Validation report form for renewal of crediting period for CDM project activities

(Version 01.0)

VALIDATION REPORT FOR RENEWAL OF CREDITING PERIOD (RCP)	
Title of the project activity	Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)
Reference number of the project activity	0648
Number and duration of the next crediting period	2nd 7-year crediting period from 01/12/2014 to 30/11/2021
Version number of the validation report for RCP	Version 2.0
Completion date of the validation report for RCP	15/10/2015
Version number of PDD to which this report applies	Version 9.1
Project participant(s)	SIL – Soluções Ambientais Ltda.
Host Party	Brazil
Sectoral scope(s), selected methodology(ies), and where applicable, selected standardized baseline(s)	Sectoral Scope: 13 - Waste handling and disposal Selected Methodology: ACM0001 - "Flaring or use of landfill gas" (version 15.0)
Estimated annual average GHG emission reductions or net anthropogenic GHG removals in the next crediting period	506,798 tCO_2e
Name of DOE	SIRIM QAS INTERNATIONAL SDN.BHD
Name, position and signature of the approver of the validation report for RCP	R. Vijayaraghavan Mr. R.Vijayaraghavan Validation Team leader Mr. Parama Iswara Subramaniam DOE representative

SECTION A. Executive summary

SIRIM QAS International Sdn. Bhd (hereinafter referred to as SIRIM) has been commissioned by Soluções Ambientais Ltda. (hereinafter referred to as SIL or PP), to perform the validation of the renewal of crediting period of "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)" (hereinafter referred to as the project activity) in Brazil. The project activity was registered as a CDM project activity by the UNFCCC on 31 December 2006 with registration no. 0648 with renewal crediting period of 7 years. The first crediting period of the project activity was from 01 December 2007 - 30 November 2014. PP had notified its intention to renew the crediting period of the project activity and un-validated PDD (version 1.0, dated 20/05/2014) to the CDM Secretariat via an email dated 29 May 2014.The scope of the validation of the renewal of crediting period is to provide an independent and objective validation assessment of the PDD version 9.0/2/ dated 31st July 2015 (hereinafter referred to as initial PDD) relating to the baseline, estimated emission reductions and the monitoring plan using the most recent version of baseline and monitoring methodology applicable to the project activity. The validation opinion is finalized based on the assessment of the revised project design document through applying standard auditing techniques including but not limited to document reviews, follow up actions (e.g. telephone or e-mail interviews) and also the review of the applicable approved methodology and underlying formulae and calculations.

The validation was carried out in accordance with the CDM VVS/1/ version 09.0 and the CDM PS/16/ version 09.0 including an assessment of the following issues:

a) the impact of new relevant national and/or sectoral policies and circumstances on the baseline taking into account relevant guidance from the Board with regard to renewal of the crediting period of the registered CDM project activity at the time of requesting renewal of crediting period of the project activity;
b) The correctness of the application of the approved methodology for the determination of the continued validity of the baseline or its update, and the estimation of emission reductions for the applicable crediting period of the registered CDM project activity.

The project activity involves the collection and destruction (through combustion) of landfill gas (LFG) through efficient and controlled conditions as well as the utilization as gaseous fuel for electricity generation at the Central de Resíduos do Recreio (CR do Recreio) Landfill (hereinafter referred to as Recreio landfill) . The collected LFG is combusted in both the installed high temperature enclosed flare and in an electricity generation facility with installed capacity of 8.556 MW respectively. The project activity results in the avoidance of emissions of methane (CH_4) into the atmosphere (that would occur in the absence of the project activity (baseline scenario)) through combustion of collected LFG. The project activity also promotes generation of electricity by using LFG as a non-conventional renewable energy source. LFG (which is rich in CH_4) has been historically generated at the Recreio landfill as result of the anaerobic decomposition of municipal solid waste (MSW) disposed in the site using appropriate MSW landfilling techniques and procedures.

The Recreio Landfill is located in the Municipality of Minas do Leão, Rio Grande do Sul State, approximately 80 km west of Porto Alegre city, in the Southern Region of Brazil.

In summary, it is the opinion of SIRIM that the CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)", as described in the PDD version 9.1 dated 14th September 2015 (hereinafter referred to as final PDD) , meets all relevant UNFCCC requirements for the CDM and correctly applies the baseline and monitoring methodology ACM0001 (version 15.0) and applicable methodological tools. SIRIM thus requests the CDM Executive Board (CDM-EB) to renew the 7-year crediting period for the project activity.

SECTION B. Validation team, technical reviewer and approver

B.1. Validation team member

No.	Role	Type of resource	Last name	First name	Affiliation (e.g. name of central or other office of DOE or outsourced entity)	Involvement in			
						Desk review	On-site inspection	Interview(s)	Validation findings
1.	Validation team leader	ER	Radhamadhavan	Vijayaraghavan	Sunrise Quality Certification Pvt. Ltd.	X		X	X

Demonstration of how the appointed verification team meets the competence required for the performance of the verification assessment is included in Appendix 2.

B.2. Technical reviewer and approver of the validation report for RCP

No.	Role	Type of resource	Last name	First name	Affiliation (e.g. name of central or other office of DOE or outsourced entity)
1.	Technical Reviewer	ER	Anbalagan	Prabu Das	Sunrise Quality Certification Pvt. Ltd.
2.	Independent Technical expert	ER	VS	Narayanan	Sunrise Quality Certification Pvt. Ltd.
3.	Approver	IR	Subramaniam	Parama Iswara	SIRIM

Demonstration of how the appointed verification team meets the competence required for the performance of the verification assessment is included in Appendix 2.

SECTION C. Means of validation

C.1. Desk review

As part of the validation assessment, the validation team had performed a desk review on all related documents including the initial PDD /3/, applied methodology/5/ and applicable tools and all other associated documentation and references. The performed document review encompassed the following:

- review of data and information to verify the correctness, credibility and interpretation of presented information;
- cross checks between information provided in the initial PDD/2/ and information from other sources (not limited to those provided by the project participants)
- reference to available information relating to other project based initiatives and/or technologies identical or similar to the one adopted by the project activity
- review of the applied CDM baseline and monitoring methodology "Flaring or use of landfill gas --- ACM0001 Version 15.0 (hereinafter referred to as applied methodology) /5/ and applicable methodological tools, of the appropriateness/correctness of formulae, calculation approaches and monitoring approaches referred in the initial PDD /2/.

- Review of intention of renewal of crediting period email against the requirements of Project cycle procedure version 9.0/17/

/2/, the following documents were inter alia assessed:

- The latest version of the PDD applicable for the first crediting period (version 8.2, dated 04/08/2014) /3/
- Validation Report for the project activity /8/
- Validation Opinion Report for post-registration changes of the project activity /42/
- Verification Reports and Monitoring Reports for periodic verifications /33/ /34/ /35/ /36/ /37/
- Relevant decisions, clarifications and guidance from the CMP and the CDM-EB
- Relevant regional and national and sectoral policies dealing with waste management

A list of all documents reviewed or referred to in the course of this validation is included in Appendix 3.

C.2. On-site inspection

Duration of on-site inspection: DD/MM/YYYY to DD/MM/YYYY				
No.	**Activity performed on-site**	**Site location**	**Date**	**Team member**
1.	N/A (no on-site inspection was performed)			

No on-site inspection was carried out, the reason for which is given below. However, interviews over telephone and communication via email with relevant representatives of PP was conducted to confirm the project implementation and its operation. Details of the interviews are presented in the Section C.3.

All information provided in the initial PDD/2/ was verified during the desk-review phase against credible sources. The PDD applicable for the first crediting period and the initial PDD/3/ apply the same methodology/5/ and applicable tools and include identical project design information. The validation team was able to confirm that all related information transferred to the initial PDD/2/ is materially the same as that of the PDD/3/ applicable for the first crediting period. Details included in the initial PDD/2/ about project design, construction and implementation phases, operation, meeting of applicability conditions for the applied methodology and applicable tools, GHG calculation approaches and monitoring practice for the project activity were not changed when compared to the PDD/3/ applicable for the first crediting period. The baseline scenario information/description was also sufficiently demonstrated not to be changed based on assessment of documented evidences (as assessed in Section D.3). By taking into account the above-mentioned aspects, the validation team decided that conducting a physical on-site visit as part of validation assessment was not necessary. This is in conformity with the provisions of paragraphs 71-76 of CDM-VVS/1/ (version 09.0). The interviews conducted by the validation team were by means of email and telephone communications, with details about such performed interviews presented in the Section C.3.

