and by taking into account the following requirements defined by ACM0001 (version 19.0):

- The gaseous stream the methodological tool shall be applied to is the stream of collected LFG which is sent to each internal combustion gas engine *j*.
- CH_4 is the greenhouse gas for which the mass flow is determined;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 or 17 in the methodological tool); and

- The mass flows should be calculated at least on a an hourly basis for each hour *h* in year *y*;
- The mass flow calculated for hour *h* is 0 if the equipment/device is not working in hour *h* ($Op_{j,h}$ = not working). Accumulated hourly values are summed to a yearly unit basis.

Applicable guidance of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) will be applied to determine $F_{CH4,sent\_flare,y}$ and $F_{CH4,EL,y}$ [48] by using one of the options A, B, C or D. The selection of the determination option will depend on project conditions and/or monitoring equipment/instruments under operation during monitoring periods within the 3rd 7-year crediting period of the project activity.

Use of Option A, B, C or D for the determination of $F_{CH4,sent\_flare,y}$ and $F_{CH4,EL,y}$:

Depending on the project conditions, one of the following measurement options will be chosen and the following formulas applied for the determination of as $F_{i,t}$ [49]:

Option	Flow of gaseous stream	Volumetric fraction
A	Volume flow dry basis	Dry or wet basis[50]
B	Volume flow wet basis	Dry basis
C	Volume flow wet basis	Wet basis
D	Mass flow dry basis	Dry or wet basis

<u>*Option A:*</u>
Flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it is necessary to demonstrate that the gaseous stream is dry to use this option. There are two ways to do this:

- Measure the moisture content of the gaseous stream ($C_{H2O,t,db,n}$) and demonstrate that this is less or equal to 0.05 kg H_2O/m^3 dry gas; or

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

If it cannot be demonstrated that the gaseous stream is dry, then the flow measurement should be assumed to be on a wet basis and the corresponding option from the table above should be applied instead.

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

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t} \quad \textbf{(7)}$$

with

[48] In the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0), the mass flow of greenhouse gas in a gaseous stream (which in the particular case of the project activity are the amount of methane in collected LFG which is sent to the flares ($F_{CH4,sent\_flare,y}$) and the amount of methane which is destroyed through combustion of collected LFG in the internal combustion gas engines ($F_{CH4,EL,y}$)) is actually represented as $F_{i,t}$.

[49] The selection of option A, B, C or D will occur on an ex-post basis depending on the type and/or specifications of monitoring equipment installed and under operation within the 3rd 7-year crediting period of the project activity.

[50] 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 analysers and dry basis analysers and both types can be used indistinctly for calculation Options A and D.

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \quad \textbf{(8)}$$

Where:

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

<u>Option B:</u>

The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined using equations (7) and (8). The volumetric flow of the gaseous stream in time interval *t* on a dry basis ($V_{t,db}$) is determined by converting the measured volumetric flow from wet basis to dry basis as follows:

$$V_{t,db} = V_{t,wb} / (1 + v_{H2O,t,db}) \quad \textbf{(9)}$$

Where:

$V_{t,db}$	Volumetric flow of the gaseous stream in time interval *t* on a dry basis (in m^3 dry gas/h)
$V_{t,wb}$	Volumetric flow of the gaseous stream in time interval *t* on a wet basis (in m^3 wet gas/h)
$v_{H2O,t,db}$	Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis (in m^3 H_2O/m^3 dry gas)

The volumetric fraction of H_2O in time interval *t* on a dry basis ($v_{H2O,t,db}$) is estimated according to the following equation:

$$v_{H2O,t,db} = \frac{m_{H2O,t,db} * MM_{t,db}}{MM_{H2O}} \quad \textbf{(10)}$$

Where:

$v_{H2O,t,db}$	Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis (in m^3 H_2O/m^3 dry gas)

$m_{H2O,t,db}$ Absolute humidity in the gaseous stream in time interval *t* on a dry basis (in kg H_2O/kg dry gas)

$MM_{t,db}$ Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)

MM_{H2O} Molecular mass of H_2O (in kg H_2O/kmol H_2O)

In case this Option is selected, the absolute humidity of the gaseous stream ($m_{H2O,t,db}$) will be determined using Option 2 specified below under "*Determination of the absolute humidity of the gaseous stream"* and the molecular mass of the gaseous stream ($MM_{t,db}$) will be determined using the following equation:

$$MM_{t,db} = \sum_k (v_{k,t,db} * MM_k) \quad \textbf{(11)}$$

Where:

$v_{k,t,db}$ Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis (in m^3 gas k/m^3 dry gas) MM_k = Molecular mass of gas *k* (kg/kmol)

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. 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. The simplification is not acceptable if it is differently specified in the underlying methodology.

<u>Option C:</u>
The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined as follows:

$$F_{i,t} = V_{t,wb,n} * v_{i,t,wb} * \rho_{i,n} \quad \textbf{(12)}$$

with

$$\rho_{i,n} = \frac{P_n * MM_i}{R_u * T_n} \quad \textbf{(13)}$$

Where:

$F_{i,t}$ Mass flow of greenhouse gas *i* in the gaseous stream in time interval *t* (in kg gas/h)

$V_{t,wb,n}$ Volumetric flow of the gaseous stream in time interval *t* on a wet basis at normal conditions (in m^3 wet gas/h)

$v_{i,t,wb}$ Volumetric fraction of greenhouse gas *i* in the gaseous stream in time interval *t* on a wet basis (in m^3 gas *i*/m^3 wet gas)

$\rho_{i,n}$ Density of greenhouse gas *i* in the gaseous stream at normal conditions (in

kg gas *i*/m³ wet gas *i*)

P_n	Absolute pressure at normal conditions (in Pa)
T_n	Temperature at normal conditions (in K)
MM_i	Molecular mass of greenhouse gas *i* (in kg/kmol)
R_u	Universal ideal gases constant (in Pa.m^3/kmol.K)

The following equation should be used to convert the volumetric flow of the gaseous stream from actual conditions to normal conditions of temperature and pressure:

$$V_{t,wb,n} = V_{t,wb} * (T_n/T_t) * (P_t/P_n) \quad \textbf{(14)}$$

Where:

$V_{t,wb,n}$	Volumetric flow of the gaseous stream in a time interval *t* on a wet basis at normal conditions (in m^3 wet gas/h)
$V_{t,wb}$	Volumetric flow of the gaseous stream in time interval *t* on a wet basis (in m³ wet gas/h)
P_t	Pressure of the gaseous stream in time interval *t* (in Pa)
T_t	Temperature of the gaseous stream in time interval *t* (in K)
P_n	Absolute pressure at normal conditions (in Pa)
T_n	Temperature at normal conditions (in K)

<u>*Option D:*</u>
Flow measurement on a dry basis is not doable for a wet gaseous stream. Therefore, it is necessary to demonstrate that the gaseous stream is dry to use this option. There are two ways to do this:

- Measure the moisture content of the gaseous stream ($C_{H2O,t,db,n}$) and demonstrate that this is less or equal to 0.05 kg H_2O/m^3 dry gas; or
- Demonstrate that the temperature of the gaseous stream (T_t) is less than 60ºC (333.15 K) at the flow measurement point.

If it cannot be demonstrated that the gaseous stream is dry, then the flow measurement should be assumed to be on a wet basis and the corresponding option from the above table should be applied instead.

The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined using equations (7) and (8). The volumetric flow of the gaseous stream in time interval *t* on a dry basis ($V_{t,db}$) is determined by converting the mass flow of the gaseous stream to a volumetric flow as follows:

$$V_{t,db} = M_{t,db}/\rho_{t,db} \quad \textbf{(15)}$$

Where:

$V_{t,db}$ Volumetric flow of the gaseous stream in time interval *t* on a dry basis (in m^3 dry gas/h)

$M_{t,db}$ Mass flow of the gaseous stream in time interval *t* on a dry basis (in kg/h)

$\rho_{t,db}$ Density of the gaseous stream in time interval *t* on a dry basis (in kg dry gas/m^3 dry gas)

The density of the gaseous stream ($\rho_{t,db}$) should be determined as follows:

$$\rho_{t,db} = \frac{P_t * MM_{t,db}}{R_u * T_t} \tag{16}$$

Where:

$\rho_{t,db}$ Density of the gaseous stream in a time interval *t* on a dry basis (in kg dry gas/m^3 dry gas)

P_t Pressure of the gaseous stream in time interval *t* (in Pa)

T_t Temperature of the gaseous stream in time interval *t* (in K)

$MM_{t,db}$ Molecular mass of the gaseous stream in a time interval *t* on a dry basis (in kg dry gas/kmol dry gas). The molecular mass of the gaseous stream ($MM_{t,db}$) is estimated by using equation (11).

Determination of the absolute humidity of the gaseous stream

The absolute humidity is as parameter required for Options B and E only, thus it will be used only in case Option B is adopted (as Option E is not selected as a measurement option for the project activity). Option 2 of the tool is selected for the project activity:

Option 2: Simplified calculation without measurement of the moisture content

This option provides a simple and conservative approach to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation. If it is conservative to assume that the gaseous stream is dry, then $m_{H2O,t,db}$ is assumed to equal 0. If it is conservative to assume that the gaseous stream is saturated, then $m_{H2O,t,db}$ is assumed to equal the saturation absolute humidity ($m_{H2O,t,db,sat}$) and calculated using equation (7).

$$m_{H_2O,t,db,SAT} = \frac{p_{H2O,t,Sat} * MM_{H2O}}{(P_t - p_{H2O,t,Sat}) * MM_{t,db}} \tag{17}$$

Where:

$m_{H2O,t,db,sat}$ Saturation absolute humidity in time interval *t* on a dry basis (in kg H_2O/kg dry gas)

$p_{H20,t,sat}$ Saturation pressure of H_2O at temperature T_t in time interval *t* (in Pa)

T_t	Temperature of the gaseous stream in time interval *t* (in K)
P_t	Absolute pressure of the gaseous stream in time interval *t* (in Pa)
MM_{H2O}	Molecular mass of H_2O (in kg H_2O/kmol H_2O)
$MM_{t,db}$	Molecular mass of the gaseous stream in a time interval *t* on a dry basis (in kg dry gas/kmol dry gas). $MM_{t,db}$ is estimated by using equation (11).

Determination of $PE_{flare,y}$ (required for the determination of $F_{CH4,flared,y}$):
As established by ACM0001 (version 19.0), $PE_{flare,y}$ is determined by following applicable guidance of the methodological tool "Project emissions from flaring" (version 03.0). Share of collected LFG is expected to be combusted (by flaring) in a set of installed high temperature enclosed flares, then $PE_{flare,y}$ is the sum of the related emissions for each individual flare of which are calculated separately (as established by the methodological tool).

For each individual flare, the calculation procedure in the referred methodological tool is applied to determine project emissions from flaring the residual gas ($PE_{flare,y}$) based on the flare efficiency ($\eta_{flare,m}$) and the mass flow of methane to the flare in question ($F_{CH4,RG,m}$). The flare efficiency is determined for each minute *m* of year *y* based either on monitored data or default values.

Calculation procedure for the determination of project emissions from flaring applied as follows under a stepwise approach:

STEP 1: Determination of the methane mass flow of the residual gas;

STEP 2: Determination of the flare efficiency;

STEP 3: Calculation of project emissions from flaring.

Step 1: Determination of the methane mass flow in the residual gas:
The methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) shall be used to determine, in kg, the mass flow of methane in the residual gaseous stream in the minute *m*: $F_{CH4,m}$.

The following requirements apply for the determination of the mass flow of methane in the gaseous stream in minute *m*:

- The methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) shall be applied to the residual gas.
- The flow of the gaseous stream shall be measured continuously;
- CH_4 is the greenhouse gas *i* for which the mass flow should be determined;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 and 17 in the tool); and
- The time interval *t* for which mass flow should be calculated is every minute *m*.

$F_{CH4,m}$, which is measured as the mass flow during minute *m*, shall then be used to determine the mass of methane in kilograms fed to the flare in question in the minute *m* ($F_{CH4,RG,m}$). $F_{CH4,m}$ shall be determined on a dry basis.

Step 2: Determination of flare efficiency:
As required by ACM0001 (version 19.0), the flare efficiency values will be determined for each installed flare. Also as per ACM0001 (version 19.0), flare efficiency represents the combustion efficiency of LFG in the flare in terms of CH_4 by considering *inter alia* the time

that the flare in question is operating. For determining the combustion efficiency for the enclosed flare in question, there is the option to apply a default efficiency value or determining the flare efficiency based on monitored data (based on applicable measurements and calculations).

The time each of the project's high temperature enclosed flare has operated is determined by monitoring the flame combustion status/condition by using a flame detector and, for the case of enclosed high temperature flares, the monitoring requirements related to operational requirements/conditions (as provided by the manufacturer's specifications for operating conditions) shall be met in addition to the confirmation of flare status/condition.

In the case of the project activity, the flare efficiency for each minute *m* ($\eta_{flare,m}$) will be, as a priority, determined by following applicable guidance as per Option B.1 of the methodological tool "Project emissions from flaring" (version 03.0), where the flare efficiency will be determined on the basis of biannual basis related measurements. In case biannual related measurements are not available for a particular monitoring period, applicable guidance as per Option A (application of default values) of the methodological tool "Project emissions from flaring" (version 03.0) will be used as an alternative.

Both options are summarized below:

Option A: Apply default value for flare efficiency.

Option B: Measure the flare efficiency.

Option A: Application of 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 of 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

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 of LFG to the flare (monitoring parameter $F_{RG,m}$) 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%.

By applying Option B.1, where the measurement is performed by an accredited independent third party entity (e.g. an independent inspection/analysis service company) on a biannual basis, the following calculation formula is applied:

Option B.1: Biannual measurement of the flare efficiency:

The calculated flare efficiency $\eta_{flare,calc,m}$ is determined as the average of two measurements of the flare efficiency made in year *y* ($\eta_{flare,calc,y}$), as follows:

$$\eta_{flare,calc,y} = 1 - \frac{1}{2}\sum_{t=1}^{2}\left(\frac{F_{CH4,EG,t}}{F_{CH4,RG,t}}\right) - 0.05 \quad \textbf{(18)}$$

Where:

$\eta_{flare,calc,y}$	Flare efficiency in the year *y*
$F_{CH4,EG,t}$	Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the time period *t* (in kg)
$F_{CH4,RG,t}$	Mass flow of methane in the residual gas on a dry basis at reference conditions in the time period *t* (in kg)
t	The two time periods in year y during which the flare efficiency is measured, each a minimum of one hour and separated by at least six months

Note: $F_{CH4,EG,t}$ is measured for each individual flare according to an appropriate national or international standard. $F_{CH4,RG,t}$ is calculated for each flare according to Step 1[51], and consists of the sum of methane flow in the minutes *m* that makes up the time period *t*.

Step 3: Calculation of project emissions from flaring:

For each individual flare, project emissions from flaring are calculated as the sum of emissions for each minute *m* in year *y*, based on the methane mass flow in the residual gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows:

$$PE_{flare,y} = GWP_{CH4} * \sum_{m=1}^{525,600} F_{CH4,RG,m} * \left(1 - \eta_{flare,m}\right) * 10^{-3} \quad \textbf{(19)}$$

Where:

$PE_{flare,y}$	Project emissions from flaring of the residual gas in year *y* (in tCO_{2e})
GWP_{CH4}	Global warming potential of methane valid for the commitment period (in tCO_2e/tCH_4)
$F_{CH4,RG,m}$	Mass flow of methane in the residual gas in the minute *m* (in kg)

[51] As per Step 1 $F_{CH4,RG,t}$ is equal to the sum of methane flow values ($F_{CH4,sent\_flare,y}$) in the minutes *m* that make up the time period *t*.

$\eta_{flare,m}$ Flare efficiency in minute *m*

Ex-ante estimation of $F_{CH4,PJ,y}$

Ex-ante estimates of $F_{CH4,PJ,y}$ is required to estimate methane baseline emissions from the AMC landfill in the context of annual estimates the emission reductions to be achieved by project activity during its 3rd 7-year crediting period.

As established by ACM0001 (version 19.0), $F_{CH4,PJ,y}$ is estimated as follows:

$$F_{CH4,PJ,y} = \eta_{PJ} * BE_{CH4,SWDS,y} / GWP_{CH4} \quad \textbf{(20)}$$

Where:

$BE_{CH4,SWDS,y}$	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* (in tCO_2e)
η_{PJ}	Efficiency of the LFG capture system that will be installed in the project activity
GWP_{CH4}	Global warming potential of CH_4 (in tCO_2e/tCH_4)

$BE_{CH4,SWDS,y}$ is determined using the methodological tool "Emissions from solid waste disposal sites" (version 08.0). The following guidance should be taken into account when applying the tool:

- f_y as per the methodological tool shall be assigned a value of 0 because the amount of LFG that would have been captured and destroyed is already accounted for when applying ACM0001 (version 19.0);
- In the tool, *x* begins with the year that the SWDS started receiving wastes (e.g. the first year of SWDS operation); and
- Sampling to determine the fractions of different waste types is not necessary because the waste composition can be obtained from previous studies.

Thus, for the ex-ante estimation of the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices ($F_{CH4,PJ,y}$) during each year y of its 3rd 7-year crediting period, the calculation of $BE_{CH4,SWDS,y}$ is given by:

$$BE_{CH4,SWDS,y} = \varphi_y * (1 - f_y) * GWP_{CH4} * (1 - OX) * \frac{16}{12} * F * DOC_{f,y} * MCF_y * \sum_{x=1}^{y} \sum_{j} W_{j,x} * DOC_j * e^{-k_j \cdot (y-x)} * (1 - e^{-k_j}) \quad \textbf{(21)}$$

Where:

$BE_{CH4,SWDS,y}$	Baseline methane emissions occurring in year *y* generated from waste disposal at a SWDS during a time period ending in year *y* (in tCO_2e / yr)
x	Years in the time period in which waste is disposed at the SWDS, extending from the first year in the time period (*x* = 1) to year *y* (*x* = *y*)
y	Year of the crediting period for which methane emissions are calculated (*y* is a consecutive period of 12 months)
$DOC_{f,y}$	Fraction of degradable organic carbon (DOC) that decomposes under the specific conditions occurring in the SWDS for year *y* (weight fraction)

$W_{j,x}$ Amount of solid waste type *j* disposed or prevented from disposal in the SWDS in the year *x* (t)

φ_y Model correction factor to account for model uncertainties for year *y*. The default value (as per Option 1 of applicable guidance in the methodological tool) is selected. Thus, $\varphi_y = \varphi_{default}$

f_y Fraction of methane captured at the SWDS and flared, combusted or used in another manner that prevents the emissions of methane to the atmosphere in year *y*. f_y in the methodological tool "Emission from solid waste disposal sites" shall be assigned a value of 0 because the amount of LFG that would have been captured and destroyed is already accounted for when applying ACM0001 (version 19.0). While as per the methodological tool "Emissions from solid waste disposal sites" (version 08.0), f_y is presented as a parameter to be monitored ex-post; by considering the related methodological approach of ACM0001 (version 19.0) and assigned value for f_y, this parameter will thus not be monitored ex-post during the 3rd 7-year credtiting period of the project activity.