C.3. Interviews

No.	Interviewee			Date	Subject	Team member
	Last name	First name	Affiliation			
1.	Danileson	Ezequiel	SIL / Companhia Riograndense de Resíduos S.A. (CRVA S.A.)	25/07/2015 and 26/07/2015	Status of the project activity and confirmation of non-existences of post-registration changes in the project activity. Meeting of applicability conditions of the applied CDM baseline and monitoring methodology and applicable methodological tools. Applicable national policies and regulations and their eventual impacts in terms of changing of the baseline scenario ad baseline emissions. Application of updated values of ex-ante determined parameters Monitoring plan.	R. Vijayaraghavan
2.	Barbosa	Nuno	Unicarbo Energia e Biogás Ltda (CDM consultant)			

C.4. Clarification requests, corrective action requests and forward action requests raised

Area of validation findings	No. of CL	No. of CAR	No. of FAR
Compliance with PDD form	-	CAR 3	-
Application of baseline and monitoring methodology and standardized baseline	-	CAR 2	-
Validity of original baseline or its update	-	CAR 1	-
Estimated GHG emission reductions or net anthropogenic GHG removals	-	-	-
Validity of monitoring plan	-	-	-
Crediting period	CL 1-	-	-
Project participants	-	-	-
Others (please specify)	-	-	-
Total	1	3	

SECTION D. Validation findings

D.1. Compliance with PDD form

Means of validation	As per the paragraph 435 and 436 of VVS[/1/] version 9.0, the validation team has checked if PP used a later valid version of the PDD form for the initial PDD[/2/]. The validation team is to determine whether information transferred to the later valid version of the PDD form is materially the same as that in the PDD applicable for the first crediting period. The validation team has determined whether PP has updated the initial PDD[/2/] updating applicability section as per the latest version of the applied methodology, baseline section, calculation of emission reduction section, monitoring section and other relevant sections of the initial PDD[/2/] in accordance with the requirements as per Project standard version 9.0[/16/] (hereinafter referred to as Project Standard).
Findings	A CAR was raised regarding the compliance of the initial PDD[/2/] against the guidelines and instructions for the completion of the PDD form.

	CAR 3: "Choice of data" in the applicable table for the ex-ante determined parameter $EF_{grid,BM,y}$ in Section B.6.2 of the initial PDD is not correctly completed as per the "Instructions for filling out the project design document form for CDM project activities".
Conclusion	The project design document uses the latest version of the PDD template /19/ version 6.0 (CDM-SSC-PDD-FORM) which is currently applicable and hence acceptable. All relevant sections of the final PDD /2/ have been revised as per paragraph 300 of the Project Standard and the instructions provided in the PDD template and information transferred to the final PDD form is materially the same as that in the PDD /3/ applicable for the first crediting period. .

D.2. Application of baseline and monitoring methodology and standardized baseline

Means of validation	As per paragraph 437 b) of VVS version 9.0 /1/, the validation team has checked whether PP have used the valid version of the approved methodology /5/ applied in the initial PDD /2/ and have demonstrated the project to be in line with the applicable conditions specified therein.
Findings	During the validation, CAR 2 was raised regarding the application 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 for renewal of crediting period" /42/ in the initial PDD /39/. **CAR 2:** Applicability conditions for the Methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" /42/ are not presented and justified in the initial PDD.
Conclusion	<u>*Assessment of meeting of applicability conditions/criteria as per applied meth and applicable methodological tools:*</u> The validation team has observed that the final PDD /2/ is in conformance with applied methodology /5/ and applicable tools. All applicability criteria/requirements for this CDM baseline and monitoring methodology and applicable methodological tools are sufficiently met. The following methodological tools are also verified to be correctly applied: 1. "Emissions from solid waste disposal sites" (version 06.0.1) /15/ (applied in the context of *ex-ante* estimates of emission reduction to be achieved by the project activity during the 2nd 7-year renewable crediting period). 2. "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 1) /11/ (applied for the determination of both baseline emissions for the project's electricity generation component and determination of project emissions due to the consumption of electricity by the project activity). 3. "Project emissions from flaring" (version 02.0.0) /10/ (applied for the determination of project emissions from flaring as part of the determination of baseline emissions) 4. "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0) /12/ (applied for the determination of baseline emissions due to combustion of methane by the project activity) 5. "Tool to calculate the emission factor for an electricity system" (version 04.0.0) /14/ (applied for the determination of both baseline emissions for the project's electricity generation component and determination of project emissions due to the consumption of electricity by the project activity) 6. Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 02) /13/ (applied for the determination of project emissions due to the consumption of fossil fuel by the project activity) 7. Assessment of the validity of the original/current baseline and to update the

baseline at the renewal of a crediting period for renewal of crediting period"/42/ in the final PDD" /39/

The detailed assessment performed by the validation of how such applicability criteria/requirements of the applied methodology /5/ is met is summarized in Appendix 5 of this report.

In summary, the validation team was able to verify that, as reported in Section B.2 of the final PDD /2/, the project activity satisfies all the applicability conditions of applied methodology/5/ and applied tools.

Assessment of the definition of the project boundary as per the final PDD/2/:

As established by the applied methodology /5/, the project boundary for the project activity is correctly identified in the final PDD /2/ as the site where LFG is captured, destroyed and utilized. In the particular case of the project activity, while (i) the project's electricity demand is predominantly met by imports of grid-sourced electricity from the National Electricity Grid of Brazil and while (ii) the project activity will export generated electricity through this electricity grid, the spatial boundary for the project activity thus correctly includes the National Electricity Grid of Brazil. All GHG emission sources and GHG gases included in the project boundary are correctly outlined in Section B.3 of the final PDD /2/ as summarized below:

GHG emission sources included in the project boundary:

	GHGs included	Description
Baseline	CH_4	Methane in LFG is generated as a result of anaerobic decomposition of the organic fraction of the municipal solid waste (MSW) disposed in the Recreio Landfill since it started to operate.
	CO_2	Baseline emissions from electricity generation using LFG as gaseous fuel.
Project	CO_2	Grid-sourced electricity consumption by the project activity (and eventually diesel consumption by the off-grid captive electricity generator). As outlined in the final PDD/2/, the captive off-grid backup electricity generator (fuelled by diesel) is expected to be used only for emergency purposes (whenever supply of grid electricity to the project activity is temporarily interrupted). However, as per the final PDD such project emissions will be determined *ex-post* during the 2nd 7-year renewable crediting period (based on applicable monitoring and calculation requirements according to the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption") and will be accounted for the determination of emission reductions. Fossil fuel LPG consumed by the project activity (for igniting the flare).
	CH_4	Not included. CH_4 emissions resulted from flaring (residual CH_4 in the exhaust gas of the flare). It is however important to note that as per the applied meth/5/, such emissions are to be considered in the context of the calculation of baseline emissions (BE_y).

The selected emission sources and GHGs are justified for the project activity. No leakage emissions are considered as leakage emissions are not required to be accounted as per applied methodology /5/. In summary, the identified project boundary is in compliance with the applied methodology /5/ and applicable tools. The definition of the project boundary is sufficiently justified in the final PDD /2/.

The validation team also confirms that there are no GHG emission sources, which are not addressed by the applied methodology, and which are expected to

	contribute more than 1% of the overall expected annual average emission reductions. It was also confirmed that all main GHG emission sources, the physical delineation of the CDM project activity, and other relevant project and baseline emission sources covered in the applied methodology are included within the project boundary for the purpose of calculating project and baseline emissions for the project activity. The project boundary specified in the PDD/3/ applicable for the first crediting period and the final PDD/2/ is materially the same, as confirmed by the validation team. As a conclusion of the assessment of this section, the validation team confirms that the application of the baseline methodology is transparent and conservative, and confirms that the applied methodology is applicable to the project activity. The validation team had also confirmed that no standardized baseline is applicable to the project activity, and all applicable tools were correctly applied with respect to the following: - Meeting of applicability conditions/criteria - Delineation of project boundary and selection of emission sources and GHGs - Baseline identification (assessment details included in Section D.3) - Algorithms and/or formulae used to determine emission reductions (assessment details included in Section D.4) - Monitoring plan (assessment details included in Section D.5)

D.3. Validity of original baseline or its update

Means of validation	In accordance with paragraph 437 of CDM-VVS (version 09.0) /1/, the validation team reviewed the validity of the current baseline scenario for the project activity against the requirements of methodological tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period" (version 03.0.1) /39/).(hereinafter referred to as baseline validity tool)
Findings	A CAR was raised regarding the application 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 for renewal of crediting period" in the initial PDD /39/. **CAR 1:** PP to demonstrate in the initial PDD/2/ all valid and relevant mandatory national and/or sectoral policies and its impact on the baseline and how the project complies with the national and/or sectoral policies.
Conclusion	Section B.4 of the final PDD/2/ includes the application of the stepwise approach of the baseline validity tool/42/ for demonstrating the validity of the current baseline scenario for the project activity. As confirmed by the validation team, the baseline scenario for the project activity was as previously determined and assessed at the time of the validation of the project activity in year 2006 and later updated in year 2014. The assessment of validity of the current baseline against the baseline validity tool/42/ is demonstrated as below. *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:* The validation team confirmed that the baseline scenario is directly determined in accordance with PDD/3/ applicable for the first crediting period as follows: *"The baseline scenario for LFG is assumed to be the atmospheric release of the 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. If all or part of the electricity generated by the project activity is exported to the grid, the baseline scenario for all or the part of the electricity exported to the grid is assumed to be electricity generation in existing and/or new grid-connected power plants. If all or part of the electricity is supplied to off-grid application, the baseline electricity generation equipment is assumed to correspond to the default emission factor from Option B2 of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"; (…)"

As confirmed by the validation team, the project activity under its current project design continues to meet the requirements for the continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of the applied methodology, the final PDD[/2/] appropriately outlines that there is no need to assess compliance of the current baseline with relevant mandatory national and/or sectoral policies in the particular context of the project activity. This is based on the validity of the continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of applied methodology in the context of the renewal of the crediting period of the project activity.