GWP_{CH4} Global Warming Potential of methane

OX Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)

F Fraction of methane in the SWDS gas (volume fraction)

MCF_y Methane correction factor for year *y*

DOC_j Fraction of degradable organic carbon in the waste type *j* (weight fraction)

k_j Decay rate for the waste type *j* (1 / yr)

j Type of residual waste or types of waste in the MSW

The value and source of information for each of the variables above are given in section B.6.2. It is important to note that the approach to take into account characteristics of the disposed waste (used as inputs for the ex-ante estimation) are the ones recommended by IPCC. Due to that, no sampling of waste is necessary. This is in accordance with both the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and ACM0001 (version 19.0). While the design of the project activity is limited to the promotion of collection and destruction/utilization of LFG at the AMC landfill (without promoting any change in the management and operation of this particular landfill), the project activity thus does not prevent any solid waste from being disposed at the AMC landfill.

The determination of $BE_{CH4,SWDS,y}$ in the context of the calculation of ex-ante estimations of emission reductions to be achieved by the project activity during its 3rd 7-year renewable crediting period is included in Section B.6.3. An emission reduction calculation spreadsheet which includes all related calculations for figures presented in Section B.6.3 is enclosed to this PDD.

Determination of $F_{CH4,BL,y}$

As required by ACM0001 (version 19.0), this step represents the application of the stepwise procedure for the determination of the amount of methane that would have been captured and destroyed in the baseline scenario (absence of the CDM project activity) at the AMC landfill due to eventually applicable regulatory or contractual requirements and/or to address eventually existent

applicable safety and odors concerns (which are collectively referred to as "*requirement*" under this step).

The four cases summarized in the table below are distinguished in ACM0001 (version 19.0). As also required by ACM0001 (version 19.0), the appropriate case for the particular baseline context of the project activity is identified and justified below.

Possible cases for determining methane captured and destroyed in the baseline as per ACM0001 (version 19.0)

Situation at the start of the project activity	Requirement to destroy methane	Existing LFG capture and destruction system
Case 1	No	No
Case 2	Yes	No
Case 3	No	Yes
Case 4	Yes	Yes

Requirement to destroy methane:

Existence of contractual requirements related to LFG management for the particular case of the AMC landfill:

Like during the previous time period encompassing the whole expired 1st and 2nd 7-year crediting periods of the project activity, currently there is still no legal municipal, state or national legally binding requirement in Lauro de Freitas city, Salvador city, Bahia State or Brazil respectively, that would establish any management requirement for LFG in new or operating landfills or waste dump sites and this situation is currently not expected to change[52]. However, for the particular case of the AMC landfill, there is a contractual requirement that indeed defines the minimum level/share of methane that should destroyed through combustion at this particular landfill as part of its operation[53]. This requirement was defined by the Administration of the Municipality of Salvador (municipal authority responsible for the public service of solid waste management for the city of Salvador) at the time of the establishment of the of terms and conditions for the public service concession contract with the project participant Battre - Bahia Transferencia e Tratamento de Resíduos Ltda. (formerly Vega Bahia Tratamento de Resíduos Ltda) in year 1999 (although the AMC landfill was already under operation by the Municipality of Salvador since 1997) for provision

[52] Evidences and further considerations about the non-obligation to flare LFG in operating or new landfills or waste dumpsites in Brazil are included in section B.2.

[53] It is important to mention that item 11 of Appendix 3 of the latest version of the registered PDD for the currently expired 1st 7-year crediting period (version 7 dated 28/01/2015, approved on 29/05/2015) establishes the following:

> *"(…) 11) It is also crucial to note that the definition of values of $CH4_{contract,y}$ by the Administration of the Municipality of Salvador (municipal authority) is a completely independent decision from this governmental entity. While there is no regional or national legislation requiring LFG to be collected and destroyed in landfills in Brazil, the selected value basically represents the maximum technically possible share of generated LFG that could be destroyed by the use of a hypothetical very well engineered and operated passive conventional LFG collection and flaring system. By making a integrative comparison between the AM0002 (version 1) against the more recent version of ACM0001 (up to version 11) comparable CDM methodology, it is to be noted that the selected value (which indeed represents about 5% of all collected LFG by the project activity) is in line (within the same range) with the % value for the comparable ACM0001's parameter Adjustment Factor AF selected for other also comparable LFG collection and destruction/utilization project initiatives in Brazil and under the CDM (using more recent versions of ACM0001 methodology). (…)"*

of public service of MSW management for the city of Salvador (incl. full operation and management of the AMC landfill as a disposal site for MSW generated and collected in the city)[54].

By taking such requirement into account (that is regarded as still being valid), the following is thus valid/applicable for the particular case of the AMC landfill in the absence of the project activity (baseline scenario) in the context of the application of the stepwise approach of ACM0001 (version 19.0) for the determination of the amount of methane in the LFG that would be flared in the baseline (absence of project activity) ($F_{CH4,BL,y}$):

- Requirement to destroy methane: *YES*

By considering the requirement existence assertion above demonstrated, Case 1 and Case 3 (which are options/cases associated to "*no requirement to destroy methane in the absence of the project activity*") are thus directly regarded as not applicable cases for the determination of $F_{CH4,BL,y}$ in the particular context of the determination of baseline emissions for the project activity within its 3rd 7-year crediting period.

Thus, the remaining possibly valid alternatives (cases) (after the analysis of existence of requirement to destroy methane in the absence of the project activity) are Case 2 and Case 4.

Existence of LFG capture and destruction system at the AMC landfill:
In the absence of project activity (baseline scenario), as also explained in the latest version of the PDDs valid for the expired 1st and 2nd 7-year crediting periods, a small fraction of methane generated at the AMC landfill would need to be destroyed through combustion as part of its operation (as established by the Administration of the Municipality of Salvador (public authority)).
As also acknowledged in the latest version of the PDDs valid for the currently expired 1st and 2nd crediting periods, in the absence of the project activity (baseline scenario) such requirement would need to be met through the gradual[55] installation and operation of a set of conventional passive LFG venting/combustion drains in which a share of LFG generated at the AMC landfill would be destroyed through combustion (in order to meet the quantitative level/share of methane destruction as established by such contractual requirement).

By taking into account (i) the date such requirement was established (end of year 1999), (ii) the date when the project participant Battre - Bahia Transferencia e Tratamento de Resíduos Ltda. started to operate the AMC landfill (year 2000), (iii) the landfill operational practice in place at the AMC landfill during the period from end of 2000 to the end of year 2003 (including amount of MSW regularly disposed during such period), (iv) the decision in year 2003 of implementing the project activity at the AMC landfill and (v) the date the project activity was actually built (end of year 2003); no LFG capture and destruction system promoting combustion of LFG was built and operated at the AMC landfill during the period from start of operations of the landfill (in year 1997) until end of year 2003, when the project activity was commissioned and was able to continuously operate.

During such pre-project implementation period, a set of conventional and rudimentary LFG venting drains[56] were available in selected areas of the AMC landfill (that was under its initial operation

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[54] A legal/regulatory opinion statement issued by chartered independent 3rd party legal consultant/advisor Mr. José Carlos W. Fagundes on 15/02/2018 also confirms that no modification in the previously defined contractually required value for the fraction of LFG required to be flared in the AMC landfill occurred.

[55] Under the baseline scenario (absence of the project activity), conventional LFG venting/combustion drains would be gradually implemented in line with the expected expansion of the MSW disposal area at the AMC landfill (as per its design and operational plan valid for its lifetime).

[56] The design of the conventional LFG venting drains available at the AMC landfill during the pre-project phase (prior of the implementation of the project activity) during the initial years of the operational phase of landfill were somehow rudimentary and did not allow continuous combustion of LFG as such LFG venting drains were not conceived/designed for combustion of LFG (e.g. not appropriated design and diameter of the head of the drains). Due to aspects and conditions such as the diameter of such LFG venting drains, typical low pressure of LFG in the drains (installed in areas of the landfill under its initial operational phase where significant volume of LFG was not even generated), influence of wind and other climate aspects (e.g. rain pattern in the region (with significant precipitation levels during the raining

stage at that time) in order to have LFG being only vented (freely emitted into the atmosphere) through such drains (without any combustion of LFG occurring during such pre-project period).

By assuming the still valid contractual requirement that defines the minimum level/share of methane required to be destroyed at the AMC landfill (as established by the Administration of the Municipality of Salvador (municipal authority)) as a requirement that would have to be met as part of the operation of the AMC landfill along remaining lifetime of the landfill under the baseline scenario (absence of the project activity); destruction of such defined level/share of generated methane would thus occur through the utilization of a set conventional LFG venting/combustion drains that would otherwise have to be gradually implemented at the landfill. By also taking into account the existent contractual requirement that defines the minimum level/share of methane required to be destroyed at the AMC landfill, it is thus assumed that passive and conventional LFG venting/combustion drains would need to be gradually implemented and used at the AMC landfill in the absence of the project activity.

Finally, by taking into account the definitions of "*LFG capture system*", "*Existing LFG capture and destruction system*" and "*existing LFG capture system*" as per ACM0001 (version 19.0)[57], it is thus assumed that while there was no "*existing LFG capture and destruction system*" at the AMC landfill prior to the implementation of the project activity, it is however acknowledged that a LFG capture and destruction system would have to be opportunely implemented[58] under the baseline scenario (absence of the project activity).
It is also acknowledged that such LFG collection and destruction system would have to be implemented under a design and operational conditions deemed appropriate to have the previously defined contractual requirement (that defines the minimum level/share of methane required to be destroyed at the AMC landfill) being sufficiently met. Such system would be operational (with LFG combustion occurring as required) along the whole landfill remaining lifetime under the baseline scenario.

In summary, by taking the above presented facts, assumptions and explanations into account, the following is thus valid/applicable for the particular case of the AMC landfill in the absence of the project activity (baseline scenario) for the application of the stepwise approach of ACM0001 (version 19.0) encompassing the determination of $F_{CH4,BL,y}$:

- Existing LFG capture and destruction system: *NO*

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season)), as well as the operational conditions at the landfill at that time (where no working staff was ever required to attempt to promote combustion LFG in the venting drains and/or to promote any type of monitoring of conditions of the LFG venting drains); no LFG was thus ever combusted in such existing conventional LFG venting drains at the AMC landfill during the pre-project phase (period prior of the implementation of the project activity). In the context of the existing contractual requirement that defines the minimum level/share of methane required to be destroyed at the AMC landfill, such requirement was finally met by the implementation of the project activity that promotes destruction of methane under a level by far higher than established by such contractual agreement.

[57] As per ACM0001 (version 19.0), "*LFG capture system*" is defined as follows: "*A system to capture LFG. The system may be passive, active or a combination of both active and passive components. Passive systems capture LFG by means of natural pressure, concentration, and density gradients. Active systems use mechanical equipment to capture LFG by providing pressure gradients. Captured LFG can be vented, flared or used."*

As per ACM0001 (version 19.0), "*existing LFG capture system*" is defined as follows: "*An existing active LFG capture system is a system that has been in operation in the last calendar year prior to the start of the operation of the project activity."* ACM0001 (version 19.0) also defines "LFG capture system" as "*A system to capture LFG. The system may be passive, active or a combination of both active and passive components. Passive systems capture LFG by means of natural pressure, concentration, and density gradients. Active systems use mechanical equipment to capture LFG by providing pressure gradients. Captured LFG can be vented, flared or used."*

[58] It is assumed that the LFG collection and destruction system to be opportunely implemented at the AMC landfill (in order to have the contract requirement being met) would comprise a set of conventional passive LFG venting/combustion drains that would to be gradually implemented. Such drains allowing combustion of LFG would be new drains to be gradually implemented in accordance with the planned expansion of the MSW disposal area in the AMC landfill (new MSW disposal cells). In the areas of the landfill covered by the pre-project rudimentary conventional venting drains, such drains would be replaced by better design LFG venting/combustion drains (e.g. with a head diameter and design appropriated for having LFG being combusted).

Therefore, Case 4 (which is an option/case associated to the existence of LFG capture and destruction prior to the implementation of the project activity) is also regarded as a not applicable case for the determination of $F_{CH4,BL,y}$ in the context of the determination of baseline emissions for the project activity within its 3rd 7-year crediting period.

Thus, the only remaining possibly valid alternative (case) (after the analysis of "*Existence of LFG capture and destruction system at the AMC landfill"*) is Case 2.

In summary, the following is thus valid in the context of the application of the stepwise procedure for the determination of $F_{CH4,BL,y}$ for the project activity during the 2nd crediting period:

- Requirement to destroy methane = *YES*
- Existing LFG capture and destruction system = *NO*

By taking into account the outcome of the above presented analysis, the following methodological approach applicable for Case 2 is thus valid for the determination of $F_{CH4,BL,y}$:

<u>Application of methodological guidance valid for Case 2:</u>

Under Case 2 of stepwise approach for the determination of $F_{CH4,BL,y}$, the following is applicable as per ACM0001 (version 19.0):

$F_{CH4,BL,y}$ is directly determined as a function of the available information contained in the requirement to destroy methane as follows:

$$F_{CH4,BL,y} = F_{CH4,BL,R,y} \quad \textbf{(22)}$$

Where:

$F_{CH4,BL,R,y}$ — Amount of methane in the LFG which is flared in the baseline due to a requirement in year y (in tCH_4/yr). By taking into account that, in accordance with contractual requirement that defines the minimum level/share of methane required to be destroyed at the AMC landfill, a percentage of the amount of LFG actually captured and destroyed by the project activity (under the project scenario) is considered for the determination of the amount of methane to be combusted in the absence of the project activity (baseline scenario), $F_{CH4,BL,R,y}$ will thus be ex-post determined as follows along the 3rd 7-year crediting period of the project activity:

$$F_{CH4,BL,R,y} = \rho_{eg,y} * F_{CH4,PJ,capt,y} \quad \textbf{(23)}$$

Where:

$F_{CH4,PJ,capt,y}$ — Amount of methane in the LFG which is captured in the project activity in year *y* (tCH_4/yr). In accordance with applicable guidance of ACM0001 (version 19.0), $F_{CH4,PJ,capt,y}$ is assumed as the sum of the amount of methane that is sent to the internal combustion gas engines and amount of methane that is sent to the flares in year *y* (however by not taking into account ex-

post determined values for flare efficiency in the particular case of the determination of $F_{CH4,BL,y}$[59]).

$\rho_{reg,y}$ Fraction of LFG that is required to be flared due to a requirement in year *y.* As established by ACM0001 (version 19.0), $\rho_{reg,y}$ will be monitored ex-post. As stated in the latest versions of the registered PDD for the currently expired 1st and 2nd 7-year crediting periods (PDD version 6 (dated 27/12/2013), PDD version 7 (dated 28/01/2015) and PDD version 14.1 (dated 02/11/2018)) and evidenced in Appendix 3, the quantity of methane currently assumed as contractually required to be destroyed at the AMC landfill was an issue in the context of the previously established public service concession contract for MSW management for the city of Salvador (incl. operation and management of the AMC landfill by Bahia Transferencia e Tratamento de Residuos S.A.) in year 1999.

However, upon request from Bahia Transferencia e Tratamento de Residuos S.A., a quantitative definition for the level/share of generated methane to be required to be destroyed was only later confirmed by the Administration of the Municipality of Salvador (municipal authority) by the end of year 2010 through the issuance of an official document titled "*Clarification about Bahia Transferencia e Tratamento de Residuos S.A.'s contractual agreement with respect to definitions of yearly quantity of methane that Bahia Transferencia e Tratamento de Residuos S.A. shall destroy in the absence of the CDM project activity currently under operation in the landfill site Aterro Metropolitano Central (baseline scenario)* [60]" (dated 20/08/2010) which is enclosed in Appendix 3.

As also stated in the latest versions of the PDD for the expired 1st and 2nd 7-year crediting periods, the approach applied by the Administration of the Municipality of Salvador for actually defining the values presented in the official declaration document is based on the outcome and conclusions from an independent evaluation technical paper published by the environmental authority of São Paulo State in Brazil that is titled "*Reducing the uncertainty of methane recovered (R) in greenhouse gas inventories from waste sector and of adjustment factor (AF) in landfill gas projects under the Clean Development Mechanism*").

This technical paper refers to the potential theoretical share of generated methane that are/could be collected by well-designed conventional LFG

[59] In the particular case of the determination of $F_{CH4,BL,y}$ for the project activity, for all monitoring periods within the 3rd 7-year crediting period, $F_{CH4,PJ,capt,y}$ will be calculated as the accumulated value for amount of methane in the LFG which is sent for destruction through combustion in both the set of 19 internal combustion gas engines ($F_{CH4,EL,y}$) and in the high temperature enclosed flares ($F_{CH4,flared,y}$) (without taking into account the hours *h* that each individual flare has operated under conformance with operational requirements (as established/defined by the flare manufacturer) and by assuming a flare efficiency of 100% (project emissions from flaring being considered as zero (null)). This represents a conservative approach as the calculated value for $F_{CH4,BL,y}$ is maximized.

[60] Translation of the original title (in Brazilian Portuguese language) into English language.

venting/combustion drains (without use of forced LFG extraction through negative pressure) in several landfills existing in Brazil (incl. the AMC landfill).

Currently, the paper is still webhosted at the website of CETESB (the environmental authority for São Paulo State in Brazil[61]).

In summary, as stated in the latest versions of the registered PDDs valid for the expired 1st and 2nd 7-year crediting periods, the existence and validity of the contractual requirement that defines the current minimum level/share of methane required to be destroyed at the AMC landfill as 5% (as defined by the Administration of the Municipality of Salvador) is evidenced on the following documents:

(i) a pre-project implementation contractual document (named "*Bahia Transferencia e Tratamento de Residuos S.A.'s original technical proposal*"[62]) that sets/defines the general terms and conditions/rules for the operations of the AMC landfill as part of the public service concession agreement previously set between Bahia Transferencia e Tratamento de Resíduos S.A. and the Administration of the Municipality of Salvador (concession agreement encompassesing MSW management related activities in the city of Salvador (e.g. street cleaning, cleaning of public parks and squares, collection and disposal of MSW, etc.)).

(ii) The above-referred complementary clarification document titled "*Clarification about Bahia Transferencia e Tratamento de Residuos S.A.'s contractual agreement with respect to definitions of yearly quantity of methane that Bahia Transferencia e Tratamento de Residuos S.A. shall destroy in the absence of the CDM project activity currently under operation in the landfill site Aterro Metropolitano Central (baseline scenario)*" (issued by the Administration of the Municipality of Salvador (municipal authority) in 20/08/2010) that confirms the current minimum volume/share of methane to be destroyed at the AMC landfill (in the absence of the project activity (baseline scenario))[63]. While the document quantitatively refers to absolute volume of methane (in normal m^3 (Nm^3)) that are valid for years 2005, 2006, 2007, 2008, 2009 and 2010, it is

[61] The paper "Reducing the uncertainty of methane recovered (R) in greenhouse gas inventories from waste sector and of adjustment factor (AF) in landfill gas projects under the Clean Development Mechanism" is available online: http://www.arauna.com.br/lfg.pdf

[62] Translation of the original title (in Brazilian Portuguese language) into English language.