By correctly assuming the validity of the continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of applied methodology in the context of the renewal of the crediting period of the project activity as valid, the baseline scenario for the project activity for the 2nd 7-year crediting period is directly determined as follows:

"In the particular case of the Recreio Landfill, it is assumed that in the absence of the project activity (baseline scenario), generated LFG would be directly emitted into the atmosphere through the surface of the landfill and through the existent pre-project conventional LFG venting/combustion drains. It is also assumed that under the baseline scenario (absence of the project activity) a minor share of LFG generated at the landfill would be combusted under uncontrolled and non-systematic manner in the existent pre-project conventional LFG venting/combustion drains. Under the baseline scenario, it is also assumed that no electricity generation would occur at Recreio Landfill and that electricity (in equivalent amount of electricity to be generated under the project scenario) would be generated by existing grid-connected power plants and addition of new power generation units, including fossil fuel fired power plants, within the National Electricity Grid of Brazil".

However, for sake of completeness and transparency, it is also appropriately outlined in the final PDD [/2/] that, regardless of the validity of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of applied methodology, there is still no legal obligation (e.g. regional or national legal requirements) to capture and destroy the LFG at the Recreio Landfill and in any other existing landfill in Brazil.

As confirmed by the validation team, although there is no regional or national legal requirement in Brazil that mandates the collection and destruction of LFG from landfills in Brazil, in the particular case of the Recreio Landfill, as per the design, construction and operational requirements applicable for this landfill and previously voluntarily defined by the PP, it is reasonably assumed that in the absence of the project activity, a non-defined and small share of generated LFG would still be vented and/or destroyed by combustion in conventional passive LFG venting/combustion drains (in order to address safety and odour concerns). As appropriately outlined in the final PDD [/2/], combustion of minor share of generated LFG in conventional passive LFG venting/combustion drains was indeed the normal practice and only existent LFG management measure in place (during the period from year 2001 to 2007) prior to the implementation of the project activity.

Thus, the validation team was able to confirm that, the current baseline is still valid for the second crediting period also.

Step 1.2: Assess the impact of circumstances
By assuming the continuation of the validity of the application of the simplified

	procedure to identify the baseline scenario and demonstrate additionality of the applied methodology in the context of the renewal of the crediting period of the project activity, it is thus assumed that there is no need to assess the impact of circumstances (such availability of new fuels or raw materials and the impact of electricity or fuel prices in the identification of the current practice for the baseline emissions) and/or sectoral policies which have come into effect after the submission of the project activity for validation or the submission of the previous request for renewal of the crediting period and are applicable at the time of requesting renewal of the crediting period. This is deemed reasonable and acceptable. By also assuming the validity of the continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of the applied methodology in the context of the renewal of the crediting period of the project activity, the demonstration of continuation of the baseline scenario for the project activity is thus assumed to be independent from the validity of conditions used to determine the baseline emissions in the previous crediting period. Assessment of the availability of new fuels or raw materials and the impact of electricity or fuel prices in the identification of the current practice for the baseline emissions is thus reasonably assumed as not required. For sake of transparency and completeness, the final PDD/2/ appropriately emphasizes that, regardless of assuming the validity of the continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of the applied meth in the context of the renewal of the crediting period of the project activity, the previously identified baseline scenario for the project activity is demonstrated as not changed at the time of requesting renewal of the crediting period. As confirmed by the validation team, a part of the Brazilian National Policy on Waste Management (Decree No. 7,404/10), there are indeed no other relevant mandatory national and/or sectoral policies which have come into effect after the submission of the project activity for validation or the submission of the previous request for renewal of the crediting period and are applicable at the time of requesting renewal of the crediting period as appropriately emphasized in the final PDD /2/. Details about the Brazilian National Policy on Waste Management (Decree No. 7,404/10) and its impacts over the baseline scenario for the project activity are correctly included in Section B.4 of the final PDD/2/. The conditions used to determine the baseline emissions in the previous crediting period are still valid in the context of the renewal of the crediting period of the project activity. In summary, the conditions and circumstances considered or taken into account to determine the baseline emissions in the previous 7-year crediting period are correctly assumed as still being valid. It is thus correctly assumed that, in the absence of the project activity, LFG generated at the Recreio Landfill would still be freely emitted into the atmosphere (with minor share of generated LFG being destroyed in conventional passive LFG venting/combustion drains in order to address safety and odour requirements) in the absence of the project activity. Generated LFG would still be freely emitted into the atmosphere through both the surface of the landfill and through the conventional passive LFG venting/combustion drains (whenever such drains are not alight). It is also correctly assumed that, in the absence of the project activity, generation of electricity (in an amount equivalent to the amount of electricity generated by the project activity) would occur in existing fossil-fuel power generation sources connected to the National Electricity Grid of Brazil and/or new additions of fossil-fuel power generation sources under the baseline scenario. It is also sufficiently demonstrated that 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 2nd 7-year renewable crediting period. *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.*

	By also assuming the validity of the continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of applied methodology in the context of the renewal of the crediting period of the project activity, the baseline scenario for the project activity remains being directly determined as outlined under application of Step 1.1. However, for sake of completeness and transparency, it is appropriately outlined in the final PDD /2/ that, regardless of validity of the continuation of the application of the simplified procedure to identify the baseline scenario and demonstrate additionality of applied methodology in the context of the renewal of the crediting period of the project activity, while the baseline scenarios previously identified at the validation of the project activity and later at the inclusion of the new project's electricity generation facility as a post-registration change in the project design were not selected 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",* application of step 1.3 is thus not applicable. *Step 1.4: Assessment of the validity of the data and parameters* The validation team confirmed that, while the PDD/3/ applicable for the first crediting period also applies the same applied meth, and applicable tools, most of the ex-ante selected data and parameters remain valid for the second crediting period also. As also confirmed by the validation team, the only ex-ante determined parameters to have value updated are "Build margin CO_2 emission factor in year *y*" ($EF_{grid,BM,}$), "Weighting of build margin emissions factor" (w_{BM}) and "Weighting of operating margin emissions factor (w_{OM})", where values for such parameters were correctly updated as per applicable guidance of the methodological tool "Tool to calculate the emission factor for an electricity system" (version 04.0, EB 75). *Step 2: Update the current baseline and the data and parameters* As appropriately outlined in the final PDD /2/, as the current baseline as well as most of data and parameters are still valid for the 2nd 7-year renewable crediting period, Step 2 is thus correctly regarded as not applicable. It is the opinion of the validation team that the 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" (version 03.0.1) /39/ for demonstrating the validity of the previously derived baseline scenario for the project activity" is deemed reasonable and correct. In summary, in accordance with applicable requirements from the CDM-VVS /1/, the validation team confirmed that the application of the stepwise approach of the baseline validity tool/42/ for demonstrating the validity of the current baseline scenario for the project activity" is deemed reasonable and correct. It is sufficiently demonstrated that the current baseline scenario for the project activity (scenario that represents GHG emissions that would occur in the absence of the project activity) is still valid (with no updated being required).

D.4. Estimated GHG emission reductions or net anthropogenic GHG removals

Means of validation	In accordance with the Paragraph 446 a) clause iv of VVS/1/ version 9.0 /1/, the validation team reviewed whether the calculation of emission reductions is correct against the requirements of the applied methodology.
Findings	No CARs and/or CLs were raised in this section.
Conclusion	As correctly outlined in the final PDD /2/, calculations of GHG emissions reductions to be achieved by the project activity are based on the application of the baseline and monitoring methodology, the applied methodology /5/ and the following methodological tools: - Tool to calculate baseline, project and/or leakage emissions from electricity consumption (version 1) /11/ - Project emissions from flaring (version 02.0.0) /10/

	- Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 02.0.0) /12/ - Tool to calculate the emission factor for an electricity system" (version 04.0.0) /14/ - Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (version 02) /13/ While as per the applied methodology /5/, no leakage emissions are required to be accounted, GHG emissions reductions (ER_y) to be achieved by the project activity during the 2nd 7-year crediting period are thus correctly defined (in tCO_2e) as the difference between baseline emissions (BE_y) and project emissions (PE_y), where BE_y and PE_y are determined as per Appendix 6 of this report. In summary, the validation team confirmed that calculations for *ex-ante* estimates of emission reductions to be achieved by the project activity during the 2nd 7-year renewable crediting period, as reported in the final PDD /2/, are deemed complete and transparent.

D.5. Validity of monitoring plan

Means of validation	In accordance with Paragraph 446 a) clause iv of VVS (version 09.0) /1/, the validation team reviewed whether monitoring plan mentioned in the initial PDD/2/ is valid and correct
Findings	No CARs and/or CLs were raised regarding the validity and design of the monitoring plan of the project activity.
Conclusion	As the PDD/3/ applicable for the first crediting period and the final PDD/2/ apply the same methodology, the description of the monitoring plan is identical in both the PDDs. In order to meet applicable CDM-VVS requirements, this Section includes assessment details for the design and description of monitoring plan as per the final PDD/2/ for the 2nd-year crediting period. As established by applied methodology /5/ and applicable methodological tools, the monitoring system for the project activity during its 2nd 7-year crediting period basically consists on measuring the amount of methane actually combusted (destroyed) in the installed high temperature enclosed flare and/or used as gaseous fuel for electricity generation and assessment of the operational conditions of the Recreio Landfill (via direct measurements/monitoring of the parameters monitored *ex-post* which are summarized in Appendix 7 of this report. Project emissions resulting from flaring of collected LFG ($PE_{flare,y}$) will also be calculated as part of the determination of baseline emissions for the project activity by following applicable measurements and calculations requirements as defined by the methodological tool "Project emissions from flaring" (version 02.0.0) /10/. Finally, project emissions due to the consumption by the project activity of both electricity (grid-sourced electricity and electricity sourced by an installed backup captive electricity generator fuelled by diesel) and fossil fuel (LPG for igniting the flare(s)) will remain also being determined by applying related monitoring requirements as per the following methodological tools: - "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 01) /11/ - "Tool to calculate the emission factor for an electricity system" (version 04.0.0) /14/ - "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (version 02) /13/ As appropriately indicated in the final PDD /2/ and under conformance with currently applicable guidance for completing the CDM-PDD form /19/, all the monitoring equipment and instruments will be maintained and managed in accordance with maintenance (service) and calibration requirements and recommendations defined by the equipment/instrument manufacturers. As also indicated in the final PDD /2/,

measurement checking and calibration of the monitoring equipment/instruments will be performed on a regular basis as per manufacturer's related requirements in order to ensure the correct measurement of data to be monitored.

The LFG flaring and electricity generation equipment will also be maintained as per recommendations of the equipment manufacturer. Monitoring information/data of flare equipment maintenance will be recorded and reported as required by applied methodology /5/ and by the tool "Project emissions from flaring" (version 02.0.0) /10/.

It is the opinion of the validation team that the revised monitoring plan will give opportunity for real measurements of achieved emission reductions. All the data pertaining to monitoring parameters will be archived for at least two years after the end of crediting period. General details of the data to be collected, frequency of data recording, and the project management responsibilities are defined and are also clearly defined in the monitoring plan of the final PDD /2/. It is the opinion of the validation team that the revised monitoring plan, as described in the final PDD /2/, is feasible for the project participant.

As also appropriately outlined in the final PDD /2/, maintenance service and routines for project's equipment and instruments includes all required preventive and corrective actions in order to ensure appropriate functioning of all project related equipment. Related maintenance activities include 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)). Furthermore, as also outlined in the final PDD /2/, spare units for some of the monitoring instruments/equipment will eventually be kept on-site.

As also indicated in the final PDD /2/, an appropriate and revised project's operational and management structure will be defined and implemented as part of the implementation of the project's electricity generation component. Such operational and management structure of the project will rely on staff with responsibilities to be clearly defined where all collaborators and employees involved with operation of project and/or monitoring will receive appropriate training. Training of the operational and management staff will encompass general competence development about LFG generation and collection, review of equipment operational principles and captors, maintenance and calibration requirements for the project's related equipment, procedures for monitoring data gathering and handling, as well as emergency and safety procedures.

In summary, it is the opinion of the validation team that the description and design of the revised monitoring plan as per the final PDD /2/ complies with all the monitoring requirements of the applied methodology/5/ and applicable tools. Such description is also in conformance with currently applicable guidelines for completing the CDM-PDD form /19/. It is also the opinion of the validation team that the project participant is potentially able to implement and operate the revised monitoring plan.

Assessment of information added in the final PDD/2/ regarding parameters to be monitored ex-post:

The parameters to be monitored *ex-post* are indicated in the final PDD/2/ as required by the applied meth /5// and the following applicable methodological tools:

- Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 1) /11/
- Project emissions from flaring" (version 02.0.0) /10/
- Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0) /12/
- Tool to calculate the emission factor for an electricity system" (version 04.0.0) /14/
- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (version 02) /13/
- As established by ACM0001 (version 15.0), the methodological tool "Emissions from solid waste disposal sites" (version 06.0.1) is applied in the final PDD/2/ only for

the purpose of ex-ante estimates of emission reductions to be achieved by the project activity during the 2nd 7-year renewable crediting period. Thus, no impact in the monitoring plan is triggered by the application of this methodological tool for completing the final PDD/2/.

The final PDD /2/ correctly includes in Sections B.7.1 and B.7.2 details about the following parameters to be monitored *ex-post* along the 7-year renewable crediting period for which assessment is also included in the Appendix 7 of this report:

As established by the applied meth /5/ and the tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" /12/ and also appropriately outlined in the final PDD /2/, the volumetric or mass flow of landfill gas captured ($V_{t,wb/db,j}$ or $M_{t,db,j}$) and the methane fraction in the landfill gas ($v_{CH4,t,db/wb,j}$) will be continuously measured in the same basis (dry or wet).
In summary, the selection of the parameters monitored *ex-post* and their monitoring procedures as outlined in the final PDD /2/, are deemed complete, transparent and in accordance with requirements of such applied CDM baseline and monitoring methodology and methodological tools.

Assessment of information added in the final PDD/2/ regarding management system and quality assurance for the monitoring process:

The monitoring plan for the project activity, as outlined in the final PDD /2//, includes inter alia sufficient details about the following management and quality related aspects:

- General description of the staff responsibilities and authorities for project management;
- General description about procedures for data gathering and data reconciliation and reporting;
- General description about monitoring equipment/instruments; As argued by the representatives of the PP during performed phone interviews and confirmed by the validation team through assessment of related documentation (Monitoring Reports valid for the 1st 7-year crediting period), it has been a practice of this project participant to include detailed information about installed monitoring equipment (incl. specification details, maintenance and calibration requirements, etc.) in the regularly issued Monitoring Reports. As declared by the project participant, this practice will continue during the 2nd 7-year renewable crediting period
- General information about calibration requirements of monitoring equipment/instruments;
- General information about data quality control, training, data management system, reporting and verification of data (data reconciliation).

A general and sufficient description of the monitoring plan is elaborated in the final PDD/2/ . The monitoring plan has been implemented in order to enable subsequent verification of emission reductions for the project activity during the 2nd 7-year renewable crediting period for which periodic verification(s) are yet to be performed.

The application of the methodology /5/ and applicable methodological tools is deemed transparent. By taking into account verified previously issued Monitoring Reports valid for the 1st 7-year crediting period /25/, the validation team considers the PP potentially able and competent enough to monitor the project activity as per the monitoring plan valid for the 2nd 7-year crediting period. The monitoring plan as per the final PDD /2/ indicates that all monitoring instruments and equipment will remain being calibrated as per manufacturer recommendations and/or as per international standards (as also outlined in the PDD/3/ applicable for the 1st 7-year crediting period /3/). In the particular case of the CH_4 content gas analyzer unit, as confirmed by the validation team through assessment of previously issued Monitoring Reports for the project activity /25/, this equipment will remain being calibrated by an independent 3rd party inspection service company, through measurement comparison with canisters of certified/calibrated span gases purchased from a reliable gas supplier. This is deemed correct and acceptable. Operational data relevant for emission reduction accounting for the project activity will remain being logged continuously by using automated computerized data logger and storage system. As per the current practice, on a monthly basis, the data will be analysed,