[63] As demonstrated in Appendix 3, the declaration official document issued by the Administration of the Municipality of Salvador (municipal authority) also confirms that, as required by the previously applied CDM baseline and monitoring methodology AM0002 (version 1), the defined contractual minimum level/share of methane currently required to be destroyed at the AMC landfill in the baseline scenario (absence of the project) is within the practice of methane destruction valid for the top 20% of the landfills operating in Brazil (in terms of methane destruction) at the time of the CDM validation of the project activity.

crucial to note that such values represent 5% of the accumulated ex-post measured values for amount methane that was collected and destroyed as a result of the operation of the implemented CDM project activity during each one of these particular years[64] and were indeed defined as such. While the official declaration document is valid for the whole remaining lifetime of the AMC landfill, for the whole time period encompassing the currently expired 2nd 7-year crediting period for the project activity, the minimum level/share of methane defined as required to be destroyed at the AMC landfill (in the absence of the project activity (baseline scenario)) thus represent 5% of the amount of methane actually collected and destroyed by the project activity by its methane destruction devices (equal to $F_{CH4,PJ,capt,y}$ (sum of the amount of methane that is sent to the internal combustion gas engines and to the flares in year *y* (however by not taking into account values for flare efficiency)))[65].

(iii) The provision included in item 11 of Appendix 3 of the latest version of the registered PDD for the currently expired 1st 7-year crediting period (version 7 dated 28/01/2015, approved on 29/05/2015) where the baseline is defined as being "(…) *5% of all collected LFG by the project activity* (…)".

As part of ex-post monitoring of $\rho_{reg,y}$, in accordance with applicable monitoring requirement of ACM0001 (version 19.0), it will be annually confirmed whether the currently applicable value of 0.05 (5%) remains being valid/regarded as the fraction of LFG that is required to be flared at the AMC landfill due to existing applicable requirement(s)[66].

[64] While the official declaration document issued by the Administration of the Municipality of Salvador is dated 20/08/2010, the declared value for the minimum amount of methane to be destroyed at the AMC landfill is based on the amount of methane actually collected and destroyed as part of the operation of the CDM project activity during the 1st semester of 2010 (without taking into consideration measured flare efficiency values and applied conservative deduction factors (due to non-compliance of performed calibration events with required calibration frequency) + gross estimates of methane collection and destruction valid for the 2nd semester of year 2010 (under a conservative assumption) that were supplied to the Administration of the Municipality of Salvador by BATTRE.

[65] By taking into account the importance of respecting the general terms and conditions/rules for the operation of the AMC landfill as part of the public service concession agreement previously set between Bahia Transferencia e Tratamento de Residuos S.A. and the Administration of the Municipality of Salvador encompassing MSW management for the city of Salvador (that among other services includes full operation and management of the AMC landfill), while the project activity has promoted destruction of methane generated at the AMC landfill since its implementation under a level that is by far higher than the considered magnitude for the level/share of generated methane required to be destroyed at the time of the concession agreement signature (in year 1999) and later finally defined/confirmed by the Administration of the Municipality of Salvador in the second half of year 2010 (as equivalent to 5% of the total amount of methane actually collected and destroyed by the project activity), there is still no legal municipal, state or national legally binding requirement in Lauro de Freitas city, Salvador city, Bahia State or Brazil respectively, that would establish any management requirement for LFG in new or operating landfills or waste dump sites and this situation is currently not expected to change.

[66] A legal/regulatory opinion statement issued by chartered independent 3rd party legal consultant/advisor Mr. José Carlos W. Fagundes on 15/02/2018 also confirms that no modification in the previously defined contractually required value for the fraction of LFG required to be flared in the AMC landfill occurred.

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

Not applicable. The only type of GHG abatement/mitigation measure encompassed by the project activity remains being destruction of methane emissions.

The project activity does not encompass electricity generation as an additional GHG abatement/mitigation measure. Thus, no emission reductions due to displacement of a more-GHG-intensive service (i.e. emission reduction due to generation of electricity using collected LFG as fuel) are eligible and/or claimable for the project activity.

Due to that Baseline emissions associated with electricity generation ($BE_{EC,y}$) are not considered. In summary, this step is not applicable.

Baseline emissions associated with heat generation ($BE_{HG,y}$)

As the project activity does not encompass any utilization of collected LFG for heat generation (in boiler, air heater, glass melting furnace(s) and/or kiln), baseline emissions associated with heat generation in year *y* ($BE_{HG,y}$) are not considered. In summary, this step is not applicable.

Baseline emissions associated with natural gas use ($BE_{NG,y}$)

As the project design does not encompass any utilization of collected LFG displacing the use of natural gas or injection of collected LFG into a natural gas distribution network or used by trucks, baseline emissions associated with natural gas use in year *y* ($BE_{NG,y}$) are not considered. Thus, this step is not applicable.

Monitoring of the management of the landfill:

As required by ACM0001 (version 19.0), during the 3rd 7-year crediting period of the project activity, the design and operational conditions of the AMC landfill will be annually monitored on the basis of different sources, including *inter alia*:

- Original design of the landfill;
- Technical specifications for the management of the AMC landfill;
- Applicable local or national regulations

During the 3rd 7-year crediting period, original operational design of the landfill should be confirmed not to be modified in order to ensure that no practice to deliberately or intentionally increase methane generation at the landfill have been occurring during the 3rd crediting period, when compared to the landfill management and operation condition prior to implementation of the project activity and/or during its currently expired 1st and 2nd crediting period. As required by ACM0001 (version 19.0), any change in the management of the landfill after the implementation of the project activity should 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). Further monitoring details are included in Section B.7.1 (under parameter "Management of SWDS").

<u>Determination of project emissions (PE_y):</u>

As established by ACM0001 (version 19.0), project emissions (PE_y) for the 3rd 7-year crediting period of the project activity are calculated (in tCO_2/yr) as follows:

$$PE_y = PE_{EC,y} + PE_{FC,y} + PE_{DT,y} \tag{26}$$

Where:

PE_y	Project emissions in year *y* (in tCO_2/yr)
$PE_{EC,y}$	Emissions from consumption of electricity due to the project activity in year *y* (in tCO_2/yr)
$PE_{FC,y}$	Emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year *y* (in tCO_2/yr)
$PE_{DT,y}$	Emissions from the distribution of compressed/liquefied LFG using trucks, in year y (in tCO_2/yr)

Since the project activity will not encompass any distribution of compressed/liquefied LFG, there will be no project emissions from the distribution of compressed/liquefied LFG using trucks ($PE_{DT,y}$ = 0).

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

Since its start of operations, the project activity has consumed Liquefied Petroleum Gas (LPG) for igniting the currently installed high temperature enclosed flares. As required by ACM0001 (version 19.0), project emissions from consumption of fossil fuels due to the project activity (for purpose other than electricity generation) ($PE_{FC,y}$) shall be calculated using the “Tool to calculate project or leakage CO_2 emissions from fossil fuel”. ACM0001 (version 19.0) establishes the following when applying this methodological tool:

- “*Processes j in the tool correspond to the sources of fossil fuel consumption due to the project activity other than for electricity generation or and any on-site transportation by trucks or cars;(…)”.* In the particular case of the project activity, process *j* corresponds to the use of LPG for igniting the flares.
- *“If in the baseline a proportion of LFG is captured and flared ($F_{CH4,BL,y}$ > 0), then the fossil fuels consumption used in calculation ($F_{Ci,j,y}$) should refer to the net of that consumed in the baseline. The determination of the amount of fossil fuels consumed in the baseline shall be transparently documented in the CDM-PDD.”* In the particular case of the project activity, while no fossil fuel has been used in the pre-project and baseline scenarios for collecting and destroying LFG, this requirement is thus not applicable.

Thus,

$$PE_{FC,y} = PE_{LPG,y} \tag{27}$$

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)

In order to determine $PE_{LPG,y}$, applicable guidance of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 03.0) is applied as follows:

$$PE_{LPG,y} = FC_{LPG,y} * COEF_{LPG,y} \quad \textbf{(28)}$$

Where:

$FC_{LPG,y}$ Quantity of LPG consumed (in ton LPG). $FC_{LPG,y}$ will be monitored ex-post based on measurements as per monitoring details included in Section B.7.1 and B.7.3.

$COEF_{LPG,y}$ CO_2 emission coefficient for LPG (in tCO_2/ton LPG).
$COEF_{LPG,y}$ is determined by following applicable guidance of Option B of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" as follows:

$$COEF_{LPG,y} = NCV_{LPG,y} * EF_{CO2,LPG,y} \quad \textbf{(29)}$$

Where:

$NCV_{LPG,y}$ Net calorific value of the fuel LPG (in GJ/ton LPG). $NCV_{LPG,y}$ will be monitored ex-post as per monitoring details included in Section B.7.1 and B.7.3.

$EF_{CO2,LPG,y}$ CO_2 emission factor of fuel LPG (in tCO_2/GJ LPG). $EF_{CO2,LPG,y}$ will be monitored ex-post as per monitoring details included in Section B.7.1 and B.7.3.

Determination of project emissions from consumption of electricity due to the project activity ($PE_{EC,y}$):

As required by ACM0001 (version 19.0), project emissions from consumption of electricity by the project activity ($PE_{EC,y}$) shall be calculated by applying the methodological approach established by the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0).

While the project activity (under its revised design configuration) fits under "Scenario C (*Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s)*) of this methodological tool, the following is also established by the tool:

> "*In the generic approach, project, baseline and leakage emissions from consumption of electricity are calculated based on the quantity of electricity consumed, an emission factor for electricity generation and a factor to account for transmission losses (…)*"[67]

[67] Since 01/01/2011, the project's electricity demand is to be met by one of the following sources/approaches:

- Imports of grid-sourced electricity (with electricity sourced by the grid-connected 20.1 MW electricity generation infrastructure fuelled by LFG and located within the geographical limits of the AMC landfill being always regarded and accounted as consumption of grid-sourced electricity as justified in Box 2 in Section A.3).
- Electricity supply by the installed backup captive off-grid electricity generator (fuelled by diesel) (expected to occur only during temporary planned or unplanned circumstances when supply of grid-sourced electricity is also interrupted).

ACM0001 (version 19.0) establishes the *following* when applying this methodological tool:

- *"$EC_{PJ,k,y}$[68] in the tool is equivalent to the amount of electricity consumed by the project activity in year y ($EC_{PJ,y}$)."*

- *"If in the baseline a proportion of LFG is destroyed ($F_{CH4,BL,y}$ > 0), then the electricity consumption in the tool ($EC_{PJ,j,y}$) should refer to the net quantity of electricity consumption (i.e. the increase due to the project activity). The determination of the amount of electricity consumed in the baseline shall be transparently documented in the CDM-PDD."*

In the particular case of the project activity under its revised design configuration, electricity sources *j* in the tool corresponds to the sources of electricity consumed due to the project activity: (i) grid-sourced electricity and (ii) electricity generated by the backup captive off-grid electricity generator (fuelled by diesel) are expected to be consumed for the operation of the project activity. No sources of electricity other than (i) and (ii) are currently expected to be used to meet the electricity demand of the project activity during its 3rd 7-year crediting period.

In the particular case of the project activity, although LFG is destroyed in the baseline scenario ($F_{CH4,BL,y}$ > 0), while the no electricity has been previously used in the pre-project and baseline scenarios (absence of the project activity) for collecting and destroying LFG through the utilization of conventional LFG venting/combustion drains, determination of the amount of electricity consumed in the baseline scenario (absence of the project activity) is thus not applicable/considered.

According to the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0), project emissions due to electricity consumption by the project activity ($PE_{EC,y}$) are calculated as follows:

$$PE_{EC,y} = \sum EC_{PJ,j,y} * EF_{EL,j,y} * (1 + TDL_{j,y}) \quad \textbf{(30)}$$

Where:

$EC_{PJ,j,y}$	Quantity of electricity consumed by the project electricity consumption source *j* in year y (in MWh).
$EF_{EL,j,y}$	CO_2 emission factor for electricity generation for source j in year y (in tCO_2/MWh).
$TDL_{j,y}$	Average technical transmission and distribution losses for providing electricity to source *j* in year *y*

In the particular case of the project activity, as grid-sourced electricity and electricity generated by the backup captive off-grid electricity generator (fuelled by diesel) are the only sources of electricity consumed by the project activity, $PE_{EC,y}$ can thus be calculated as:

$$PE_{EC,y} = PE_{EC,grid,y} + PE_{EC,captive,y} \quad \textbf{(31)}$$

Where:

[68] As per the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0), $EC_{PJ,j,y}$ is the quantity of electricity consumed by the project electricity consumption source j in year y.

$PE_{EC,grid,y}$ Project emissions from consumption of grid electricity due to the project activity in year y (in tCO_2/yr)

$PE_{EC,captive,y}$ Project emissions from consumption of electricity generated by a captive off-grid electricity generator fuelled by fossil fuel (diesel) in year *y* (in tCO_2/yr)

$PE_{EC,grid,y}$ and $PE_{EC,captive,y}$ are calculated according to the following approach:

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

By following applicable guidance of the methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03.0), project emissions due to grid electricity consumption by the project activity ($PE_{EC,grid,y}$), are determined as follows:

$$PE_{EC,grid,y} = EC_{PJ,grid,y} * EF_{EL,grid,y} * (1 + TDL_{grid,y}) \quad \textbf{(32)}$$

Where:

$EC_{PJ,grid,y}$ Quantity of grid sourced electricity consumed by the project activity in year y. As detailed in Section B.7.1 and B.7.3, $EC_{PJ,grid,y}$ will be measured and monitored in MWh as per the provisions of the methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03.0).

$TDL_{grid,y}$ Average technical transmission and distribution losses for grid sourced electricity consumed by the project activity in year *y.*

$EF_{EL,grid,y}$ CO_2 emission factor for grid-sourced electricity in year y (in tCO_2/MWh). $EF_{EL,grid,y}$ is determined by following applicable guidance of the methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” as follows:

> *“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 following above-quoted options of the methodological tool will thus be analysed ex-post for the determination of $EF_{EL,grid,y}$ (with the most conservative (higher) value being chosen) as follows:

- Option A.2: $EF_{EL,grid,y}$ is directly determined as 1.3 tCO_2/MWh (applicable conservative default value of the methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03.0)).

- <u>Option B.2:</u> $EF_{EL,grid,y}$ is directly determined as 1.3 tCO_2/MWh (applicable conservative default value of the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0)).

<u>Determination of leakage emissions (LE_y):</u>

No leakage emissions are expected to occur. Moreover, no leakage effects are accounted for under ACM0001 (version 19.0)[69].

[69] In the view of BATTRE, in the particular context of the project activity encompassing methane destruction as its unique measure, displacement of a more-GHG-intensive service (i.e. emission reductions due to generation of electricity using collected LFG as fuel) could in theory even be regarded as negative leakage emissions. Anyhow, while leakage emissions are not applicable as part of ACM0001 (version 19.0), such emissions are neglected.

B.6.2. Data and parameters fixed ex ante

Data/Parameter	**$OX_{top\ layer}$**
Data unit	Dimensionless
Description	Fraction of methane that would be oxidized in the top layer of the SWDS in the baseline
Source of data	Consistent with how oxidation is accounted for in the methodological tool “Emissions from solid waste disposal sites” (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 19.0)
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data/Parameter	**GWP_{CH4}**
Data unit	t CO_2e/t CH_4
Description	Global warming potential of CH_4
Source of data	“Global Warming Potential for Given Time Horizon” in table 2.14 of the errata to the contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, based on the effects of greenhouse gases over a 100-year time horizon. Available at: www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14 The applied values are also in accordance with the “Standard for application of the global warming potential to clean development mechanism project activities and programmes of activities for the second commitment period of the Kyoto Protocol”.
Value(s) applied	25
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	The applied value shall be updated according to any future COP/MOP decisions and/or decision by the CDM-EB.

Data/Parameter	η_{PJ}
Data unit	Dimensionless
Description	Efficiency of the LFG capture system that will be installed in the project activity
Source of data	Value obtained from technical literature
Value(s) applied	0.9280
Choice of data or measurement methods and procedures	Value obtained from technical literature[70] and by also taking into consideration the design and operational characteristics/aspects of the AMC landfill plus the general construction, design and forecasted implementation of the project's LFG collection network during its 3rd 7-year crediting period.
Purpose of data	Calculation of baseline emissions
Additional comment	Selected value can also be represented as percentage, since 0.9280 = 92.80%

[70] The technical paper "*Measuring landfill gas collection efficiency using surface methane concentration*" (which was published by Raymond L. Huitric and Dung Kong, from the Solid Waste Management Department of the Los Angeles County Sanitation Districts), states the following regarding LFG collection efficiency for a well-managed LFG collection system:

> *"Measuring landfill gas collection efficiency is important for gauging emission control effectiveness and energy recovery opportunities. Though researched for years, practical measures of collection efficiency are lacking. Instead, a default efficiency of 75% based on surveys of industry estimates is commonly used, for example, by the United States Environmental Protection Agency (US EPA). Though few, actual emission measurements indicate substantially higher efficiencies ranging from 85 to 98%."*

This document also mentions *"(…) landfill gas collection efficiencies should routinely reach 100%."*
Practical results, shown on table 4 of the study: Weighted average collection efficiency, show a collection efficiency of 92.8 to 96.1% on well-engineered landfills with vacuum systems to extract LFG.
The paper "*Measuring landfill gas collection efficiency using surface methane concentration*" is available at http://www.arb.ca.gov/cc/ccea/comments/april/huitric_kong.pdf

Data/Parameter	**R_u**
Data unit	$Pa.m^3/kmol.K$
Description	Universal ideal gases constant
Source of data	Default value as per the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0)
Value(s) applied	8,314
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	**-**

Data/Parameter	**MM_i**
Data unit	kg/kmol
Description	Molecular mass of greenhouse gas *i*
Source of data	Default values as per the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0)
Value(s) applied	The following values of molecular mass are applicable for CH_4 (the only GHG which is considered): Compound: Methane; Structure: CH_4; Molecular mass (kg/kmol): 16.04
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Compound	Structure	Molecular mass (kg/kmol)
Methane	CH_4	16.04

Data/Parameter	**MM_k**
Data unit	kg/kmol
Description	Molecular mass of gas *k*
Source of data	Default values as per the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0)
Value(s) applied	For considered gases *k* that are greenhouse gases (GHGs), the values below are applied for MM_k. As per the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”: *“The determination of the molecular mass of the gaseous stream ($MM_{t,db}$) requires measuring the volumetric fraction of all gases (k) in the considered gaseous stream. However, as a simplification, only the volumetric fraction of gases k that are greenhouse gases and are considered in the emission reduction calculation in the underlying methodology must be monitored and the difference to 100% may be considered as pure nitrogen. The simplification is not acceptable if it is differently specified in the underlying methodology.* ACM0001 (version 19.0) 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) and the difference to 100% is just considered as pure nitrogen. Compound: Nitrogen; Structure: N_2; Molecular mass (kg/kmol): 28.01
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	-

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

Data/Parameter	**MM_{H2O}**
Data unit	kg/kmol
Description	Molecular mass of water
Source of data	Default value as per the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (version 03.0)
Value(s) applied	18.0152
Choice of data or measurement methods and procedures	-

Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data/Parameter	P_n
Data unit	Pa
Description	Total pressure at normal conditions
Source of data	Default value as per the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)
Value(s) applied	101,325
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data/Parameter	T_n
Data unit	K
Description	Temperature at normal conditions
Source of data	Default value as per the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0)
Value(s) applied	273.15
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data/Parameter	$\varphi_{default}$
Data unit	-
Description	Default value for the model correction factor to account for model uncertainties

Source of data	Default value applicable for determination of baseline emissions as per the methodological tool "Emissions from solid waste disposal sites" (version 08.0). Value applicable for humid/wet conditions as per Application A is selected (based on the climate conditions valid for the location of the project activity). Source for weather condition data: http://www.bbc.com/weather
Value(s) applied	0.75
Choice of data or measurement methods and procedures	Determined based on default value of table 3 of the referred methodological tool as per Option 1, Application A (value applicable for humid/wet conditions).
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**OX**
Data unit	-
Description	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data	Applicable default value as per 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	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**F**
Data unit	-
Description	Fraction of methane in the SWDS gas (volume fraction)
Source of data	Applicable default value as per the methodological tool “Emissions from solid waste disposal sites” (version 08.0)
Value(s) applied	0.5
Choice of data or measurement methods and procedures	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, under anaerobic conditions in the considered SWDS. A default value of 0.5 is recommended by IPCC.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**$DOC_{f,default}$**
Data unit	Weight fraction
Description	Default value for the fraction of degradable organic carbon (DOC) in MSW that decomposes in the SWDS
Source of data	Applicable default value as per the methodological tool “Emissions from solid waste disposal sites” (version 08.0), which refers to applicable value as per IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Value(s) applied	0.5
Choice of data or measurement methods and procedures	This factor reflects the fact that some degradable organic carbon does not degrade, or degrades very slowly, in the SWDS. The default value was applied as per Application A of the methodological tool “Emissions from solid waste disposal sites” (version 08.0): “*The CDM project activity mitigates methane emissions from a specific existing SWDS”.*
Purpose of data	Calculation of baseline emissions
Additional comment	Application A of the methodological tool “Emissions from solid waste disposal sites” (version 08.0) is the applicable case of the project activity.