	consolidated and a condensed monthly internal project performance report will be issued during the 2nd 7-year crediting period. For the 2nd 7-year crediting period, data records will remain being stored on an appropriate computer software or data recording system where daily log-sheet files will serve for backup and crosscheck purpose and archived at project site. Monthly project performance reports will be made available at both the project site and administrative office in both electronic copy and hard copy to ensure data integrity. All monitoring data will be kept up to 2 years after the end of crediting period. Training of operational staff for the relevant data record keeping, operation and maintenance related procedures are also considered. Moreover, staff will continue to be trained on procedures for applicable corrective actions. In conclusion, it is the opinion of the validation team that the description of the monitoring procedures for the project activity as described in the final PDD /2/ is deemed complete, reasonable and its implementation is potentially feasible for the PP. Through document check and performed phone interview with representatives of the project participant, it is verified that the monitoring plan as described in the final PDD /2/ provides sufficient information and it is described in compliance with the applied CDM baseline and monitoring methodology and applicable methodological tools. Moreover, all monitoring arrangements as per the monitoring plan are feasible within the project design and project participant's competence. General description of the monitoring plan is well elaborated in the final PDD /2/. It is the opinion of the validation team that the monitoring plan will potentially enable subsequent verification of emission reductions for the project activity. The application of the applied methodology /5/ and applicable methodological tools is deemed transparent and correct. As a conclusion, the validation team has confirmed that the monitoring plan of the final PDD/2/ (as well as other sections of the final PDD/2/ that describes the approaches to be applied for the determination of related baseline and project emissions) are correctly completed in the final PDD /2/. It is the opinion of the validation team that the descriptions of the monitoring plan (and descriptions in related sections of the final PDD/2/ describing the approaches for determining baseline and project emissions) do not negatively affect the accurateness and correctness of the determination of baseline emissions. By checking the current list of valid standardized baselines as outlined in the applicable section of the UNFCCC CDM website, the validation team confirmed that no standardized baseline is applicable to the project activity. The validation team has confirmed that final PDD /2/ is fully in conformance with the applied meth. /5/ and applicable methodological tools. As assessed in Section D.2 and correctly outlined in Section B.2 of the final PDD /2/, all applicability criteria/requirements for methodology is met. By directly applying the "Simplified procedure to identify the baseline scenario and demonstrate additionality" of ACM0001 (version 15.0) /5/, the baseline scenario for the project activity is directly and correctly identified as follows in the final PDD /2/ (Section B.4): *"(…)* *In the particular case of the CR do Recreio Landfill, it is assumed that in the absence of the project activity (baseline scenario), generated LFG would be directly emitted into the atmosphere through the surface of the landfill and through the existent pre-project conventional LFG venting/combustion drains. It is also assumed that under the baseline scenario (absence of the project activity) a minor share of LFG generated at the landfill would be combusted under uncontrolled and non-systematic manner in the existent pre-project conventional LFG venting/combustion*

	drains. Under the baseline scenario, it is also assumed that no electricity generation would occur at CR do Recreio Landfill and that electricity (in equivalent amount of electricity to be generated under the project scenario) would be generated by existing grid-connected power plants and addition of new power generation units, including fossil fuel fired power plants, within the National Electricity Grid of Brazil. (…)" As assessed by the validation team, the monitoring plan for the project activity, as outlined in Section B.7.1 and B.7.2 of the final PDD /2/, meets all requirements and criteria of the applied meth /5/ and applicable methodological tool. Sections B.7.1 and B.7.2 of the final PDD /2/ were also confirmed by the validation team to be completed under full compliance with applicable guidance for completing the latest version of the CDM-PDD form (version 06.0) /19/. Thus, it was confirmed by the validation team that the monitoring plan satisfies the requirements of the applied methodology/5/ and its applicable tools.

D.6. Crediting period

Means of validation	In accordance with Paragraph 446a (clause v) of the CDM-VVS (version 09.0) /1/, the validation team reviewed whether the starting date and length of the 2nd crediting period, as outlined in the final PDD /2/, meets all applicable requirements for renewal of crediting period.
Findings	A CL (CL1) was raised on this section.
Conclusion	The 2nd crediting period is defined in the final PDD /2/ as starting on 01/12/2014 and ending on 30/11/2021. As reviewed by the validation team, the PP had within nine to six months prior to the date of expiration of the 1st crediting period successfully notified the CDM Secretariat of its intention to request a renewal of crediting period of the project activity. This was carried out through an email and along with a draft version of the CDM-PDD (version 1.0, dated 20/05/2014) on 29 May 2014. The notification also included the details about their selection of a DOE for performing the required validation assessment. The 1st crediting period had expired on 31/11/2014 and since the PP had met the conditions stipulated in the VVS version 9.0, the validation team thus confirms that the 2nd crediting period starting on 01/12/2014 and ending on 30/11/2021 is deemed correct and in full compliance with all applicable requirements for the determination of starting date and length of this 2nd crediting period for the project activity. The assessment team confirmed that the correct crediting period has been applied in the final PDD/2/.

D.7. Project participants

Means of validation	In accordance with paragraph 446 clause a) vi of the CDM-VVS (version 09.0) /1/, the validation team had checked the names of the project participants included in the initial PDD/2/ against the name included in the PDD/3/ applicable to the first crediting period as well as in the UNFCCC website. The validation team had also confirmed the correctness of corporate identity of project participant as included in the initial PDD/2/ against information included in the latest version of the completed Modalities of Communication (MoC) /45/ for the project activity.
Findings	No findings were raised on this section.
Conclusion	The validation team confirmed that the correctness of the name of the project participant as included in the final PDD/2/.

D.8. Post-registration changes

Type of post-registration changes (PRCs)	Confirmation (Y/N)	Validation report for PRCs	
		Version	Completion date
Temporary deviations from the registered monitoring plan, monitoring methodology or standardized baseline	N		
Corrections	N		
Inclusion of a monitoring plan to a registered project activity	N		
Permanent changes from registered monitoring plan, monitoring methodology or standardized baseline	N		
Changes to the project design of a registered project activity	N		
Types of changes specific to afforestation and reforestation project activities	N		

SECTION E. Internal quality control

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SIRIM has established an internal quality control process. A Technical Reviewer is appointed to review the final draft validation report and the final validation report. The comments made by the Technical Reviewer are taken into consideration and incorporated in the final report. The final report (after resolutions of all findings) is then submitted to the CDM Quality Manager for review and approval.

SECTION F. Validation opinion

SIRIM QAS International Sdn Bhd (SIRIM) has performed the validation of the final Project Design Document (PDD) for the registered CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)" for the purpose of renewal of the crediting period. The first crediting period had ended on 30th November 2014. The second crediting period is expected to start from 01st December 2014 to 30th November 2021.

The validation was performed in accordance with the Validation and Verification Standard (CDM-VVS) (version 9.0)/1/ and included the assessment of the following issues:

- Evaluation of the impact of new relevant national and / or sectoral policies and circumstances on the previously determined baseline taking into account relevant guidance from the CDM Executive Board with regard to renewal of the crediting period of the registered CDM project activity at the time of requesting renewal of crediting period of the project activity;
- Evaluation of the correctness of the application of the approved methodology for the determination of the continued validity of the baseline or its update, and the estimation of emission reductions for the applicable crediting period of the registered CDM project activity

The review of the final PDD (version 9.1 , dated 14/09/2015) /2/ and the subsequent performed follow-up interviews with representatives of the project participant, Soluções Ambientais Ltda. (SIL) have provided the validation team with sufficient evidence to determine the validity of the original baseline scenario.

The validation team confirmed that the final PDD for the 2nd crediting period of the project activity (version 9.1, dated 14/09/2015) /2/ has correctly applies the CDM baseline and monitoring methodology ACM0001, "Flaring or use of landfill gas" (version 15.0)".

As part of its assessment, besides assessing all changes as per the PDD, the validation team also assessed a revised spreadsheet with calculations of *ex-ante* estimations of emission reductions to be achieved by the project activity during the 1st 7-year renewable crediting period. Such spreadsheet is enclosed to the final PDD.

The validation team is of the opinion that the project activity has potential to achieve GHG emission reductions along the 2nd 7-year crediting period as per ex-ante estimates of emission reductions indicated in the final PDD /2/. As verified by the validation team, all explanations and justifications provided by the PP regarding information and assumptions added in the final PDD are deemed reasonable, trustful, and acceptable.

In our opinion, the project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)" meets all relevant UNFCCC requirements and hence SIRIM recommends the renewal of the crediting period of this project.

Appendix 1. Abbreviations

Abbreviations	Full texts
ACM	Approved Consolidated Methodology (CDM baseline and monitoring methodology)
ANP	Brazilian National Agency of Petroleum, Natural Gas and Biofuels (*Agência Nacional do Petróleo, Gás Natural e Biocombustíveis)*
CAR	Corrective Action Request
CDM-EB	CDM Executive Board (the board)
CDM-PS	Clean Development Mechanism Project Standard
CDM-VVS	Clean Development Mechanism Validation and Verification Standard
CER	Certified Emission Reduction
CETESB	Companhia Ambiental do Estado de São Paulo (Environmental Agency/Authority for São Paulo State in Brazil)
CH_4	Methane
CL	Clarification Request
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DOE	Designated Operational Entity
ER	Emission Reduction
GHG	Greenhouse gas(es)
LFG	Landfill gas
MP	Monitoring Plan
MR	Monitoring Report
OPEX	Operational expenditure
PAHO	Pan American Health Organization
PDD	Project Design Document
PP	Project Participant
QA/QC	Quality Assurance / Quality Control
SIRIM	SIRIM QAS INTERNATIONAL SDN.BHD
UNFCCC	United Nations Framework Convention on Climate Change

Appendix 2. Competence of team members and technical reviewers

Mr. R. Vijayaraghavan holds BE in Mechanical Engineering, M.Tech in Energy Conservation and Management and MBA in Technology Management. He is certified as Energy Auditor by Bureau of Energy Efficiency (BEE), Government of India. He has 10 years of working experience in energy sector including validation / verification of sixty CDM and VCS projects and has undergone extensive training on CDM validation and verification and has been qualified as Lead Auditor for TA 1.1, TA 1.2 and TA 13.1.

Mr. A Prabu Das, holds a M. Tech Degree in Energy Conservation and Management and B. Tech Degree in Petro-chemical Technology. He is a certified Energy Auditor by Bureau of Energy Efficiency (BEE), Government of India. He has around 8 years of work experience in design of biomass power plants, preparing Techno Economic Feasibility Reports (TEFR), carrying out energy audits, of which last six years have been in CDM consultancy and validation services. He has undergone extensive training on CDM validation and verification and is a qualified as Lead Auditor for technical areas TA 1.2 and TA 13.1.

Mr. V.S. Narayanan holds a Bachelor Degree in Chemical Engineering from Anna University. He has around 40 years of work experience in various levels including waste water treatment system. Currently he is working as Deputy General Manager heading a 60 MLD Sewage Treatment Plant project and handling the environmental projects such as water, waste water treatment and solid waste management. He is a qualified technical reviewer in Sectoral Scope 13 in accordance with procedures of SIRIM procedures.

Appendix 3. Documents reviewed or referenced

No.	Author	Title	References to the document	Provider
/1/	UNFCCC/CDM-EB	Clean Development Mechanism Validation and Verification Standard (CDM-VVS), version 09.0 as per EB 82	Dated 20/02/2015. Available online: http://cdm.unfccc.int/Reference/Standards/index.html	Others
/2/	SIL	Initial Project Design Document (PDD) for the registered CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)". Version 9.0 dated 31st July 2015 Final PDD for the registered CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)". Version 9.1 dated 14th Sep 2015 .	Dated 31/07/2015.	Project Participant. All document with provider indicated as "Project Participants" were sourced by the host-country project participant and project owner SIL
/3/	SIL	Project Design Document (PDD) valid for the 1st 7-year crediting period for the CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)". Version 8.2 dated 4th August 2014.	Dated 04/08/2014. Available online: https://cdm.unfccc.int/Projects/DB/DNV-CUK1158844635.31/view	Project Participant
/4/	SIL	Emission reduction calculation spreadsheet with *ex-ante* estimations of emission reductions to be achieved by the CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)" during the 2nd 7-year renewable crediting period. Version 9.0. File name: "*CRRLGP Ex-ante ER - Rev 9.0*"	Dated 31/07/2015.	Project Participant
/5/	UNFCCC/CDM-EB	Consolidated baseline and monitoring methodology ACM0001 - "Flaring or use of landfill gas¨, version 15.0 as per EB 76.	Dated 11/05/2012. Available online: http://cdm.unfccc.int/methodologies/DB/D44X8FH8SFCXREE6037AXJSBGGFVDO	Others
/6/	UNFCCC	Kyoto Protocol to the United Nations Framework Convention on Climate Change	Dated 1998. Available online: http://unfccc.int/resource/docs/convkp/kpeng.pdf	Others
/7/	UNFCCC	Decision 3/CMP. 1 (Marrakesh –	Dated 30/03/2006.	Others

		Accords)	Available online: https://cdm.unfccc.int/Reference/COPMOP/08a01.pdf	
/8/	Det Norske Veritas Certification Ltd.	Validation Report for the CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)". Report No. 2006-0520. Revision No. 02B.	Dated 20/09/2006. Available online: https://cdm.unfccc.int/Projects/DB/DNV-CUK1158844635.31/view	Others
/9/	IPCC	1996 IPCC Guidelines for National Greenhouse Gas Inventories: work book; 2006 IPCC Guidelines for National Greenhouse Gas Inventories: work book.	Available online: http://www.ipcc-nggip.iges.or.jp/public/gl/invs5.html http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol5.html	Others
/10/	UNFCCC/CDM-EB	"Project emissions from flaring", version 02.0.0 as per EB 68.	Dated 20/07/2012. Available online: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v2.0.pdf/history_view	Others
/11/	UNFCCC/CDM-EB	"Tool to calculate baseline, project and/or leakage emissions from electricity consumption", version 01 as per EB 39.	Dated 16/05/2008. Available online: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf/history_view	Others
/12/	UNFCCC/CDM-EB	¨Tool to determine the mass flow of a greenhouse gas in a gaseous stream¨, version 02.0.0 as per EB 61.	Dated 03/06/2011. Available online: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-v2.0.0.pdf/history_view	Others
/13/	UNFCCC/CDM-EB	"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion", version 02 as per EB 41.	Dated 02/08/2008. Available online: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf/history_view	Others
/14/	UNFCCC/CDM-EB	"Tool to calculate the emission factor for an electricity system", version 04.0 as per EB 75.	Dated 04/10/2013. Available online: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v1.1.pdf/history_view	Others
/15/	UNFCCC/CDM-EB	"Emissions from solid waste disposal sites", version 06.0.1.	Dated 02/03/2012. Available online: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-04-v6.0.1.pdf/history_view	Others

/16/	UNFCCC/CDM-EB	Clean Development Mechanism Project Standard (CDM-PS), version 09.0 as per EB 82	Dated 20/02/2015. Available online: http://cdm.unfccc.int/Reference/Standards/index.html	Others
/17/	UNFCCC/CDM-EB	Clean Development Mechanism Project Cycle Procedure (CDM-PCP), version 09.0 as per EB 82	Dated 20/02/2015. Available online: http://cdm.unfccc.int/Reference/Procedures/index.html#proj_cycle	Others
/18/	UNFCCC/CDM-EB	Consolidated baseline and monitoring methodology ACM0001 - "Consolidated methodology for landfill gas project activities", version 3.0 as per EB 24.	Dated 12/05/2006. Available online: http://cdm.unfccc.int/methodologies/DB/D44X8FH8SFCXREE6037AXJSBGGFVDO	Others
/19/	UNFCCC	Project design document form for CDM project activities (incl. the Attachment "Instructions for filling out the project design document form for CDM project activities", version 06.0.	Dated 09/03/2015. Available online: https://cdm.unfccc.int/Reference/PDDs_Forms/index.html	Others
/20/	Federal Government of Brazil	Federal Resolution CONAMA nº 001/86.	Dated 23/01/1986. Available online: http://www.mma.gov.br/port/conama/res/res86/res0186.html	Others
/21/	FEPAM (regional environmental authority of Rio Grande do Sul State)	Installation License 41/2014-DL valid for the construction of an electricity generation facility fuelled by LFG at the CR do Recreio landfill.	Dated 13/01/2014.	Others
/22/	UNFCCC/CDM-EB	Standard for application of the global warming potentials to clean development mechanism project activities and programmes of activities for the second commitment period of the Kyoto Protocol. Version 01.0 as per EB 69.	Dated 13/09/2012.	Others
/23/	Huitric, R. L. and Kong, D. et al	"Measuring landfill gas collection efficiency using surface methane concentration"	Available online: http://www.arb.ca.gov/cc/ccea/comments/april/huitric_kong.pdf	Others
/24/	Arquipélago Engenharia Ambiental Ltda.	Communication letter clarifying operational specifications and conditions for the high temperature enclosed flare installed at the CR do Recreio landfill as part of the CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)".	Dated March 2014	Others
/25/	SIL	Monitoring Reports for the registered CDM project activity	Available online: http://cdm.unfccc.int/Projects/	Project Participants