Data/Parameter	**$MCF_{default}$**
Data unit	-
Description	Methane correction factor
Source of data	Value is sourced by the methodological tool “Emissions from solid waste disposal sites” (version 08.0), that refers to IPCC 2006 Guidelines for National Greenhouse Gas Inventories.
Value(s) applied	1.0
Choice of data or measurement methods and procedures	Value is selected as per Application A of the methodological tool, under the following conditions: “*1.0: for anaerobic managed solid waste disposal sites. These must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) leveling of the waste;”* The day-to-day MSW disposal activities at the AMC landfill encompass utilization of appropriate MSW landfilling practices (covering, leveling and mechanical compacting of disposed material, etc.) as part of the operation of this landfill. The AMC landfill is regarded as a well-managed landfill site.
Purpose of data	Calculation of baseline emissions

Additional comment	-

Data/Parameter	**DOC_j**
Data unit	-
Description	Fraction of degradable organic carbon in the waste type *j* (weight fraction)
Source of data	Values are selected as per applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0), that refers to IPCC 2006 Guidelines for National Greenhouse Gas Inventories, (adapted from Volume 5, Tables 2.4 and 2.5).
Value(s) applied	(see table below)
Choice of data or measurement methods and procedures	The selected values are based on wet waste basis (moisture concentrations in the waste streams as waste is delivered to the SWDS). The IPCC 2006 Guidelines also specifies DOC values on a dry waste basis, which refers to the moisture concentrations after complete removal of all moisture from the waste. However, this selection is not practical for the situation/practice at the AMC landfill.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Waste type *j*	**DOC_j (% wet waste)**
Wood and wood products	43
Pulp, paper and cardboard (other than sludge)	40
Food, food waste, beverages and tobacco (other than sludge)	15
Textiles	24
Garden, yard and park waste	20
Glass, plastic, metal, other inert waste	0

Data/Parameter	**k_j**
Data unit	1/yr
Description	Decay rate for the waste type *j*
Source of data	Values are selected as per applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0). The methodological tools refers to values as per IPCC 2006 Guidelines for National Greenhouse Gas Inventories (adapted from Volume 5, Table 3.3).

Value(s) applied	<table><tr><th>Degradation speed</th><th>Waste type</th><th>k_j</th></tr><tr><td rowspan="2">Slowly degrading</td><td>Wood, wood products, rubber and leather</td><td>0.035</td></tr><tr><td>Pulp, paper and cardboard (other than sludge), textiles</td><td>0.07</td></tr><tr><td>Moderately Degrading</td><td>other (non-food) organic putrescible Garden, yard and park waste</td><td>0.17</td></tr><tr><td>Rapidly degrading</td><td>Food, food waste, sewage sludge, beverages and tobacco</td><td>0.4</td></tr></table>
Choice of data or measurement methods and procedures	Parameters are selected in accordance to the climate zone valid for the project site: Mean Annual Temperature (MAT) = 25 ºC Mean Annual Precipitation (MAP) = 1,781 mm – (wet climate). Source of data for mean annual temperature (MAT) and mean annual precipitation (MAP): http://pt.climate-data.org/location/854/
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**W_j**
Data unit	-
Description	Weight fraction of the waste type *j*
Source of data	Values are selected as per applicable guidance of IPCC 2006 Guidelines for National Greenhouse Gas, Volume 5, Chapter 2, tables 2.3-2.5, MSW composition regional default values for South-America.
Value(s) applied	<table><tr><th>Waste type j</th><th>W_j (% wet waste)</th></tr><tr><td>Wood and wood products</td><td>4.7</td></tr><tr><td>Pulp, paper and cardboard (other than sludge)</td><td>17.1</td></tr><tr><td>Food, food waste, beverages and tobacco (other than sludge)</td><td>44.9</td></tr><tr><td>Textiles</td><td>2.6</td></tr><tr><td>Garden, yard and park waste</td><td>0.0</td></tr><tr><td>Glass, plastic, metal, other inert waste</td><td>30.7</td></tr></table>
Choice of data or measurement methods and procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	No composition analysis for MSW disposed at the AMC landfill is currently available.

<table>
<tr><td>Data/Parameter</td><td>$SPEC_{flare}$</td></tr>
<tr><td>Data unit</td><td>Temperature - °C
Flow rate or heat flux – kg/h or Nm^3/h
Maintenance schedule - number of days</td></tr>
<tr><td>Description</td><td>Manufacturer’s flare specifications for temperature, flow rate and maintenance schedule</td></tr>
<tr><td>Source of data</td><td>Flare manufacturer[71]</td></tr>
<tr><td>Value(s) applied</td><td>The specifications of the 3 high temperature enclosed flares encompassed by the project activity are listed below:
<table>
<tr><th>$SPEC_{flare}$</th><th>Min.</th><th>Max.</th></tr>
<tr><td>Operational LFG flow (for continuous operation):</td><td>500 Nm^3/h</td><td>5,360 Nm^3/h</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 year (min each 365 days)</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” (version 03.0), the flare specifications and operational + maintenance requirements (as set/recommended by the equipment manufacturer) are documented and considered for the ex-ante determination of applicable values for the parameter $SPEC_{flare}$. During the 3rd 7-year crediting period, ex-ante selected data will be compared against monitored data related to the operation of the flares, including:
a) Minimum and maximum monitoring records for data regarding inlet LFG flow rate, if necessary converted to flow rate at reference conditions or heat flux,
(b) Minimum and maximum monitoring records for data of temperature in the exhaust gas of each individual high temperature enclosed flare; and
(c) Duration in days of time periods between maintenance events for each individual high temperature enclosed flare.</td></tr>
<tr><td>Purpose of data</td><td>Calculation of baseline emissions[72].</td></tr>
</table>

[71] The manufacturer of the flare is “BTS Termodinâmica de Sistemas Ltda.”, which is a flaring equipment manufacturer based in Brazil.

[72] As also highlighted in Section B.3, it is important to note that residual project emissions of CH_4 due to the combustion of LFG in the installed enclosed flare are considered in the context of the determination of baseline emissions (although ACM0001 (version 19.0) refers to the term “project emissions from flaring”).

Additional comment	All flare specification and operation details/requirements are based on information provided by the equipment manufacturer.

Data/Parameter	**$EF_{EL,captive,y}$**
Data unit	tCO_2/MWh
Description	CO_2 emission factor for electricity sourced by the captive off-grid electricity generators
Source of data	Applicable default as per the methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03.0) (by following option B2 of the underlying 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 “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03.0).
Purpose of data	Calculation of project emissions
Additional comment	-

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 “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03.0) (by following option A.2 of the underlying 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 “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03.0).
Purpose of data	Calculation of project emissions (due to the consumption of grid-sourced electricity by the project activity).
Additional comment	-

B.6.3. Ex ante calculation of emission reductions

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As presented in Section B.6.1, while emission reductions to be achieved by the project activity are determined as the difference between baseline emissions (BE_y) and project emissions (PE_y), as established by ACM0001 (version 19.0), the following relevant equations and conditions are applied for the ex-ante estimation of emission reductions to be achieved by the project activity during the 3rd 7-year renewable crediting period:

Determination of ex-ante estimates for baseline emissions (BE_y):

While the project activity encompasses methane destruction through collection and combustion of LFG in high temperature enclosed flares and in a set of 19 internal combustion gas engines, by following the applicable methodological approaches and assumptions + ex-ante determined values presented in Section B.6.1 and B.6.2 respectively, baseline emissions (BE_y) are thus determined as follows:

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

Where:

$BE_{CH4,y}$ Baseline emissions of methane from the SWDS in year y (tCO_2e/yr)

Determination of $BE_{CH4,y}$:

$BE_{CH4,y}$ is 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 that would be oxidized in the top layer of the SWDS in the baseline. OX_{top_layer} is ex-ante determined as 0.1. See Section B.6.2 for further details.

$F_{CH4,BL,y}$ Amount of methane that would be flared in the baseline in year y ($t\ CH_4/yr$). $F_{CH4,BL,y}$ is currently estimated as being equal to 0.05 * $F_{CH4,PJ,y}$[73]. See Section B.6.1 for further details.

[73] While, as outlined in Section B.6.1, $F_{CH4,BL,y}$ will be ex-post confirmed whether being equal to 0.05 * $F_{CH4,PJ,capt,y}$ (with validity of such assumption being annually confirmed through the ex-post monitoring of parameter "Fraction of LFG that is required to be flared due to a requirement in year *y*." ($\rho_{reg,y}$)); in the particular context of ex-ante estimates of emission reductions to be achieved by the project activity along the 3rd 7-year crediting period, as a simplification, $F_{CH4,PJ,capt,y}$ is directly assumed as being equal to $F_{CH4,PJ,y}$.Thus, $F_{CH4,BL,y}$ is directly estimated as being equal to 0.05 * $F_{CH4,PJ,y}$. The rationale for such assumption is that while $F_{CH4,PJ,capt,y}$ represents the sum of the amount of methane that is sent to the flares for combustion in year *y* (however by not taking into account the flare combustion efficiency) in the particular case of the of the ex-post determination of $F_{CH4,BL,y}$ along the 3rd crediting period, $F_{CH4,PJ,capt,y}$ will be ex-post calculated as the accumulated value for amount of methane in the LFG which is destroyed by flaring ($F_{CH4,flared,y}$) but without taking into account the hours *h* that each individual flare has operated under conformance with operational requirements (as established/defined by the flare manufacturer) and by assuming a flare efficiency of 100% (project emissions from flaring being considered as zero (null)). This represents a conservative approach as the calculated value for $F_{CH4,BL,y}$ is maximized in the particular context of determination of achieved emission reduction for monitoring periods along the 3rd crediting period. In the particular context of ex-ante estimates of emission reductions to be achieved by the project activity during its 3rd 7-year crediting period, by directly taking into account that $F_{CH4,PJ,y}$ represents the amount of methane that is estimated to be flared, $F_{CH4,BL,y}$ is thus directly assumed as being equal to 0.05 * $F_{CH4,PJ,y}$.

GWP_{CH4} Global warming potential of CH_4 ($tCO_2e/t\ CH_4$). GWP_{CH4} is ex-ante determined as 25.

$F_{CH4,PJ,y}$ Amount of methane in the LFG which is combusted in the installed flares and/or in the set of 19 internal combustion gas engines in year y (tCH_4/yr). In the context of ex-ante estimation of emission reductions, as established by ACM0001 (version 19.0), $F_{CH4,PJ,y}$ is determined (in tCH_4/year) as follows in the particular case of the project activity:

Determination of ex-ante estimations of $F_{CH4,PJ,y}$:

$$F_{CH4,PJ,y} = \eta_{PJ} * BE_{CH4,SWDS,y} / GWP_{CH4}$$

Where:

η_{PJ}	Efficiency of the LFG capture system that will be installed in the project activity. η_{PJ} is ex-ante determined as 0.9280. See Section B.6.2 for further details.
GWP_{CH4}	Global warming potential of CH_4 (tCO_2e/tCH_4). GWP_{CH4} is ex-ante determined as 25. See Section B.6.2 for further details.
$BE_{CH4,SWDS,y}$	Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* (in tCO_2e/yr). $BE_{CH4,SWDS,y}$ is estimated as follows:

$$BE_{CH4,SWDS,y} = \varphi_y * (1 - f_y) * GWP_{CH4} * (1 - OX) * \frac{16}{12} * F * DOC_f * MCF * \sum_{x=1}^{y} \sum_j W_{j,x} * DOC_j * e^{-k(y-x)} * (1 - e^{-kj})$$

For the determination of $BE_{CH4,SWDS,y}$, the ex-ante determined values for all parameters in the formulae above as well as historical and forecasts of MSW disposal at the AMC landfill are applied. See Section B.6.2 for details about such ex-ante determined values.

A calculation spreadsheet including ex-ante estimates of emission reduction to be achieved by the project activity is enclosed to this PDD. This calculation spreadsheet includes all required related calculations for the ex-ante estimation of $BE_{CH4,y}$ and $BE_{EC,y}$ during the 3rd 7-year crediting period.

The ex-ante estimation of $BE_y = BE_{CH4,y}$ is thus summarized as follows:

Year	Estimation of $BE_{CH4,SWDS,y}$ (tCO_2e)	Estimation of $F_{CH4,PJ,Y}$ (tCH_4)	Estimation of $F_{CH4,BL,y}$ (tCH_4)	Estimation of $BE_{CH4,y}$ = Baseline emissions (BE_y) (tCO_2e)
	$BE_{CH4,SWDS,y} = \varphi (1-f) * GWP_{CH4} * (1-OX) * 16/12 * F * DOC_f * MCF * \Sigma\Sigma w_{j,x} * DOC_j * e^{-kj(y-x)} * (1-e^{-kj})$	$F_{CH4,PJ,y} = n_{PJ} * BE_{CH4,SWDS,y} / GWP_{CH4}$	$F_{CH4,BL,y} = F_{CH4,BL,R,y} = \rho_{reg,y} * F_{CH4,PJ,y}$	$BE_y = BE_{CH4,y} = (1- OX_{top\_layer}) * (F_{CH4,PJ,y}-F_{CH4,BL,y}) * GWP_{CH4}$
2018	651,928	28,809	1,440	514,241
2019	659,731	29,154	1,458	520,396
2020	797,982	29,621	1,481	629,448
2021	812,848	30,173	1,509	641,175
2022	829,314	30,784	1,539	654,163
2023	846,928	31,438	1,572	668,056
2024	865,393	32,123	1,606	682,622
Total	**5,464,123**	**212,102**	**10,605**	**4,310,100**
Annual average	666,303	25,808	1,290	525,580

Determination of ex-ante estimations for (PE$_y$):

As outlined in Section B.6.1, the sources of project emissions to be considered in the context of the determination of emission reductions to be achieved by the project activity are those due to the consumption of both electricity and LPG by the project activity. The related ex-ante estimations of the corresponding project emissions are determined as follows:

Determination of ex-ante estimations of project emissions due to consumption of grid electricity by the project activity ($PE_{EC,grid,y}$):

By following the applicable methodological approaches and assumptions + ex-ante determined values presented in Section B.6.1 and B.6.2 respectively, $PE_{EC,grid,y}$ is determined as follows:

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

Where:

$PE_{EC,grid,y}$ Project emissions due to consumption of grid sourced electricity by the project activity in year *y* (in tCO_2/yr).

$EC_{PJ,grid,y}$ Quantity of grid sourced electricity consumed by the project activity in year *y* (in MWh). $EC_{PJ,grid,y}$ is estimated as being 1,892 MWh per year. Further details are included in Section B.7.1. This value is assumed based on the installed nominal power output for the main electrical equipment currently installed as part of the project activity (e.g installed centrifugal blowers) plus an additional 10 kW for ancillary equipment and also by assuming that such equipment will work continuously (24 hours a day) under full power during the whole 3rd 7-year crediting period[74].

[74] It is important to note that additional power consuming equipment (e.g. additional centrifugal blowers) may be installed as part of the project activity in order to accommodate projected increment in the quantity of LFG to be collected and destroyed by the project activity. In this sense, the conservative approach hereby assumed for estimating $EC_{PJ,grid,y}$ during the 3rd 7-year crediting period (equipment continuously operating under full power) is appropriate (and under a certain level incorporates an increase in grid electricity consumption by the project activity that may occur).

$EF_{EL,grid,y}$ CO_2 emission factor for grid-sourced electricity in year y (in tCO_2/MWh). As per the methodological approach indicated in Section B.6.1, $EF_{EL,grid,y}$ is estimated as being the most conservative value between the emission factor values determined as per applicable guidance for scenarios A.2 and B.2. As both Option A.2 and Option B.2 $EF_{EL,grid,y}$ are directly determined as 1.3 tCO_2/MWh (applicable conservative default values of the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0)). Thus, applied value is equal to 1.3 tCO_2/MWh.

$TDL_{grid,y}$ Average technical transmission and/or distribution losses for grid sourced electricity consumed by the project activity in year *y.* For the particular case of estimates of $PE_{EC,grid,y}$, $TDL_{,grid,y}$ is selected as 20%. Further details are included in Section B.7.1.

Determination of ex-ante estimations of project emissions due to consumption of electricity sourced by the backup captive off grid electricity generators fuelled by diesel by the project activity ($PE_{EC,captive,y}$):

The captive off-grid backup electricity generator (fuelled by diesel) are expected to be used only for emergency purposes (whenever supply of grid electricity to the project activity is temporarily interrupted). Thus, in the particular context of ex-ante estimates of emission reductions to be achieved by the project activity, there is no estimated amount of electricity to be generated by this generator nor estimated amount of fossil fuel diesel to be consumed by the generator. Project emissions due to the consumption of electricity sourced by such fossil-fuel electricity generator are thus estimated as zero (null) in the context of ex-ante estimates of emission reductions to be achieved by the project activity. It is however crucial to note that such related project emissions will be determined ex-post along the crediting period (based on applicable monitoring and calculation requirements as presented in Section B.6.1) and will thus be accounted for the ex-post determination of emission reductions.

Determination of ex-ante estimations of project emissions due to consumption of LPG by the project activity ($PE_{LPG,y}$):

In the particular context of ex-ante estimates of emission reductions to be achieved by the project activity within the 3rd 7-year crediting period, no consumption of LFG is considered. $FC_{LPG,y}$ is estimated to be 0 ton of LPG per year. This value is assumed based on reported and verified LPG consumption figures as part of the latest periodic verifications for the project activity within the currently expired 2nd crediting period (monitoring period from 12/05/2016 to 31/12/2017)[75].

[75] In each one of the operational flares, the main fuel line for the auxiliary flame-based system that supports/allow the flare burner ignition includes a manually selectable switching valve from which an upstream thin fuel supply line or an upstream thin LFG supply line can alternately selected as the start-up fuel line for flare burner ignition as part of each event of flare operation starting. In each flare, both the thin LPG supply line and the thin LFG supply line include appropriate pressure reduction valves and other elements which allow the selected start-up fuel (LPG or LFG) being combusted in auxiliary flame-based system under pressure and very flow that are required for the starting-up process of the flare under conformance with its functioning design. Upon the occurred replacement in June/2011 of the previously installed pressure reduction valve in the thin LFG supply line by a new valve (with improved/appropriate functioning and design), it finally became more reliable and safer to use LFG as primary start-up fuel, thus displacing use of LPG as start-up fuel for the flares. The use of very low amount of collected LFG as start-up fuel in high temperature enclosed flares is common practice in well-designed LFG collection and destruction initiatives across the world (incl. project-based initiatives under the CDM).

Ex-ante estimations of total project emissions during the 3rd 7-year crediting period are thus summarized as follows:

PE_y	Electricity consumed from the grid (MWh)	Electricity supplied by the captive diesel backup generator (MWh)	Project emissions due to electricity consumption (tCO_2e)	LPG consumed by the project activity (ton)	Project emissions due to LPG consumption by the project activity (tCO_2)	Total Project emissions promoted the project activity - PEy (tCO_2e)
Year	$EC_{PJ,grid,y}$	$EC_{PJ,captive,y}$	$PE_{EC,y} = (EC_{PJ,grid,y} * EF_{EL,grid,y} * (1+TDL_{grid,y,import})) + (EC_{PJ,captive,y} * EF_{EL,captive,y} * (1 + TDL_{captive,y}))$	$FC_{LPG,y}$	$PE_{LPG,y} = FC_{LPG,y} * NCV_{LPG,y} * EF_{CO2,LPG,y}$	$PE_y = PE_{EC,y} + PE_{LPG,y}$
2018	1,892	0	2,952	0	0	2,952
2019	1,892	0	2,952	0	0	2,952
2020	1,892	0	2,952	0	0	2,952
2021	1,892	0	2,952	0	0	2,952
2022	1,892	0	2,952	0	0	2,952
2023	1,892	0	2,952	0	0	2,952
2024	1,892	0	2,952	0	0	2,952
Total	**13,246**	**0**	**20,663**	**0**	**0**	**20,663**

Summarized ex-ante estimations of emission reductions (ER_y):
By taking into account the above summarized values for baseline and project emissions, the ex-ante estimations of the emission reductions for the project activity along the 3rd 7-year renewable crediting period are summarized as follows:

In the particular case of the flares of the project activity, in each individual flare operation starting event, the thin LFG supply line (or the thin LPG supply line as an alternative) supply relatively small amount of LFG for keeping the small flame of the auxiliary flame-based system lid (typically about 5 minutes). Moreover, it is relevant to note that, for each operational flare, LFG is injected in the thin LPG supply line for the auxiliary flame-based system used for flare ignition from a LFG supply points within the project's main LFG pipeline which is located upstream to the location within the pipeline where the installed LFG flow meter sets for measuring amount of LFG sent to the project's methane destruction devices are located. Thus, no emission reduction associated with such relatively very low consumption of LFG in each individual flare starting process is accounted. This is conservative.

It is also important to note that the use of LPG as start-up fuel is still being available as a backup alternative (e.g. in case of any required planned or unplanned maintenance/repair work in the LFG supply line for igniting the flare). While no LPG was not consumed during the monitoring period from 12/05/2016 to 31/12/2017, LPG was indeed widely used as a start-up fuel for the flares prior to the above referred replacement of the pressure reduction valve in the LFG in June/2011 (as reported in 4 previously compiled and verified Monitoring Reports valid for 1st 7-year crediting period of the project activity ending on 31/12/2010).

Emission reductions (tCO_2e)	
Year	*Emission reductions =* ER_y - PE_y
2018	511,289
2019	517,444
2020	626,496
2021	638,223
2022	651,211
2023	665,105
2024	679,670
Total	**4,289,437**
Annual average	612,777

Details about all the ex-ante determined parameters which are used for the ex-ante estimations of emissions reductions are included in the previous section. An emission reduction calculation spreadsheet with all related calculations for the ex-ante estimations of emission reductions to be achieved by the project activity during the 3rd crediting period is enclosed to this PDD.

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2018	514,241	2,952	0	511,289
2019	520,396	2,952	0	517,444
2020	629,448	2,952	0	626,496
2021	641,175	2,952	0	638,223
2022	654,163	2,952	0	651,211
2023	668,056	2,952	0	665,105
2024	682,622	2,952	0	679,670
Total	**4,310,100**	**20,663**	0	**4,289,437**
Total number of crediting years	7			
Annual average over the crediting period	615,729	2,952	0	612,777

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	**Management of SWDS**
Data unit	Dimensionless
Description	Management of the SWDS
Source of data	Measurements/monitoring performed by the project participants. The design and operational conditions of the solid waste disposal site (SWDS) AMC landfill will be annually monitored on the basis of different sources, including *inter alia*: - Original construction and operational design of the AMC landfill; - Technical specifications and requirements for the management of the AMC landfill; - Applicable local or national regulations dealing with management and operation of existing landfills. Any occurred or planned relevant change in terms of management of the landfill will be reported and justified.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 3rd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that is currently installed as part of the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Original construction and operational design of the AMC landfill should be confirmed as not being modified during the 3rd 7-year crediting period. This is to ensure that no practice aiming to increase methane generation in the landfill has been occurring after the implementation of the project activity. As required by ACM0001 (version 19.0), any change in the management of the landfill after the implementation of the project activity should be justified by referring to technical or regulatory specifications.
Monitoring frequency	Annually.
QA/QC procedures	Not applicable.
Purpose of data	Calculation of baseline emissions.
Additional comment	-

Data/Parameter	**$V_{t,wb,j}$**
Data 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).
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate LFG flow meters.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 3rd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that is currently installed as part of the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Volumetric flow measurement of collected LFG should always refer to the actual LFG absolute pressure and LFG temperature. Use of measuring instrument/equipment with recordable electronic signal (analogical or digital) is assumed.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events for the LFG flow meters will be performed by using a reference primary device provided by a third party independent accredited calibration laboratory. Calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions.
Additional comment	This parameter will be monitored in case Options B or C of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) are applied for the determination of $F_{CH4,flared,y.}$ and $F_{CH4,EL,y}$.

Data/Parameter	**$V_{t,db,j}$**
Data unit	m³ dry gas/h
Description	Volumetric flow of LFG stream in time interval *t* on a dry basis for *j* (where *j* is the LFG delivery pipeline to each internal combustion gas engine and LFG delivery pipeline to each flare)
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate LFG flow meters.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 3rd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that is currently installed as part of the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Volumetric flow measurement of collected LFG should always refer to the actual LFG absolute pressure and LFG temperature. Calculated based on the wet basis LFG flow measurement plus water concentration measurement. Use of measuring instrument/equipment with recordable electronic signal (analogical or digital) is assumed.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events for the LFG flow meter(s) will be performed by using a reference primary device provided by a third party independent accredited calibration laboratory. Calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions.
Additional comment	This parameter will be monitored in case Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is applied for the determination of $F_{CH4,flared,y}$.and $F_{CH4,EL,y}$.

Data/Parameter	$v_{CH4,t,db,j}$
Data unit	m^3CH_4/m^3 dry gas
Description	Volumetric fraction of CH_4 in the collected LFG in time interval *t* on a dry basis for *j* (where *j* is the LFG delivery pipeline to each internal combustion gas engine and LFG delivery pipeline to each flare)
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying an appropriate continuous CH_4 content gas analyzer.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 3rd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that is currently installed as part of the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measurements to be performed by appropriate continuous gas analyzer operating in dry-basis. Volumetric flow measurement should always refer to the actual pressure and temperature. Use of measuring instrument/equipment with recordable electronic signal (analogical or digital) is assumed.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events in the continuous CH_4 content gas analyzer will be performed by utilization of calibration span gas with certified CH_4 content (for span checking/adjustment). Utilization of an inert calibration gas (e.g. N_2) will also occur (for span checking/adjustment). All calibration gases (span gases) must have a certificate provided by the gas supplier and must be under their validity period. Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions.
Additional comment	This parameter will be monitored in case Option B of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is applied for the determination of $F_{CH4,flared,y}$ and $F_{CH4,EL,y}$. This parameter may be monitored in case Options A or D of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) are applied instead. $F_{CH4,flared,y}$ and $F_{CH4,EL,y}$.

Data/Parameter	$v_{CH4,t,wb,j}$
Data unit	m^3 CH_4/m^3 wet gas
Description	Volumetric fraction of CH_4 in the collected LFG in time interval *t* on a wet basis for *j* (where *j* is the LFG delivery pipeline to each internal combustion gas engine and LFG delivery pipeline to each flare)
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate continuous CH_4 content gas analyzer.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 3rd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that is currently installed as part of the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measurements to be continuously performed by appropriate gas analyzer operating in wet-basis. Volumetric flow measurement should always refer to the actual pressure and temperature. (calculated based on the dry basis analysis plus water concentration measurement or continuous in-situ analyzers). Use of measuring instrument/equipment with recordable electronic signal (analogical or digital) is assumed.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events in the continuous CH_4 content gas analyzer will be performed by utilization of calibration span gas with certified CH_4 content (for span checking/adjustment). Utilization of an inert calibration gas (e.g. N_2) will also occur (for span checking/adjustment). All calibration gases (span gases) must have a certificate provided by the gas supplier and must be under their validity period. Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions.
Additional comment	This parameter will be monitored in case Option C of the methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is applied for the determination of $F_{CH4,flared,y}$. and $F_{CH4,EL,y}$. This parameter may be monitored in case Options A or D of the methodological tool are applied instead.

Data/Parameter	$M_{t,db,j}$
Data unit	kg/h
Description	Mass flow of the LFG stream in time interval *t* on dry basis for *j* (where *j* is the LFG delivery pipeline to each internal combustion gas engine and LFG delivery pipeline to each one of the flares)
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate LFG flow meters.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 3rd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that is currently installed as part of the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Continuous measurements to be performed by applying appropriate flow meter operating in dry-basis. Mass flow measurement should always refer to the actual pressure and temperature (calculated based on the wet basis flow measurement plus water concentration measurement). Instruments with recordable electronic signal (analogical or digital) are required.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events for the LFG flow meter(s) will be performed by using a reference primary device provided by a third party independent accredited calibration laboratory. Calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions.
Additional comment	This parameter will be monitored only in case Option D of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) is applied for the determination of $F_{CH4,flared,y}$ and $F_{CH4,EL,y}$.

Data/Parameter	**T_t**
Data unit	K[76]
Description	Temperature of the LFG stream in time interval *t*
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate LFG temperature sensor.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 3rd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that is currently installed as part of the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measured to determine the density of methane ρ_{CH4}. No separate monitoring of LFG temperature is necessary when using LFG flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters (by considering standard temperature and pressure (STP) conditions). Instruments with recordable electronic signal (analogical or digital) are required.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events will be performed in the LFG temperature sensor by a third party independent accredited calibration laboratory in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions.
Additional comment	In case of measurements for the applicable LFG flow parameter are automatically converted and recorded in normalized cubic meters (by considering standard temperature and pressure (STP) conditions), monitoring of this parameter may not be required except if the applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted. Under this circumstance, this parameter shall be monitored continuously to assure the applicability condition is indeed met.

[76] Measurements for T_t will be recorded and reported in ºC. Recorded/reported data will be converted to Kelvin in order to also being recorded/reported in K.

Data/Parameter	P_t
Data unit	Pa[77]
Description	Pressure of the LFG stream in time interval *t*
Source of data	Measurements/monitoring performed by the project participants. Measured as part of the operation of the project activity by applying appropriate LFG pressure sensor.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 3rd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that is currently installed as part of the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measured to determine the density of methane ρ_{CH4}. No separate monitoring of LFG pressure is necessary when using LFG flow meters that automatically measure temperature and pressure, expressing LFG volumes in normalized cubic meters (by considering standard temperature and pressure (STP) conditions). Instruments with recordable electronic signal (analogical or digital) are required.
Monitoring frequency	Continuous measurements will be recorded and reported with an every-minute frequency.
QA/QC procedures	Periodic calibration events will be performed in the LFG pressure sensor by a third party independent accredited calibration laboratory in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions.
Additional comment	-

[77] Depending on installed measurement instrument, measurements for P_t will be recorded and reported in mbar. Recorded/reported data will be converted into Pascal in order to be also recorded and reported in Pa.

Data/Parameter	$p_{H20,t,Sat}$
Data unit	Pa (depending on measurement instrument, measurement records in mbar will be converted and also reported in Pa)
Description	Saturation pressure of H_2O at temperature T_t in time interval *t*
Source of data	Data as per the literature "*Fundamentals of Classical Thermodynamics*"; Authors: Gordon J. Van Wylen, Richard E. Sonntag and Borgnakke; 4º Edition 1994. Published by John Wiley & Sons, Inc.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 3rd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that is currently installed as part of the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	This parameter is solely a function of the LFG stream temperature T_t and can be found at above-referenced literature for a total pressure equal to 101,325 Pa.
Monitoring frequency	-
QA/QC procedures	-
Purpose of data	Data will be used for the determination of baseline emissions.
Additional comment	-

Data/Parameter	$EC_{PJ,grid,y}$
Data unit	MWh
Description	Amount of grid electricity consumed by the project activity during the year *y*
Source of data	Measured as part of the operation of the project activity by applying appropriate electricity meter(s).
Value(s) applied	It is estimated that the project activity will consume 1,892 MWh of grid sourced electricity per year during the 3rd 7-year crediting period. In the context of the ex-ante estimation of emission reductions to be achieved by the project activity during the 3rd 7-year crediting period, it is considered that the project's electricity demand will be met entirely by imports of grid-sourced electricity.
Measurement methods and procedures	Authorized electricity meters. Measurement records will be cross-checked against available electricity

	consumption receipts/invoices issued by the local electricity distribution company. The parameter $EC_{PJ,y}$ is equivalent to the parameter $EG_{EC,y}$ as indicated in ACM0001 (version 19.0).
Monitoring frequency	Continuous measurements will be aggregated automatically. Accumulated measurement records will be reported at least once a week.
QA/QC procedures	Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of project emissions.
Additional comment	The values considered in the context of the ex-ante estimation of emission reductions were selected based on the total combined nameplate installed power output for the installed centrifugal blowers. The installed centrifugal blowers are the most electricity intensive equipment of the project activity). Additional 10 kW in the estimated value for electricity consumption is considered in order to address the potential electricity consumption of other less electricity intensive equipment. Also as an assumption, it is considered that the project activity will operate 24 hours a day during the 3rd 7-year renewable crediting period. 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 20.1 MW electricity generation infrastructure (fuelled by LFG and located within the geographical limits of the AMC landfill) (for which the set of internal combustion gas engines represents the major components) will always be regarded and accounted as consumption of grid-sourced electricity (with related monitoring (data measurements and records) being performed and with project emissions being determined ex-post accordingly).

Data/Parameter	**$Op_{j,h}$**
Data unit	-
Description	Operation of the equipment that consumes LFG (i.e. set of 19 internal combustion gas engines (as additional/alternative methane destruction devices)).
Source of data	Measured as part of the operation of the project activity.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 3rd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane

	destruction devices in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that is currently installed as part of the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	As established by ACM0001 (version 19.0), for each equipment unit *j (*internal combustion gas engine*)* promoting utilization of LFG, it will be monitored whether the equipment is operating in hour *h* by monitoring any one or more of the following three parameters: (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; (b) Flame. Flame detection system is used to ensure that the equipment is in operation; (c) Products generated. Monitor the generation of steam for the case of boilers and air-heaters and glass for the case of glass melting furnances. This option is not applicable to brick kilns. $O_{pj,h}$ = 0 when: (a) One of more temperature measurements are missing or below the minimum threshold in hour *h* (instantaneous measurements are made at least every minute); (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.* Otherwise, $O_{pj,h}$ = 1
Monitoring frequency	Hourly
QA/QC procedures	Calculation of baseline emissions.
Purpose of data	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 19.0), the monitoring parameter $Op_{j,h}$ is not applicable to the project's high temperature enclosed flares.
Additional comment	-

Data/Parameter	**$F_{CH4,EG,t}$**
Data 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*
Source of data	Measurements undertaken by a third party accredited entity for each operational flare
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 3rd 7-year

	crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that is currently installed as part of the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measure the mass flow of methane in the exhaust gas of each operational flare according to an appropriate national or international standard (such as the UK's Technical Guidance LFTGN05 or a similar standard). The time period *t* over which the mass flow is measured must be at least one hour. The average flow rate to the flare during the time period *t* must be greater than the average flow rate observed for the previous six months.
Monitoring frequency	Biannual
QA/QC procedures	QA/QC procedures are to be applied by the entity responsible for performing the related measurements as per requirements of the applied standard. Periodic calibration events in the applied instruments will be performed by a third party independent accredited calibration laboratory (in a frequency as per instrument specifications and/or instrument manufacturer's recommendations). Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of baseline emissions[78].
Additional comment	Monitoring of this parameter is required in the case of enclosed flares and if the project participants select Option B.1 to determine flare efficiency.

Data/Parameter	**$T_{EG,m}$**
Data unit	ºC
Description	Temperature in the exhaust gas of the enclosed flare in minute *m*
Source of data	Measurements performed for each operational flare by the project participants
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 3rd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in

[78] It is relevant to note that, as shown in Section B.6.1., as per the applied methodological approach, monitoring records of $F_{CH4,EG,t}$ are used for the determination of project emissions from flaring ($PE_{flare,y}$), of which are accounted for the determination of baseline emissions (and not used for the determination of project emissions despite of being termed as "project emissions" from flaring).

	year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that is currently installed as part of the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measure the temperature of the exhaust gas of each operational high temperature enclosed flare by appropriate temperature measurement equipment (e.g. thermocouples). Measurements outside the operational temperature specified/recommended by the manufacturer may indicate that one or more flares is/are not functioning correctly and may require maintenance. Flare manufacturers must provide suitable monitoring ports for the monitoring of the temperature of the exhaust gas of the flare. These would normally be expected to be in the middle third of the flare.
Monitoring frequency	Continuous measurements will be recorded and reported with a least every minute frequency.
QA/QC procedures	Temperature measurement equipment should be replaced or calibrated in accordance with their maintenance schedule.
Purpose of data	Calculation of baseline emissions.
Additional comment	Unexpected changes such as a sudden increase/drop in temperature can occur for different reasons. As part of the monitoring procedure, these events will be 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. Periodic calibration events will be performed in the instruments by a third party independent accredited calibration laboratory in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.

Data/Parameter	**$Flame_m$**
Data unit	Flame status "*on*" or flame status "*off*"
Description	Flame detection of flare in the minute *m*
Source of data	Measurements/monitoring for each operational flare performed by the project participants. Whenever, flame is detected in the flare, flame status "*on*" is attributed. Whenever, flame is not detected in the flare, flame status "*off*" is attributed.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 3rd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated

	by estimating the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that is currently installed as part of the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Measure for each operational flare using a fixed installation optical flame detector: Ultra Violet detector or Infra-red or both.
Monitoring frequency	Once per minute.
QA/QC procedures	Equipment shall be maintained and calibrated in accordance with manufacturer's recommendations.
Purpose of data	Calculation of baseline emissions.
Additional comment	Applicable to all flares. The condition will be regularly monitored for each individual high temperature enclosed flare. Periodic calibration events will be performed in the instruments by a third party independent accredited calibration laboratory in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.