		"Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)" for the 1st, 2nd, 3rd, 4th, 5th and 6th verifications (monitoring periods from 12/01/2007 to 10/12//2008; from 11/12/2008 to 20/10/2009, from 21/10/2009 to 31/10/2011, from 01/11/2011 to 31/08/2012, from 01/09/2012 to 31/12/2012 and from 01/01/2013 to 31/12/2013 respectively).	DB/DNV-CUK1158844635.31/view	
/26/	DNA of Brazil	Resolução de nº 8, de 26 de maio de 2008, que adota, para fins de atividade de projeto de MDL, um único sistema como definição de sistema elétrico do projeto no Sistema Interligado Nacional. (Resolution no. 8, that adopts a single national electricity grid for CDM Project activities).	Dated 26/05/2008. Available online: http://www.mct.gov.br/upd_blob/0024/24719.pdf	Others
/27/	SIL Soluções Ambientais Ltda. / CRVR S.A.	Schematic technical drawing with the lay-out of the new electricity generation facility.	Dated August 2014.	Project Participants
/28/	Federal Republic of Brazil, Ministry of Environment	"Gestão integrada de resíduos sólidos"	Dated 2007.	Others
/29/	Federal Republic of Brazil ,Ministry of Science and Technology	The second Brazilian Greenhouse Gases Emissions Inventory Report."	Dated 2010. Available online: http://www.mct.gov.br/upd_blob/0213/213909.pdf	Others
/30/	ABRELPE	"Panorama dos Resíduos Sólidos no Brasil- 2014".	Available online: http://www.abrelpe.org.br/panorama_apresentacao.cfm	Others
/31/	UNFCCC/CDM-EB	"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", version 01.0 as per EB 69.	Dated 13/09/2012. Available online: https://cdm.unfccc.int/faq/Reference/Standards/meth/reg_stan02.pdf	Others
/32/	SGS United Kingdom Ltd.	Verification and Certification Report for the registered CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)". Monitoring Period from 01/12/2007 to 10/12/2008 (1st verification). Report No. CDM.VER0446 MP1. Version 5.1.	Dated 09/03/2011. Available online: https://cdm.unfccc.int/Projects/DB/DNV-CUK1158844635.31/iProcess/SGS-UKL1232979270.24/view	Others
/33/	Germanischer Lloyd Certification GmbH	Verification and Certification Report for the registered CDM project activity "Central de Resíduos do Recreio Landfill	Dated 31/07/2012. Available online https://cdm.unfccc.int/Projects/DB/DNV-	Others

		Gas Project (CRRLGP)". Monitoring Period from 11/12/2008 to 20/10/2009 (2nd verification). GLC Report No. 054. Rev. 08.	CUK1158844635.31/iProcess/Germanischer1265124397.97/view	
/34/	Germanischer Lloyd Certification GmbH	Verification and Certification Report for the registered CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)". Monitoring Period from 21/10/2009 to 31/10/2011 (3rd verification). GLC Report No. 244. Rev. 06.	Dated 05/02/2013. Available online: https://cdm.unfccc.int/Projects/DB/DNV-CUK1158844635.31/iProcess/Germanischer1333372036.55/view	Others
/35/	Germanischer Lloyd Certification GmbH	Verification and Certification Report for the registered CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)". Monitoring Period from 01/11/2011 to 31/08/2012 (4th verification). GLC Report No. 295. Rev. 06.	Dated 22/04/2013. Available online: https://cdm.unfccc.int/Projects/DB/DNV-CUK1158844635.31/iProcess/Germanischer1349207269.06/view	Others
/36/	Germanischer Lloyd Certification GmbH	Verification and Certification Report for the registered CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)". Monitoring Period from 01/09/2012 to 31/12/2012 (5th verification). GLC Report No. 309. Rev. 06.	Dated 08/07/2013. Available online: https://cdm.unfccc.int/Projects/DB/DNV-CUK1158844635.31/iProcess/Germanischer1361951091.71/view	Others
/37/	Germanischer Lloyd Certification GmbH	Verification and Certification Report for the registered CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)". Monitoring Period from 01/01/2013 to 31/12/2013 (6th verification). GLC Report No. 368. Rev. 05.	Dated 14/08/2014. Available online: https://cdm.unfccc.int/Projects/DB/DNV-CUK1158844635.31/iProcess/Germanischer1392879494.15/view	Others
/38/	Brazilian Ministry of City Infrastructure	Diagnóstico do Manejo de Resíduos Sólidos Urbanos – 2010 (translated into English language as "Outlook/diagnostic for municipal/urban solid waste management – year 2010).	Dated June 2012. Available online: http://www.snis.gov.br/PaginaCarrega.php?EWRErterterTERTer=93	Others
/39/	UNFCCC/CDM-EB	"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 per EB 66.	Dated 02/03/2012. Available online: http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-11-v3.0.1.pdf	Others
/40/	Pan American Health Organization (PAHO)	"Analysis of the municipal solid waste management situation – Report on the regional evaluation of municipal solid	Dated year 2005. Available online: http://www.bvsde.ops-oms.org/bvsars/fulltext/inform	Others

		waste management services in Latin America and the Caribbean".	eng/cap3.pdf	
/41/	Environment Agency of the State of Sao Paulo, Brazil (CETESB); Authors: Alves, João Wagner Alves	"Methane to Markets Partnership – Country Profiles: Brazilian Country Profile."	Dated year 2007. Available online: http://www.globalmethane.org/documents/landfills_cap_brazil.pdf	Others
/42/	Germanischer Lloyd Certification GmbH	Validation Opinion on Post-Registration Changes for the registered CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)". GLC Report No. 368.1. Rev. 04.	Dated 09/12/2014. Available online: https://cdm.unfccc.int/Projects/DB/DNV-CUK1158844635.31/view	Others
/43/	Gordon J. Van Wylen, Richard E. Sonntag and Borgnakke	Fundamentals of Classical Thermodynamics; 3rd Edition, John Wiley & Sons, Inc. Table A-4: Saturated Water-Temperature.	Dated 1996. Available online: http://fireflylabs.com/disted/courses/m275-data(all%20years)/SaturatedWaterTables-T&P.pdf	Others
/44/	SIL	Draft version of the revised Project Design Document (PDD) for the registered CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)" submitted by SIL Soluções Ambientais Ltda. in order to notify the Secretariat of the CDM Executive Board (CDM-EB) their intention to request a renewal of a crediting period of the registered CDM project activity. Version 1.0.	Dated 20/05/2014.	Project Participants
/45/	SIL	Completed Modalities of Communication (MoC) form for the CDM project activity "Central de Resíduos do Recreio Landfill Gas Project (CRRLGP)"	Dated 28/02/2014. Available online: https://cdm.unfccc.int/Projects/DB/DNV-CUK1158844635.31/view	Project Participants
/46/	Brazil's Interministerial Commission on Global Climate Change (DNA of Brazil)	CO_2 emission factors for electricity generation in Brazil National Interconnected System – Base year 2014.	Available online: http://www.mct.gov.br/index.php/content/view/307492.html	Others
/47/	SIL	Internal records of expenditures with fuel type LPG during the period from October 2014 to May 2017 and dates of delivery of fuel LPG at the project site.	Data retrieved from the financial/accounting management financial system of Essencis Soluções Ambientais S.A on 29/06/2015.	Project Participants
/48/	Empresa Brasileira de Pesquisa Energética (EPE)	Balanço Energético Nacional 2014 | Ano base 2013. Brazilian Energetic Balance Report year 2014 (base year 2013).	Available online: https://ben.epe.gov.br/downloads/Relatorio_Final_BEN_2014.pdf	Others

/49/	Brazilian National Agency of Petroleum, Natural Gas and Biofuels (*Agência Nacional do Petróleo, Gás Natural e Biocombustíveis - ANP*)	Resolution 15.	Dated 18/05/2005. Available online: http://nxt.anp.gov.br/nxt/gateway.dll/leg/resolucoes_anp/2005/maio/ranp%2015%20-%202005.xml	Others
/50/	UNFCCC/CDM-EB	List of valid standardized baselines applicable for CDM project activities.	Available online: https://cdm.unfccc.int/methodologies/standard_base/new/sb7_index.html	Others

Appendix 4. Clarification requests, corrective action requests and forward action requests

Table 1. CL from this validation

CL ID	1	**Section no.**	D.6	**Date:** 04/08/2015
Description of CL				
PP to clarify how the project satisfies the requirement of PCP v9.0 para 290 and 291 (or equivalent to previous versions of PCP). In doing so, PP required to provide email sent to the UNFCCC which contains the PDD and name of the selected validating DOE. PP is also required to send the PDD version 1.0 dated 20th May 2014 which shall be the basis of validation assessment.				
Project participant response				**Date:** 14/09/2015
Evidence of the mail sent to the CDM Secretariat notifying the change in the DOE selected to perform the validation assessment for the renewal of crediting period for the project activity was forwarded to the DOE performing the validation assessment. PP has checked the VVS requirements and nowhere is it mentioned that PDD sent as part of intention of renewal has to be the basis of validation assessment. PP wants to clarify that PDD sent as part of intention of renewal is older version of PDD. Version 8.2 of PDD is the latest than the PDD version 1.0. Hence at the start of the validation assessment by SIRIM, PDD version 9.0 is available hence forms the basis of validation assessment. PDD version 9.0 is sent again to you.				
Documentation provided by project participant				
Email that was sent to UNFCCC secretariat				
DOE assessment				**Date:** 13/10/2015
The validation team have accepted the argument of PP.				

Table 2. CAR from this validation

CAR ID	1	**Section no.**	D.3	**Date:** 04/08/2015
Description of CAR				
PP to demonstrate in the PDD all valid and relevant mandatory national and/or sectoral policies and its impact on the baseline and how the project complies with the national and/or sectoral policies.				
Project participant response				**Date:** 14/09/2015
Sections A.3, B.4 and B.6.1 of the PDD present information about the non-existence of municipal, state or national requirements that establish any requirement or guidance in terms of LFG management in landfills or waste dump sites neither in 2006 (when the project activity was validated) or currently which would be applicable for the CR do Recreio landfill or any other landfill in Brazil.				
Documentation provided by project participant				
PDD version 9.1				
DOE assessment				**Date:** 13/10/2015
The validation team have accepted the argument of PP.				