Data/Parameter	**$Maintenance_y$**
Data unit	Calendar dates
Description	Maintenance events completed in year *y* as monitored by the project participants.
Source of data	Measurements/monitoring performed by the project participants.
Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 3rd 7-year crediting period. Baseline emissions of methane from the SWDS ($BE_{CH4,y}$) are ex-ante estimated by estimating the amount of methane which is destroyed by the project activity through combustion of collected LFG in project's methane destruction devices in year *y* ($F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$) as a function of ex-ante estimated values for efficiency of the LFG capture system that is currently installed as part of the project activity (η_{PJ}) as well as ex-ante estimations for the amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* ($BE_{CH4,SWDS,y}$) by applying applicable guidance of the methodological tool "Emissions from solid waste disposal sites" (version 08.0) and considering aspects/characteristics of the landfill.
Measurement methods and procedures	Record the date that maintenance events were completed in year *y*. Records of maintenance logs must include all aspects of the maintenance including the

	details of the person(s) undertaking the work, parts replaced, or needing to be replaced, source of replacement parts, serial numbers and calibration certificates.
Monitoring frequency	Annual
QA/QC procedures	Records must be kept in a maintenance log for two years beyond the life of the flare.
Purpose of data	Calculation of baseline emissions.
Additional comment	Monitoring of this parameter is required for the case of enclosed flares and the project participant selects Option B to determine flare efficiency. These dates are required so that they can be compared to the maintenance schedule to check that maintenance events were completed within the minimum time between maintenance events specified by the manufacturer ($SPEC_{flare}$).

Data/Parameter	**$FC_{LPG,y}$**
Data unit	ton
Description	Quantity of LPG consumed by the project activity in year *y*
Source of data	Monitoring based on measurements performed by applying weight scale
Value(s) applied	It is estimated that 0 kg (0 ton) of LPG will be consumed by the project activity per year during the 3rd 7-year crediting period[79].
Measurement methods and procedures	Recording of measurements of LPG consumed by project activity in year *y* by using appropriate mass meter (weight scale).
Monitoring frequency	Continuous measurements of quantity of LPG by the project activity will be monitored with frequency not lower than once a month.
QA/QC procedures	LPG purchasing receipts may be used for crosschecking of valid measurement records.
Purpose of data	Calculation of project emissions.
Additional comment	Periodic calibration events will be performed in the mass meters by a third party independent accredited calibration laboratory in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Instruments will be subject to a regular maintenance and testing regime in accordance to appropriate national/international standards/requirements and/or best practice. Spare instrument(s) may be kept.

Data/Parameter	**$NCV_{LPG,y}$**
Data unit	GJ/ton LPG
Description	Net calorific value of the fuel LPG in year y
Source of data	Value provided by the fuel supplier in invoices, regional or national default values or 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[80]). Source of value applied in the context of ex-ante estimation of emission reductions during the 3rd 7-year crediting period: Brazilian Energetic Balance Report, year 2019 (Table VIII.9 – Specific Mass and Heating Values – 2018[81])

[79] The estimated null value (no consumption of LPG) is determined by taking into account the previously reported values of LPG consumed by the project activity during the latest performed verification for the project activity (monitoring period from 12/05/2016 to 31/12/2017 which is encompassed by the currently expired 2nd 7-year crediting period).

[80] Any future revision of the IPCC Guidelines will be taken into account.

[81] The Brazilian Energetic Balance Report – 2019 (Relatório Balanço Energético Nacional (BEN) – 2019) is the latest report and it is based on data for year 2015. This official governmental report was published by the entity Empresa de Pesquisa Energética (EPE) and is available online:

http://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-377/topico-470/Relat%C3%B3rio%20S%C3%ADntese%20BEN%202019%20Ano%20Base%202018.pdf

Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 3rd 7-year crediting period since, in the particular context of such ex-ante estimation, it is assumed that no LPG will be consumed by the project activity per year during the 3rd 7-year crediting period.
Measurement methods and procedures	-
Monitoring frequency	In case values are provided by the fuel supplier in invoices, the applied weighted average annual value will be determined based on provided related information in the context of each individual fuel delivery event. In case regional or national default values or IPCC default values are considered an every year monitoring frequency is applied.
QA/QC procedures	Both values provided by the fuel supplier in invoices as well as regional or national default values will be confirmed to be within the uncertainty range of the IPCC default values (as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines). If the considered values fall below this range, additional information and/or justification will be collected and will be used to justify the outcome. The laboratory (ies) sourcing related measurements or analysis will be confirmed to have ISO17025 accreditation (or it will be justified that it/they can comply with similar quality standards).
Purpose of data	Calculation of project emissions.
Additional comment	If the LPG supplier does provide related NCV values and CO_2 emission factor for the delivered fuel on the invoice and these two values are based on measurements for this specific fuel, this source will be used for the determination of values for the monitoring parameter $NCV_{LPG,y}$. In case, another source(s) for the values is/are applied, regional or national default values or IPCC default values will thus be considered.

Data/Parameter	**$EF_{CO2,LPG,y}$**
Data unit	tCO_2/GJ LPG
Description	CO_2 emission factor of fuel LPG in year *y*
Source of data	Value provided by the fuel supplier in invoices, regional or national default values or 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)[82]. Appropriate net calorific value (NCV) for LPG may be used for converting energy basis data into mass basis data. For the ex-ante estimation of emission reductions to be achieved by the project activity during the 3rd 7-year crediting period, the 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)).

[82] Any future revision of the IPCC Guidelines will be taken into account.

Value(s) applied	No estimated value is required for the determination of ex-ante estimation of emission reduction to be achieved by the project activity during the 3rd 7-year crediting period since, in the particular context of such ex-ante estimation, it is assumed that no LPG will be consumed by the project activity per year during the 3rd 7-year crediting period.
Measurement methods and procedures	-
Monitoring frequency	In case values are provided by the fuel supplier in invoices, the applied weighted average annual value will be determined based on provided related information in the context of each individual fuel delivery event. In case regional or national default values or IPCC default values are considered an every year monitoring frequency is applied.
QA/QC procedures	Both values provided by the fuel supplier in invoices as well as regional or national default values will be confirmed to be within the uncertainty range of the IPCC default values (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).). If the considered values fall below this range, additional information and/or justification will be collected and will be used to justify the outcome.
Purpose of data	Calculation of project emissions.
Additional comment	If the LPG supplier does provide related NCV values and CO_2 emission factor for the delivered fuel on the invoice and these two values are based on measurements for this specific fuel, this source will be used for the determination of values for the monitoring parameter $NCV_{LPG,y}$. In case, another source(s) for the values is/are applied, regional or national default values or IPCC default values will thus be considered.

Data/Parameter	**$EG_{Diesel\text{-}Generator,y} = EC_{PJ,captive,y}$**
Data unit	MWh
Description	Quantity of electricity generated by captive diesel backup generator during the year *y* Quantity of electricity consumed from captive diesel backup generator during the year *y*
Source of data	Measurements by the project participants.
Value(s) applied	No estimated value is considered for the determination of ex-ante estimation of emission reductions to be achieved by the project activity during the 3rd 7-year crediting period. In the particular context of the ex-ante estimation of emission reductions to be achieved by the project activity during the 3rd 7-year crediting period, it is considered that the project's electricity demand will be met entirely by imports of grid-sourced electricity. The installed backup off-grid electricity generator is expected to be used only during emergency situations (interruption of the supply of grid-sourced electricity to the project activity).
Measurement methods and procedures	Use appropriate electricity meters.

Monitoring frequency	Measurements will be aggregated manually or automatically. Accumulated measurement records will be reported at with at least every-month frequency.
QA/QC procedures	Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Monitoring equipment/instrument(s) will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Spare instrument(s) may be kept.
Purpose of data	Calculation of project emissions.
Additional comment	The captive off-grid backup electricity generator (fuelled by diesel) is used only for emergency purposes. Thus, in the context of ex-ante estimates of emission reductions to be achieved by the project activity, there is no estimated amount of electricity to be generated this generator and/or amount of fossil fuel diesel to be consumed by the generators either. Project emissions due to the consumption of electricity sourced by this generator are thus estimated as zero (null) in the context of ex-ante estimates of emission reductions to be achieved by the project activity. However, such project emissions will be determined ex-post along the crediting period (based on applicable monitoring and calculation requirements as presented in Section B.6.1) and will be accounted for the determination of emission reductions. It is important to note that, if all electricity generated by the backup captive off-grid electricity generator (fuelled by Diesel) are consumed by the project activity, $EG_{Diesel\text{-}Generator,y} = EC_{PJ,captive,y}$.

Data/Parameter	$\rho_{reg,y}$
Data unit	-
Description	Fraction of LFG that is required to be flared due to a requirement in year *y*
Source of data	The validity of the previously defined contractual requirement that establishes the valid/applicable minimum level/share of methane required to be destroyed through combustion at the AMC landfill as part of the operation of this landfill (as a requirement previously established by the Administration of the Municipality of Salvador (municipal authority responsible for the public service of solid waste management for the city of Salvador)) will be annually confirmed. Such annual confirmation will be based on checking and assessment of information of new regulatory or non-regulatory requirements relating to LFG (new contractual requirements or new requirements to address safety and odour concerns) at municipal, regional and/or national level[83].
Value(s) applied	5% (0.05)
Measurement methods and procedures	Not applicable.
Monitoring frequency	It will be annually confirmed whether the currently applicable value of 0.05 (5%) (that represents minimum level/share of methane currently required to be destroyed through combustion at the AMC landfill) will remain being valid.
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions.
Additional comment	This parameter is applicable to the project activity as Case 2 of ACM0001 (version 19.0) was selected for the determination of the amount of methane captured and destroyed in the baseline.

Data/Parameter	$TDL_{grid,y}$
Data unit	-

[83] It is crucial to note that as explained in Section B.6.1, as also applicable/valid for the time period encompassing the currently expired 1st and 2nd 7-year crediting periods for the project activity, currently there is still no additional legal municipal, state or national legally binding requirement in Lauro de Freitas city, Salvador city, Bahia State or Brazil respectively, that would establish any management requirement for LFG in new or operating landfills or waste dump sites and this situation is currently not expected to change. For the particular case of the AMC landfill, there is a still valid contractual requirement that indeed defines the minimum level/share of methane that should destroyed through combustion at the AMC landfill as part of its operation. This requirement was previously established by the Administration of the Municipality of Salvador (municipal authority responsible for the public service of solid waste management for the city of Salvador) at the time of the establishment of the of terms and conditions for the public service concession contract with BATTRE (formerly Vega Bahia Tratamento de Resíduos Ltda) in year 1999 (although the AMC landfill was already under operation by the Municipality of Salvador since 1997) for service of MSW management for the city of Salvador (incl. full operation and management of the AMC landfill as a disposal site for MSW generated and collected in Salvador). Such requirement is regarded as still being valid. Approval and implementation of new municipal, state or national legally binding requirement in Lauro de Freitas city, Salvador city, Bahia State or Brazil respectively (or any type of new requirement), that would establish additional management requirement for LFG in new or operating landfills or waste dump sites (incl. the AMC landfill) will be annually checked/confirmed in the context of ex-post monitoring of parameter $\rho_{reg,y}$.

Description	Average technical transmission and distribution losses for grid sourced electricity consumed by the project activity.
Source of data	Use of recent, accurate and reliable data available within the host country or selection of applicable default value as per Option C.III of the methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03.0) or use of recent, accurate and reliable data available within the host country.
Value(s) applied	20%
Measurement methods and procedures	Value should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed CDM project activity is connected to. The technical distribution losses in the grid should not contain other types of grid losses (e.g. commercial losses/theft). The distribution losses can either be calculated by the project participants or be based on references from utilities, network operators or other official documentation.
Monitoring frequency	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.
QA/QC procedures	-
Purpose of data	Data is used for determination of project emissions (due to consumption of grid-sourced electricity by the project activity).
Additional comment	-

Data/Parameter	**$TDL_{captive,y}$**
Data unit	-
Description	Average technical transmission and distribution losses for electricity sourced by the captive electricity generator.
Source of data	Use of recent, accurate and reliable data available within the host country or selection of the applicable default value valid for Option C.III as per the methodological tool “Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (version 03.0). For the ex-ante estimates of emission reductions, the default value is applied.
Value(s) applied	No estimated value is considered for the determination of ex-ante estimation of emission reductions to be achieved by the project activity during the 3rd 7-year crediting period. In the particular context of the ex-ante estimation of emission reductions to be achieved by the project activity during the 3rd 7-year crediting period, it is considered that the project’s electricity demand will be met entirely by imports of grid-sourced electricity. The installed backup off-grid electricity generator is expected to be used only during emergency situations (interruption of the supply of grid-sourced electricity to the project activity).
Measurement methods and procedures	Value should be estimated for the distribution and transmission networks of the electricity grid of the same voltage as the connection where the proposed CDM project activity is connected to. Value can either be calculated by the project participants or be based on relevant references.
Monitoring frequency	Annually. In the absence of data from the relevant year, most recent figures should be used, but not older than 5 years.

QA/QC procedures	-
Purpose of data	Data is used for determination of project emissions (due to consumption of grid-sourced electricity by the project activity).
Additional comment	-

Data/Parameter	**Status of biogas destruction device**
Data unit	-
Description	Operational status of biogas destruction device(s)
Source of data	Not applicable.
Value(s) applied	Not applicable.
Measurement methods and procedures	Monitoring and documenting may be undertaken through monitoring of the operation of the flare(s) (by means of s flame detector in each flare) and the operation of the internal combustion gas engines (by means of direct monitoring of operation status for each engine) in order to demonstrate the actual destruction of methane in such installed biogas destruction devices. Emission reductions will not accrue for periods in which the underlying destruction device(s) (high temperature enclosed flare(s) and/or internal combustion gas engine(s)) is/are not operational.
Monitoring frequency	Continuous measurements will be recorded and reported with a least every minute frequency.
QA/QC procedures	Not applicable.
Purpose of data	Calculation of baseline emissions.
Additional comment	Monitoring records for the monitoring parameter “Flame detection of flare in the minute *m*” ($Flame_m$) will be considered for the installed flares. Monitoring records for the monitoring parameter “Operation of the equipment that consumes LFG (i.e. set of 19 internal combustion gas engines (as additional/alternative methane destruction devices))” ($Op_{j,h}$) will be considered for the internal combustion gas engines.

B.7.2. Sampling plan

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Not applicable.

B.7.3. Other elements of monitoring plan

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General monitoring:

The following instruments/equipment will be used to monitor required data along the 3rd 7-year renewable crediting period of the project activity (depending on the applied measurement options and calculation approaches - to be chosen ex-post)[84]:

Instrument or Source of data	**Measurement option**		**Data monitored**	
Appropriate volumetric or mass flow meters (one individual LFG flow meter for each operational high temperature enclosed flare and for each internal combustion gas engine, with separated measurement data being recorded and reported for each one of these methane destruction devices)	A	Volume flow – dry basis; Volumetric fraction dry or wet basis	$\mathbf{V_{t,db,j}}$	Volumetric flow of LFG stream *j* in time interval *t* on a dry basis (in m^3 dry gas/h). *j* = LFG delivery pipeline to each operative high temperature enclosed flare and/or to each operative internal combustion gas engine (i.e. each installed methane destruction device).
	B	Volume flow – wet basis; Volumetric fraction dry basis	$\mathbf{V_{t,wb,j}}$	Volumetric flow of LFG stream *j* in time interval *t* on a wet basis (in m^3 dry gas/h). *j* = LFG delivery pipeline to each operative high temperature enclosed flare and/or to each operative internal combustion gas engine (i.e. each installed methane destruction device).
	C	Volume flow – wet basis; Volumetric fraction wet basis	$\mathbf{V_{t,wb,j}}$	Volumetric flow of LFG stream *j* in time interval *t* on a wet basis (in m^3 wet gas/h). *j* = LFG delivery pipeline to each operative high temperature enclosed flare and/or to each operative internal combustion gas engine (i.e. each installed methane destruction device).
	D	Mass flow – dry basis; Volumetric fraction dry or wet basis	$\mathbf{M_{t,db,j}}$	Mass flow of LFG stream *j* in time interval *t* on a dry basis (in kg/h). *j* = LFG delivery pipeline to each operative high temperature enclosed flare and/or to each operative internal combustion gas engine (i.e. each installed methane destruction device).
Continuous CH_4 content gas analyser unit	-		$\mathbf{v_{CH4,t,db/wb,j}}$	Volumetric fraction of methane on the LFG stream directed to the flares and/or to the internal combustion gas engines in a time interval *t* on a dry or wet basis (in m^3 CH_4/m^3 dry or wet gas)
LFG pressure sensor	**-**		$\mathbf{P_t}$	Pressure of the LFG stream directed to the flares and/or to the internal combustion gas engines in time interval *t* (in Pa or mbar) Note: $\mathbf{P_t}$ may not be monitored when using LFG flow meters that automatically consider and measures LFG temperature and LFG pressure, thus expressing LFG volumetric or

[84] Measurement options defined in the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) when referring to "*Adequate volumetric or mass flow meter(s)*" and defined in the methodological tool Project emissions from flaring" (version 03.0) in other cases.

Different measurement options are indeed defined in the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 03.0) when referring to "Adequate volumetric or mass flow meter (s)". The applicable guidance of the methodological tool "Project emissions from flaring" (version 03.0) also refers to different measurement and calculation options.

Instrument or Source of data	Measurement option	Data monitored	
			mass flows in normalised units.
LFG temperature sensor	-	T_t	Temperature of the LFG stream directed to the flares and/or to the internal combustion gas engines in time interval *t* (in K or ºC) Note: T_t may not be monitored when using LFG flow meters that automatically consider and measures LFG temperature and LFG pressure, thus expressing LFG volumetric or mass flows in normalised units.
Not based on measurements. Monitoring performed in the context of operation/monitoring for the project activity (based on calculations)	-	$p_{H20,t,Sat}$	Saturation pressure of H_2O at temperature T_t in time interval *t* This parameter is solely a function of the LFG stream temperature T_t and can be found at referenced literature.
Electricity meters		$EC_{PJ,y} = EC_{grid,y}$	Amount of grid electricity consumed by the project activity in year *y* (in MWh)
		$EG_{Diesel\text{-}Generator,y}$ $EC_{PJ,captive,y}$	Quantity of electricity generated by / consumed from captive diesel backup generator during the year *y* (in MWh)
Mass/weight scale		$FC_{LPG,y}$	Amount of LPG consumed by the project activity in year *y* (in ton)
	Calculation approach (option) 1 or 3	$FC_{Diesel,y}$	Quantity of fuel Diesel combusted by the captive off-grid electricity generator (in liters)
Not based on measurements performed in the context of operation/monitoring for the project activity	-	**Management of SWDS**	Management of SWDS The design and operational conditions of the landfill will be annually monitored on the basis of different sources, including *inter alia*: - Original design of the landfill; - Technical specifications for the management of the landfill; - Applicable local or national regulations
Not based on measurements performed in the context of operation/monitoring for the project activity	-	$\rho_{reg,y}$	Fraction of LFG that is required to be flared due to a requirement in year *y* The amount of methane otherwise required to be captured and combusted in the absence of the project activity (baseline scenario) will be annually monitored. Approval and implementation of new municipal, state or national legally binding requirement in Lauro de Freitas city, Salvador city, Bahia State or Brazil

Instrument or Source of data	Measurement option	Data monitored	
			respectively (and/or any type of new requirement) that would establish any additional management requirement for LFG in new or operating landfills or waste dump sites (incl. the AMC landfill) will be annually checked/confirmed.
Meter or equipment electronics.	**-**	**$Op_{j,h}$**	Operation of the equipment that consumes LFG (internal combustion gas engines). For each internal combustion gas engine *j* combusting LFG (destroying methane), it will be continuously monitored whether the equipment is operating in hour *h* by monitoring any one the following sub-parameters/conditions: - Amount of electricity generated in hour *h* - Operational status of the engine-generator set during each hour *h*.
Not based on measurements Monitoring performed in the context of operation/monitoring for the project activity (based on calculations)	**-**	**$NCV_{LPG,y}$**	Net calorific value of the fuel LPG in year y (in GJ/ton LPG). Data will be determined as per applicable guidance of the methodological tool “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” (version 03.0).
Not based on measurements Monitoring performed in the context of operation/monitoring for the project activity (based on calculations)	**Calculation approach (option) 1 or 3**	**$NCV_{Diesel,y}$**	Net calorific value of the fuel Diesel in year y (in GJ/ton LPG). Data will be determined as per applicable guidance of the methodological tool “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” (version 03.0).
Not based on measurements Monitoring performed in the context of operation/monitoring for the project activity (based on calculations)		**$EF_{CO2,LPG,y}$**	CO_2 emission factor of fuel LPG in year *y* (in tCO_2/GJ). Data will be determined as per applicable guidance of the methodological “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” (version 03.0).
Not based on measurements	**Approach 1 or 3**	**$EF_{CO2,Diesel,y}$**	CO_2 emission factor of fuel Diesel in year *y* (in tCO_2/GJ). Data will be determined as per

Instrument or Source of data	Measurement option	Data monitored	
Monitoring performed in the context of operation/monitoring for the project activity (based on calculations)			applicable guidance of the methodological tool "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 03.0).
Measurements undertaken by a third party accredited entity	**B.1**	**$F_{CH4,EG,t}$**	Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the time period *t* (kg) For each one of the installed high temperature enclosed flare, it will be measured the mass flow of methane in the exhaust gas according to an appropriate national or international standard (e.g. UKs Technical Guidance LFTGN05). The time period *t* over which the mass flow is measured must be at least one hour. The average flow rate to the flare during the time period *t* must be greater than the average flow rate observed for the previous six months. Monitoring of this parameter is only required in the case the project participants select Option B.1 to determine the efficiency values for the high temperature enclosed flares.
Thermocouples	**A or B.1**	**$T_{EG,m}$**	Temperature in the exhaust gas of the enclosed flare in minute *m* (ºC) For each one of the installed high temperature enclosed flare, it will be continuously measured the temperature of the exhaust gas through use of appropriate temperature measurement instrument (e.g. thermocouples). Measurements outside the operational temperature specified by the flare manufacturer may indicate that the flare is not functioning correctly and may require maintenance or repair work. For each flare, the temperature of the exhaust gas in each flare have to be measured in a suitable monitoring port. In high temperature enclosed flares, monitoring ports are normally expected to be located within the middle third of the flare. In case more than one temperature port is fitted to the high temperature enclosed flare, the flare manufacturer must provide written instructions detailing the conditions under which each location shall be used and the port most suitable for monitoring the operation of the flare according to manufacturer's specifications for temperature of exhaust gas. The four high

Instrument or Source of data	Measurement option	Data monitored	
			temperature enclosed flares currently installed as part of the project activity only have one monitoring port for temperature of the exhaust gas. Measurements are required to determine if manufacturer's flare specifications for operating temperature are met.
Optical flame detector (using ultra violet or infra-red technology or both	**A or B.1**	**$Flame_m$**	Flame detection of flare in the minute *m* (Flame "*on*" or Flame "*off*") For each installed high temperature enclosed flare, continuous monitoring of flame detection through use of appropriate installation (e.g. optical flame detector (using ultra violet or infra-red technology or both).
Records from the project participants gathered as part of the operation of the project activity.	**B.1**	**$Maintenance_y$**	Maintenance events completed in year *y* (Calendar dates) for each one of the high temperature enclosed flare combusting LFG. For each installed high temperature enclosed flare, record the date when maintenance events are performed in year *y*. Records of maintenance logs will include all aspects of the maintenance including the details of the person(s) undertaking the work, parts replaced/repaired, or needing to be replaced, source of replacement parts, serial numbers and related calibration certificates.
Not based on measurements	**Calculated or application of default value**	**$TDL_{grid,y}$ / $TDL_{captive,y}$**	Use of recent, accurate and reliable data available within the host country or selection of the applicable default value as per the methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0).
Project participants	**-**	**Status of biogas destruction device**	Operational status of biogas destruction device The same procedures as adopted for monitoring parameter $Flame_m$ (in the case of the flares) and for parameter $Op_{j,h}$ (in the case of internal combustion gas engines). For installed high temperature enclosed flares), continuous monitoring of flame detection through use of appropriate installation (e.g. optical flame detector (using ultra violet or infrared technology or both). For installed internal combustion gas engines, continuous monitoring of operational status signal in each engine.

During the 3rd 7-year crediting period, all continuously measured LFG related parameters as well as measurements related to the exhaust gas of the flares (temperature in the exhaust gas of the flares) and parameters related to flare operational conditions (i.e. status of methane destruction

devices) will all be recorded electronically via an appropriate data logger / data acquisition system (to be located within the site boundary).
The data logger / data acquisition system will have the capability to record all data in a safe and reliable manner (thus ensuring the required data reliability and validity). Data recording and reporting frequency for these parameters will be at least every one minute.

Records of electricity consumed by the project activity will also be recorded electronically via an appropriate data logger / data control / data acquisition system (to be located within the site boundary). Data from invoices of purchased grid-sourced electricity (issued by local electricity transmission/commercialization company) may also be used as cross-checking. Moreover, records of electricity generated by the backup captive off-grid electricity generator (fueled by diesel) may also be regularly recorded (depending on the approach applied for the determination of project emissions from consumption of electricity source by such backup electricity generator).

During the 3rd 7-year crediting period of the project activity, records of quantity of LPG eventually consumed by the project activity will be aggregated manually or automatically (depending on the specifications of related measurement instrument to be applied). Accumulated related measurement records will be reported at with an at least every-month frequency. Data from related eventual LPG purchasing receipts or invoices (to be issued by local LPG distribution company) will also be used as cross-checking.

By the use of appropriate software application, recorded monitoring data will be regularly retrieved, aggregated and reported in order to be considered in the context of calculations of emission reduction achieved by the project activity.

Monitoring records available in the data logger / data acquisition system might be regularly retrieved remotely by modem or directly on site. If automatic data logging by the logger / data acquisition system fails, measurement data might be recorded manually (whenever it is possible). If data is not properly recorded or cannot be retrieved, no emissions reductions will be claimed for the period encompassing such data recording/reporting failure.

During the 3rd 7-year crediting period, all monitoring data will be recorded and backed-up in a central database. As per the applicable monitoring procedure, data records will be summarized into emission reduction calculations prior to each periodic CDM verification. All data recorded by the data logger / data acquisition system will be made available to the Designated Operational Entities (DOEs) responsible for each periodic verification. This will ensure that data integrity and reliability for related monitoring data.

As per the monitoring procedure adopted by Battre - Bahia Transferencia e Tratamento de Resíduos Ltda., access to monitoring data will be restricted and controlled. All monitoring records will be kept archived until at least two years after the end of the crediting period or at least two years after the last issuance of CER's for the project activity, whichever occurs later.

It will be the responsibility of the appointed monitoring team manager to ensure that all monitoring data is properly measured and recorded as part of operation of the project activity.

Technical specifications for monitoring instruments/equipment (e.g. manufacturer, model, serial numbers, accuracy, etc.) will be detailed in the Monitoring Reports for each periodic verification.

Maintenance and calibration for monitoring instruments/equipment and project's equipment/components in general:
During the 3rd 7-year crediting period of the project activity, all maintenance service and routines will include all preventive and corrective actions necessary for ensuring good functioning of all project related equipment, such as:

- Visual control of the equipment state and real-time check of displayed parameters,

- Cleaning up the equipment and the sensors,
- Lubrication and greasing,
- Replacement or overhauling of defective parts (including regular welding service in the HDPE pipelines and manifolds).

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.

General malfunction of equipment: if monitoring instruments/equipment or project's equipment/components present failure or malfunction, applicable repair or replacement actions will be carried out. Spare units for some of the monitoring instruments/equipment may be kept on site.

Project's operational and management structure:
An appropriate project's operational and management structure will be made available as part of the operation of the project activity during its 3rd 7-year crediting period.

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

a) General competence development about LFG generation and collection;
b) Review of equipment operational principles and captors;
c) Maintenance and calibration requirements for project's related equipment;
d) Procedures for monitoring data gathering and handling;
e) Emergency and safety procedures;
f) General competence development about methane destruction through combustion of LFG in high temperature enclosed flares;
g) General competence development about methane destruction through combustion of LFG in internal combustion gas engines.

The monitoring plan will be implemented during the 3rd 7-year crediting period of the project activity by reflecting the best practice in terms of monitoring efforts for LFG collection and destruction project based initiatives under de CDM.

Monitoring of the management of the landfill:
As required by ACM0001 (version 19.0), the design and operational conditions of the AMC landfill during the 3rd 7-year renewable crediting period will be monitored on the basis of different sources, including *inter alia*:

- Original design of the landfill;
- Technical specifications for the management of the AMC landfill;
- Applicable local or national regulations

During the 3rd 7-year crediting period of the project activity, original operational design of the landfill should be confirmed not to be modified in order to ensure that no practice to increase methane generation at the landfill have been occurring, when compared to the landfill management and operation condition prior to implementation of the project activity. As required by ACM0001 (version 19.0), any change in the management of the landfill after the implementation of the project activity should 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). Further monitoring details are included in Section B.7.1 (under parameter "Management of SWDS").

The occurred permanent change in the project design, the revision of the monitoring plan and performed corrections (in information which do not affect project design) represent post-registration changes that do not adversely affect the previously demonstrated compliance of the project activity with applicability requirements of ACM0001 (version 19.0) + applied methodological tools. The scale and the level of accuracy and completeness in overall monitoring of the project activity are not adversely affected by such post-registration changes either. Monitoring (including the design of the monitoring plan) is however improved and complemented, thus meeting additional monitoring requirements for the project activity (under its revised design).

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>
At the time the CDM project activity "Salvador da Bahia Landfill Gas Management Project" was validated and registered as a CDM project activity (during period encompassing the year of 2003), the start date of the project was selected as being 01/01/2004.

C.2. Expected operational lifetime of project activity

>>
A total operational lifetime of 20 years is expected for project infrastructure[85].

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>
While the project activity applies 7-year renewable crediting period option, this PDD is thus valid for the 3rd 7-year renewable crediting period.

C.3.2. Start date of crediting period

>>
The 3rd 7-year renewable crediting period starts on 01/01/2018.

C.3.3. Duration of crediting period

>>
7 years and 0 months.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
Information about the analysis of the environmental impacts for the project activity (under its previous design configuration) and related validation assessment by the responsible DOE are all presented in the latest version of its PDD valid for the currently expired 1st 7-year crediting period (PDD version 7, dated 28/01/2015) + Validation Report for the project activity (dated 20/04/2005).

D.2. Environmental impact assessment

>>
Information about the analysis of the environmental impacts for the project activity (under its previous design configuration) and related validation assessment by the DOE are presented in the

[85] Lifetime for the project's infrastructure may actually exceed 20 years if required service and maintenance is performed correctly and related equipment is always operated and maintained (serviced) as per recommendation and requirements set by manufacturers of related equipment/instruments.

latest version of the PDD valid for the 1st 7-year crediting period (PDD version 7, dated 28/01/2015) + Validation Report for the project activity (dated 20/04/2005).

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

>>

Information about solicitation of comments from local stakeholders (including received comments) and related validation assessment by the DOE are presented in the latest version of the PDD valid for the 1st 7-year crediting period (PDD version 7, dated 28/01/2015) + Validation Report for the project activity (dated 20/04/2005).

E.2. Summary of comments received

>>

Information about solicitation of comments from local stakeholders (including received comments) and related validation assessment by the DOE are presented in the latest version of the PDD valid for the 1st 7-year crediting period (PDD version 7, dated 28/01/2015) + Validation Report for the project activity (dated 20/04/2005).

E.3. Consideration of comments received

>>

Information about solicitation of comments from local stakeholders (including received comments) and related validation assessment by the DOE are presented in the latest version of the PDD valid for the 1st 7-year crediting period (PDD version 7, dated 28/01/2015) + Validation Report for the project activity (dated 20/04/2005).

SECTION F. Approval and authorization

>>

A Letter of Approval (LoA) from the Designated Operational Entity (DNA) of host Party Brazil was issued on 02/06/2004. This LoA confirms the voluntary participation of the former project participant Vega Bahia Tratamento de Resíduos Ltda[86] and Brazil in the CDM and confirms that the proposed project activity contributes towards Sustainable Development in Brazil. The project was also granted with an LoA from the DNAs of Japan (LoA dated 12/01/2005), United Kingdom of Great Britain and Northern Ireland (LoA dated 20/04/2005) and the Netherlands (LoA dated 31/08/2006).

More recently, an updated LoA from the DNA of Brazil was issued on 19/05/2019 due to the occurred change in the designation/name of the host country project participant[87].

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[86] The name of the host country Project participant was later replaced by Bahia Transferencia e Tratamento de Resíduos S.A. (BATTRE).

[87] The name of the host-country project participant was updated at UNFCCC in August/2019 from “Bahia Transferencia e Tratamento S.A.” to “Battre - Bahia Transferencia e Tratamento de Resíduos Ltda.” as outlined in the updated version of the following documents valid for the project activity:

- completed Modalities of Communication (MoC) form

- Letter of Approval (LoA) issued by the DNA of Brazil

This occurred change correct reflects the previously occurred and required change in the registration name of the company as a result of occurred change in its statutory and shareholder organizational structure.

Appendix 1. Contact information of project participants

Organization name	Battre - Bahia Transferencia e Tratamento de Resíduos Ltda.
Country	Brazil
Address	Estrada Cia-Aeroporto, km 6.5 41505-050 – Salvador - BA
Telephone	+55 11 3124 3681
Fax	-
E-mail	dnicoletti@solvi.com
Website	www.solvi.com
Contact person	Mr. Diego Nicoletti

Organization name	Belekton d.o.o.
Country	Slovenia
Address	Cvetkova ulica 25 1 000 Ljubljana
Telephone	+ 386 1 620 88 54
Fax	-
E-mail	jernej.kozlevcar@belektron.eu
Website	www.belektron.eu
Contact person	Mr. Jernej Kozlevcar

Appendix 2. Affirmation regarding public funding

Not applicable. The implementation and operation of the project do not involve any kind of public funding from Parties included in Annex I.

Appendix 3. Applicability of methodologies and standardized baselines

While all information about the applicability of selected methodology is presented in Section B.2, this appendix includes relevant information about the following issues:

- Official declaration document issued by the Administration of the Municipality of Salvador (municipal authority) confirming the minimum level/share of methane required to be destroyed at the AMC landfill valid for years 2005, 2006, 2007, 2008, 2009 and 2010
- Poor performance of the project activity in terms of collection of LFG resulting in limited utilization of available total combined nameplate installed capacity of the grid-connected 20.1 MW electricity generation infrastructure located within the geographical limits of the AMC landfill since 01/01/2011

Official declaration document issued by the Administration of the Municipality of Salvador (municipal authority) confirming the minimum level/share of methane required to be destroyed at the AMC landfill valid for years 2005, 2006, 2007, 2008, 2009 and 2010 (including its translation into English Language)

Copy of official declaration document dated 20/08/2010 and issued by the Administration of the Municipality of Salvador (municipal authority) that confirms the minimum level/share of methane required to be destroyed at the AMC landfill valid for years 2005, 2006, 2007, 2008, 2009 and 2010 (including its translation into English Language) is presented below. This document complements a pre-project implementation contractual document (named "*Bahia Transferencia e Tratamento de Residuos S.A.'s original technical proposal*" [88]) that sets/defines the general terms and conditions/rules for the operations of the AMC landfill as part of a the public service concession agreement set between Bahia Transferencia e Tratamento de Residuos S.A. and the Administration of the Municipality of Salvador encompassing MSW management related activities in the city of Salvador (e.g. street cleaning, cleaning of public parks and squares, collection and disposal of MSW, etc.).

[88] Translation of the original title (in Brazilian Portuguese language) into English language.

PREFEITURA DE SALVADOR
PREFEITURA DE UM NOVO TEMPO

Secretaria Municipal de Serviços Públicos e Prevenção à Violência SESP

Salvador, 20 de agosto de 2010.

OF. GAB – 758/2010

Ref.: Esclarecimento do Contrato da BATTRE, com respeito a definição da quantidade de metano por ano que a BATTRE deveria queimar na ausência da atividade de projeto de MDL atualmente em operação no Aterro Metropolitano Centro (cenário de linha de base).

Prezado Senhor,

Em atendimento a solicitação da BATTRE e,

Considerando que o Contrato de Concessão, assinado em 29 de dezembro de 1999, originário da Concorrência Público SESP Nº 004/99 que conferiu à BATTRE - BAHIA TRANSFÊRENCIA E TRATAMENTO DE RESÍDUOS SÓLIDOS LTDA. na Cláusula Primeira – Do Objeto, 1.1. Constitui o objeto do presente contrato a execução, na forma prevista na Lei, sob o regime de Concessão de serviços Públicos, conforme discriminados abaixo, os seguintes serviços:

1. Implantação e operação e manutenção do Aterro Metropolitano Centro, com capacidade para dispor 2.800 t/dia de resíduos sólidos urbanos.
2. Implantação, operação e manutenção de uma Estação de Transbordo, com capacidade para transferir 1.800t/dia de resíduos sólidos urbanos.

Considerando que o supra citado contrato de concessão, estabelece somente a exigência de apresentação dos diagramas esquemáticos da rede de captação e de

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http://www.pms.ba.gov.br/sesp

drenagem de gás de aterro gerado no AMC, com a Cláusula Décima Primeira – Responsabilidades, Obrigações e Direitos da Concessionária: 11.20 - Antes da entrada em operação do Aterro Sanitário Metropolitano Centro, fornecer os projetos executivos das obras e instalações, acompanhados da indicação dos respectivos responsáveis técnicos, no mínimo: 11.20.9 – Plantas do sistema de captação, drenagem, e remoção do biogás gerado, com os respectivos detalhes, cones, indicação dos métodos construtivos e materiais utilizados, sem que haja manifestação sobre o assunto do biogás;

Considerando que até a presente data não existe legislação federal, estadual e municipal vigente que obriga ou recomenda a captação e queima de gás (biogás) em aterros sanitários;

Considerando que na Proposta Técnica, parte integrante do contrato, define no item J.3.1 "Mecanismos de Produção do Biogás" que se faz necessário reconfirmar a produção de biogás ao longo da operação do aterro, em função dos parâmetros reais;

Considerando estudos recentes desenvolvidos pela Companhia de Tecnologia de Saneamento Básico (CETESB), entidade de reconhecida competência técnica no Brasil, que estimam quantitativamente a emissão passiva da queima de biogás em lixões, aterros controlados e em aterros sanitários, em um rol de 35 cidades do Brasil, utilizando formas de cálculo das emissões passivas de metano e que representa boas práticas exercidas no setor de disposição de resíduos;

Considerando a nota técnica da CETESB, o volume de CH_4, assim demonstrado no Quadro I, em condições normais de temperatura e pressão;

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PREFEITURA DE SALVADOR
PREFEITURA DE UM NOVO TEMPO

Secretaria Municipal de Serviços Públicos e Prevenção à Violência SESP

Quadro I - Volume de Metano - CH_4 (Nm^3)

Ano	Volume de Metano-CH_4 (Nm^3)
2005	1.971.601
2006	2.349.427
2007	1.890.050
2008	2.064.097
2009	1.790.928
2010	1.533.000

Nota: Os dados acima estão nas condições normais de temperatura e pressão (CNTP).

As informações acima apresentadas e os dados Quadro1, respaldam que esse novo quantitativo de metano coletado e queimado está adequado.

Atenciosamente,

[illegible] de Oliveira
Assessora da ASPLA
LIMPURB

Fábio Mota
Secretário

Ilmº. Sr.
Reinaldo Bomfim de Carvalho
Diretor da BATTRE – Bahia Transferência e Tratamento de Resíduos S.A.
Nesta.

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Salvador, 20th August 2010

TRANSLATION OF THE COMMUNICATION OF .GAB – 758/2010 ISSUED ON 20 AUG. 2010

Ref.: Clarification about Battre's contractual agreement, with respect to definition of yearly quantity of methane that BATTRE shall destroy in the absence of the CDM project activity currently under operation in the landfill site Aterro Metropolitano Centro (baseline scenario).
Dear Sir,

In response to a request from BATTRE and,

By considering that the concession contract, signed on 29 December 1999, resulted from the public tendering process SESP004/99 which allow BATTRE – BAHIA TRANSFERÊNCIA E TRATAMENTO DE RESÍDUOS SÓLIDOS LTDA, in its first clause - Object 1.1. It is the object the contract the execution, as per applicable legislation, under the regime of concession of public service, as described below, the following services:

1. Implementation, operation and maintenance of the landfill Aterro Metropolitano Centro, with municipal solid waste disposal capacity of 2,800 ton/day.
2. Implementation, operation and maintenance of a waste transfer station with municipal solid waste transferring capacity of 1,800 ton/day.

By considering that the referred concession contract only establishes as requirement, the presentation and submission of schematic diagrams of the system for collecting and drainage of landfill gas generated at AMC landfill as per Clause XI –"Responsibilities, Rights and Obligations of the Concessionaire"; 11:20 – Prior to the operation starting of the Aterro Metropolitano Centro landfill, the executive project of construction work and installation shall be submitted, with indication of respective responsible technicians enclosed at least; 11.20.9 – Diagrams and drawings of biogas drainage and collection system, with its specification details, cones, indication of the construction methods and utilized materials, without any requirement of manifestation about biogas issue.

By considering that up to present date, there is no federal, state or municipal legislation requiring or recommending capture and combustion of biogas from landfills;

By considering that as indicated in the Technical Proposal, as part of the contract documentation, defines in its item J.3.1 "Biogas Production Mechanisms", that it is required to re-confirm biogas production along the operation of the landfill, depending on the actual parameters;

By considering that recent studies developed by Companhia de Tecnologia de Saneamento Básico (CETESB), which is an organization of recognized technical expertise in Brazil, which it is quantitatively estimated the emission due to combustion of biogas in passive flares in dump sites, controlled landfill and sanitary landfills located in 35 Brazilian cities , using calculation approach for determination of passive emissions of methane and of which represent good practice on solid waste disposal;

By considering the technical note from CETESB, the CH4 volume, as demonstrated in Table 1, under standard temperature and pressure:

Table 1 – Volume of methane (Nm³)

Year	Volume of Methane (Nm³)
2005	1.971.601
2006	2.349.427
2007	1.890.050
2008	2.064.097
2009	1.790.928
2010	1.533.000

Note: The above data is converted to standard temperature and pressure.

The above presented information and data as per Table 1, supports that this new quantitave definition of amount of methane collected and destroyed is appropriate.

Sincerely,

Fabio Mota
Secretary

Poor performance of the project activity in terms of collection of LFG resulting in limited utilization of available total combined nameplate installed capacity of the grid-connected 20.1 MW electricity generation infrastructure since 01/01/2011:

The edited curve below (retrieved from pag. 30 of the previous version of PDD of the project activity valid for its expired 1st 7-year crediting period (PDD version 5, dated March/2005)) shows the rationale (in terms of availability of LFG) of the incurrence of capital expenditures (in year 2009) for implementing the grid-connected 20.1 MW electricity generation infrastructure fuelled by LFG and within the geographical limits of the AMC landfill (for which the set of 19 internal combustion gas engines represents major components).

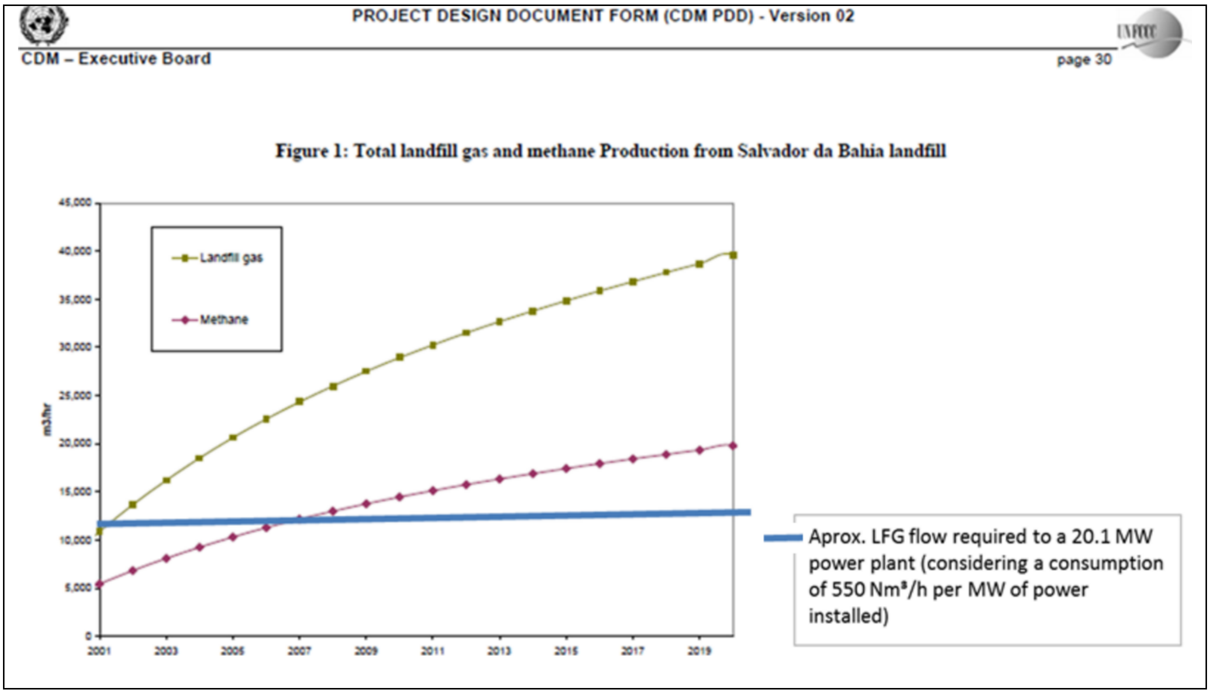

Figure App-1 - Edited curve (retrieved from pag. 30 of the previous version of PDD of the project activity valid for its expired 1st 7-year crediting period (PDD version 5, dated March/2005)) showing the rationale (in terms of availability of LFG) of the incurrence of capital expenditures (in year 2009) for implementing the grid-connected 20.1 MW electricity generation infrastructure fuelled by LFG within the geographical limits of the AMC landfill (for which the set of 19 internal combustion gas engines represents major components).

While the overall performance of the project activity (both in terms of the amount of LFG collected and destroyed and CH_4 content in collected LFG) was quite limited since year 2007, the project's overall performance (in terms of CH_4 destruction) indeed became even worse in year 2010.

The even weaker overall performance of the project activity in year 2010 (with significant decrease in the project's LFG collection/destruction occurring) was a direct outcome of the challengeable design and operational conditions of the project's LFG collection infrastructure at the AMC landfill.

The main cause of occurred further decrease in the overall performance of the project activity in year 2010 was working activities in the AMC landfill encompassing of a set of measures within the design & operation of the project's LFG collection infrastructure. Such measures were gradually implemented along years 2009 and 2010 as an attempt to boost the performance of the project's LFG collection infrastructure in order to achieved LFG supply flow sufficiently enough to have all the later implemented set of 19 internal combustion gas engines being powered.

Other causes for the further decrease in in the overall performance of the project activity in year 2010 are operational aspects/factors at AMC landfill such as very unfavorable raining pattern in the region, geotechnical challenges in the landfill, challenges for management of leachate in the landfill, etc. These aspect/factor somehow offset improvements previously made in the LFG collection infrastructure during years 2009 and 2010 (e.g. improvements in the design and operation of LFG collection well network and LFG pipeline network).

The project's significant underperformance in year 2010 is especially reflected in the verified significant decrease of the average content of CH_4 in collected LFG. With part of the project's LFG collection infrastructure under intervention (re-design) and with the AMC landfill under unfavorable conditions (e.g. *inter alia* in terms of leachate management and geotechnical aspects, etc.), more ambient air was mixed with LFG during such project underperformance period, thus oxidizing methane in collected LFG. These aspects and conditions resulted in a reported dramatic further decrease of the average CH_4 content in collected LFG as part of the operation of the project activity within year 2010. It is relevant to note that the internal combustion gas engines (that started operating on 01/01/2011) requires LFG with a minimum of 45% CH_4 content in order to ensure operational conditions and performance defined by equipment manufacturer.

With the AMC landfill and the project activity under the above-summarized unfavorable conditions, the starting of operations of the internal combustion gas engines on 01/01/2011 was obviously negatively impacted by qualitative and quantitative deficiencies in the supply of LFG (to be used as gaseous fuel for electricity generation), despite of a number of efforts made to remediate the faced challenges and problems at that time.

On 01/01/2011, the set of internal combustion gas engines started operating with its total combined nameplate installed capacity been significantly limited in terms of utilization. Unfortunately, after more than 8 years of continuous operation, the set of internal combustion gas engines remains operating in November/2019 with its total combined nameplate installed capacity not being fully utilized.

The tables below correctly summarize (i) the evolution of average LFG flow and average CH_4 content in collected LFG during the period from year 2007 to 2010; (ii) the evolution of the performance of the project activity within year 2011 (1^{st} year with the internal combustion gas engines under operation) and (iii) the evolution of annual average of LFG supply to such infrastructure + annual achieved average of combined capacity factor for the whole infrastructure during the period from 01/01/2011 to 31/12/2017.

Table App 1 – Evolution of average LFG flow and average CH_4 content in collected LFG – period 2007 - 2010

Year	2007	2008	2009	2010
Average LFG flow (Nm^3/h)	4,257	4,469	3,900	2,062
Average CH_4 fraction in collected LFG	40.27%	43.64%	43.02%	36.20%

Table App 2 – Evolution of the performance of the project activity within year 2011

Month / Year	Jan 2011	Feb 2011	Mar 2011	Apr 2011	Mai 2011	Jun 2011
Average LFG flow (Nm^3/h)	4,446	4,357	3,782	5,431	7,341	7,160
Average number of engine-generator under operation	7	7	6	8	11	11
Month / Year	Jul 2011	Aug 2011	Sep 2011	Oct 2011	Nov 2011	Dec 2011
Average LFG flow (Nm^3/h)	7,661	10,461	11,037	11,042	11,520	12,537
Average number of internal combustion gas engines under operation	12	12	12	12	12	12

Table App 3 – Evolution of the performance of the grid-connected 20.1 MW electricity generation infrastructure within the geographical limits of the AMC landfill (for which the set of 19 internal combustion gas engines represents major components) (period year 2011 – year 2017)

Year	2011	2012	2013	2014	2015	2016	2017
Amount of electricity generated (MWh)	85,073	110,254	111,640	101,946	106,216	116,511	119,790
Average annual achieved capacity factor for the whole grid-connected 20.1 MW electricity generation infrastructure	52%	68%	69%	63%	65%	72%	74.02%

The above illustrated general underperformance of the grid-connected 20.1 MW electricity generation infrastructure unfortunately occurred due to the following main reasons and factors:

1) Differently than previously considered/expected at the time of the project initial conceptualization and its implementation, the previously conceived design and operational plan of the AMC landfill, the later conceived design details for the project's LFG collection infrastructure (e.g. LFG collection wells and pipeline) and the raining pattern in the region where AMC landfill is located have all revealed extremely unfavorable for the promotion of effective leachate draining and LFG management at the AMC landfill under the project scenario despite of the mitigation work performed.

   At the time of the incurrence (in year 2009) of major capital expenditures for the implementation of the grid-connected 20.1 MW electricity generation infrastructure within the limits of the AMC landfill, although the design and operational plan of the AMC landfill remained the same and the raining pattern in the region of the landfill remained unfavorable, the implementation of a set of measures encompassed by a whole design & operation revision plan for the project's LFG collection infrastructure was approved as an attempt to remediate problems and deficiencies. The following measures were implemented at the AMC landfill: design revision of project's LFG collection wells, determination of more appropriate LFG suction pressure values to be applied in such wells, a set of improvements in working

procedures related to operation, maintenance and repair for the project's LFG collection infrastructure, etc. At that time, based on perceived positive results of similar remediation measures implemented at that time in similar CDM project activities hosted in Brazil (also promoting LFG collection and destruction/utilization), such remediation measures were expected to rapidly promote dramatic increase in the quality and quantity of LFG collected by the project activity.

All events related to the incurrence (in year 2009) of major capital expenditures for implementing the grid-connected 20.1 MW electricity generation infrastructure (i.e. financing structure, procurement, logistics, hiring of contractors, etc.) were thus performed under an environment of expectations of dramatic and rapidly improvements of the project activity in terms of LFG collection at the AMC landfill as part of operation of the project activity.

2) While the set of remediation measures encompassed by a whole design & operation revision plan for the project's LFG collection infrastructure were gradually implemented along years 2009 and 2010, unforeseen and/or previously not appropriately considered aspects and factors of the AMC landfill (i.e. very unfavorable raining pattern in the region, geotechnical challenges in the landfill, challenger for management of leachate in the landfill, etc.) have unfortunately somehow offset most of such implemented measures. As a resulted of that, with all previous financing and equipment procurement work concluded, the electricity generation infrastructure ended-up being implemented with relative excess of nameplate installed capacity (vis-à-vis the best and more optimistic realistic quantitative/qualitative projections in terms of LFG collection available at that time).

3) The acknowledged relative excess of nameplate installed capacity of the electricity generation infrastructure has clearly resulted on available nameplate installed capacity for the electricity generation infrastructure being partially/limitedly utilized (since its starting of operations on 01/01/2011). Besides of the lack of LFG to have all 19 engine-generator sets simultaneously being powered, the electricity generation infrastructure has suffered from high content of Volatile Methyl Siloxanes (VMS) in LFG collected at the AMC landfill since its starting of operations[89].

4) Volatile Methyl Siloxanes (VMS) in LFG convert into silicon dioxide when combustion takes place in the engine-generator sets. The silicon dioxide combines with other elements in LFG and with the lubrication oil to form a very hard solid matrix that gets accumulated on the elements/parts of the combustion chambers of the engine-generator sets. As such deposits get accumulated, the conversion efficiency of the engine-generator sets falls causing inter alia detonation problems in such equipment. At this point, the electronic control system of the engine-generator sets automatically promotes de-rating in the engine (output reduced) in order to prevent significant engine damage and to excessive emissions. As a result of excess of the very hard solid matrix that gets accumulated on the elements/parts of the combustion chambers of the engine-generator sets severe damage have occurred to valves, pistons, piston rings, liners, cylinder heads, spark plugs and turbochargers of the some of the installed engine-generator sets, demanding premature overhauling service, costly repairs, thus significantly increasing O&M costs for the electricity generation infrastructure as a whole. As an strategy for dealing with the excess of the very hard solid matrix that gets accumulated on the elements/parts of the combustion chambers of the engine-generator sets and by taking into

[89] Volatile Methyl Siloxanes (VMS) are a class of chemicals with an increasing range of applications. They are widely used in personal care products such as deodorants, tooth-pastes, skin care preparations, hair conditioners and as carriers in deodorants. VMS are also used as effective cleaning agents of electronic circuitry. Recently legislation and consumer patterns in different countries have encouraged the dry cleaning industry to change from using chlorofluoro solvents to more environmentally friendly products, such as Siloxanes. The waste from these industries are frequently disposed of in landfill sites. As organic matter decomposes it produces methane and carbon dioxide. The Siloxanes blend with this and contaminate LFG. Further details about VMS and related problems with engine-generator sets fuelled by LFG are available online:
http://www.xebecinc.com/pdf/e_white_paper.pdf

account the existent limitations in terms of supply of collected LFG, the engine-generator sets of the grid-connected electricity generation infrastructure located within the geographical limits of the AMC landfill have worked alternately and/or under reduced load. This strategy has been under a certain level effective for avoiding premature overhauling service, increasing in cost of repairs for the electricity generation infrastructure as a whole. On the other hand, such operation strategy has resulted in further decrease in the average capacity factor for the electricity generation infrastructure as a whole along its latest 6 years of operation, thus promoting negative impacts in terms of generation of electricity.

5) Despite of all problems and challenges faced in the context of the operation of the project activity as a whole, it is also noteworthy that, due to the occurred significant gain of experience and expertise of the project's operational and management staff along more than 14 years of operation of the project activity, regardless of the above-summarized challenges and difficulties, marginal qualitative and quantitative increments/improvements in terms of LFG supply to the electricity generation infrastructure have indeed been achieved along the latest years of operation of the infrastructure.

<u>Utilization expectations/plans for available total combined nameplate installed power generation capacity since 01/01/2011:</u>

After continuously operating the project activity for more than 14 years, with the grid-connected 20.1 MW electricity generation infrastructure being continuously operated (under reduced capacity factor) for more than 7 years, it is being currently evaluated possible additional measures for continue with the more recently achieved marginally qualitative and quantitative increases in terms of collection of LFG. Such measures encompass *inter alia* further improvements in terms of treatment of collected LFG (siloxane removal) and in terms of design and operation of the project's LFG collection infrastructure (i.e. LFG collection wells, LFG pipeline and LFG suction equipment (e.g. setting of centrifugal blowers)).

In summary, the grid-connected 20.1 MW electricity generation infrastructure indeed started its continuous operations on 01/01/2011 (with installed engine-generator set being put under operational conditions, regardless of the above explained quantitative and qualitative deficiencies in terms of supply of LFG to such infrastructure).

Appendix 4. Further background information on ex ante calculation of emission reductions

All information about the ex-ante calculation of emission reductions are summarized in Section B.6.3. An emission reduction calculation spreadsheet includes all calculations of figures which are indicated in Section B.6.3. This particular spreadsheet is enclosed to this PDD.

Appendix 5. Further background information on monitoring plan

All information about the design and operation of the monitoring plan are presented in Sections B.7.1 and B.7.3.

Appendix 6. Summary report of comments received from local stakeholders

Information about solicitation of comments from local stakeholders (including received comments) and related validation assessment by the DOE are presented in the latest version of the PDD valid for the 1st 7-year crediting period (PDD version 7, dated 28/01/2015).

Appendix 7. Summary of post-registration changes

This initial version of the PDD valid for the 3rd 7-year crediting period of the project activity does not encompass post-registration changes.

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Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.

Version	*Date*	*Description*
10.0	7 June 2017	Revision to: • Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

Version	*Date*	*Description*

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project activities, project design document