CAR ID	2	Section no.	D.2	Date: 04/08/2015
Description of CAR				
Applicability conditions for the methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" are not presented and justified in the PDD.				
Project participant response				**Date:** 14/09/2015
As a response to the raised CAR, applicability conditions for the methodological tool "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period" were included in Section B.2 of the PDD.				
Documentation provided by project participant				
PDD version 9.1-				
DOE assessment				**Date:** 13/10/2015
The validation team have accepted the argument of PP.				

CAR ID	3	Section no.	D.1	Date: 04/08/2015
Description of CAR				
"Choice of data" in the applicable table for the ex-ante determined parameter $EF_{grid,BM,y}$ in Section B.6.2 of the PDD is not correctly completed as per the "Instructions for filling out the project design document form for CDM project activities".				
Project participant response				**Date:** 14/09/2015
As a response to the raised CAR, the applicable table for the ex-ante determined parameter $EF_{grid,BM,y}$ was corrected by considering the applicable "Instructions for filling out the project design document form for CDM project activities".				
Documentation provided by project participant				
PDD version 9.1				
DOE assessment				**Date:** 13/10/2015
The validation team have accepted the argument of PP.				

Table 3. FAR from this validation

FAR ID	Xx	Section no.		Date: DD/MM/YYYY
Description of FAR				
No FARs were raised during this assessment.				
Project participant response				**Date:** DD/MM/YYYY
-				
Documentation provided by project participant				
-				
DOE assessment				**Date:** DD/MM/YYYY
-				

Appendix 5:

Applicability criteria of the applied meth	Validation team conclusion
1.The methodology is applicable under the following conditions: (a) Install a new LFG capture system in a new or existing SWDS 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	PDD[/3/] applicable for the first crediting period and the final PDD[/2/] apply the same version of the methodology. Applicability criteria (b – i) is fulfilled, as part of the project design encompasses the installation of an active (forced) LFG capture system in an existing landfill replacing a previously existent passive LFG combustion system (using conventional passive LFG venting/combustion drains). While the installed active (forced) LFG capture system as part of the project activity encompasses entirely new equipment (centrifugal blowers, flares, and yet to be installed new engine-generator sets, etc.), by assuming that the project activity replaces the previously existent pre-project passive LFG venting and combustion

activity and its efficiency is not impacted on 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 (d) Do not reduce the amount of organic waste that would be recycled in the absence of the project activity."	system (using conventional passive LFG venting/combustion drains) at the Recreio landfill, in the particular context of the demonstration of meeting of applicability criteria for applied methodology , 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, prior to the implementation of the project activity, while a share of generated LFG was captured and vented through existent conventional venting/combustion drains, a minor share of collected LFG was combusted in such drains under a non-systematic or controlled manner. Such pre-project existent conventional LFG venting/combustion drains used operated without any forced negative pressure gradient and were replaced by the project's LFG collection wells. No collected LFG were utilized for electricity or heat generation in the pre-project scenario either. No collected LFG were supplied to consumers through a natural gas distribution network or by trucks either. As a conclusion, no systematic or continuous monitoring of LFG (under a quantitative or qualitative perspective) has ever occurred prior to the implementation of the project activity at the Recreio landfill in year 2007. Condition (c) (i) is also fulfilled as the project activity include flaring of collected LFG and utilization of collected LFG as gaseous fuel for electricity generation. No utilization of LFG as fuel for heat generation (boiler, air heater or kiln) or glass melting furnace; and/or being supplied to consumers through a natural gas distribution network or by trucks is currently encompassed by the project design and such potential utilization options are not expected to occur in the future either. Thus, only criteria (c) (i) are an applicable alternative. Condition (d) is also applicable as there has been no expected change in the operation of the landfill as a result of the implementation of the project activity and no change is expected to occur in the future either. No change in the current practice of landfilling of MSW at the Recreio landfill occurred after the implementation of the project activity either. With or without the project activity, no recycling of the organic fraction of the waste, neither aerobic treatment, neither incineration has occurred or is expected to occur at the Recreio landfill. In fact, recycling of organic matter, aerobic treatment and incineration has not ever been common practice in Brazil and in the region of influence of the Recreio landfill either. As part of validation assessment, in order to confirm the applicability of applied methodology /5/, interview was conducted with the PP and it was confirmed that operation of the Recreio landfill site is not expected to be changed under any aspect. By taking into account the content/rationale for the applicability condition (d), and based on

	assessment of (i) detailed information made available in the final PDD /2/ regarding how the condition (d) is met and (ii) assessment of credible documented information/evidences /28/ /29/ /30/ /38/ /40/ /41// (of which some are interpreted and referenced in the final PDD /2/ in a correct manner), thus sufficiently justifying the plausibility and correctness of information made available in the final PDD /2/); the validation team is of the opinion that it is sufficiently justified the implementation and operation of the project activity has never represented and it is not expected to represent any driver or incentive to promote any kind of reduction in the amount of organic waste that would be recycled in the absence of the project activity (baseline scenario) at the Recreio landfill and/or at any other existent or potential (hypothetical) waste treatment or utilization facility under the area of influence of this particular landfill. The prevailing waste management practices pertinent to organic solid waste recycling in the region attended by the Recreio landfill was also assessed by the validation team. As verified, detailed information (including aspects, facts and statistics related to recycling of organic fraction of MSW in the region of influence of the Recreio landfill and in other regions of Brazil) are included in the related documented evidences assessed by the validation team /28/ /29/ /30/ /38/ /40/ /41// which are appropriately referred in the final PDD /2/. Such data sources confirm the non-existence of any facility with relevant scale/size to promoting utilization or recycling of organic fraction of solid waste (such as a solid waste composting plant) in the region of the project site. The validation team also assessed the amount of organic waste currently being recycled or utilized in the region and whether such amount has ever being potentially negatively impacted by the previously occurred implementation of the project activity. Available and credible statistical data and information sources were assessed by the validation team (including both related sources indicated in the final PDD/2/ evidences as well as other credible sources selected by the validation team /28/ /29/ /30/ /38/ /40/ /41//). Assessed data and information sufficiently confirm the suitability and plausibility of all related argumentation and explanations which are made available in the final PDD /2/. Furthermore, based on assessment of related construction and design documentation for the Recreio landfill and also based on interviews performed with representatives of the project participant, the validation team was also able to confirm that no initiative involving recycling of organic fraction of MSW (or any other type of solid waste) is currently expected to be implemented at the Recreio landfill or in any other site by PP. Furthermore, by also taking into account the applicable regulatory framework and typical business environment for waste management services (as a public service) in Brazil, it is also the

	understanding and opinion of the validation team (based on its sectoral expertise and performed assessment of related sectoral literature /28/ /29/ /30/ /38/ /40/ /41//), that occurred implementation of the project activity in year 2007 has not represented and it is not expected to represent any potential incentive or driver for any administration of municipalities in the region, for any other public entity or for any other relevant recycling practitioner (if existent in the future) to promote eventual changes in existent regional policies, rules and practices involving recycling of organic waste in the region. The publication "Panorama dos Resíduos Sólidos no Brasil – 2014" /30/ (Outlook of Solid Waste Sector in Brazil – 2014 states the following: "solid waste recycling initiatives in Brazil are quite limited and encompass mostly aluminium, paper, plastic (including PET bottles) and glass material. In case of existing recycling activities, material to be recycled is separated from waste stream prior to being disposed in a landfill or dumpsite. For the specific case of recycling of organic waste material, paper waste sent to disposal in landfills is not even regarded as recyclable material (and thus not even accounted in the available statistics for recyclable material). Only clean (not contaminated) and previously separated paper waste material is considered as recyclable material. No other type of organic material has been recycled in Brazil". In the particular case of the landfill where the project activity is implemented, no received organic waste stream has ever been directed to recycling. Thus, the project activity has never promoted any volume or practice changes in terms of recycling of organic solid waste. The "Panorama dos Resíduos Sólidos no Brasil – 2014" /30/ is a publication published by the "Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais – ABRELPE" (Brazilian Association for Municipal Solid Waste and Special Waste) and represents the most credible outlook and statistics source for the solid waste management sector in Brazil. The validation team judges that this source of information is reliable and also realistic evidence that the management of Recreio landfill has never changed after the project activity implementation and no change is expected to occur in the future either. As a conclusion, it is sufficiently demonstrated that under no circumstance the implementation and expected continuous operation of project activity would per se represent a driver or incentive to have any party reducing or preventing the volume of organic waste stream that would be recycled in the baseline scenario (e.g. in order to get such solid waste stream being disposed using landfilling practices at the Recreio landfill or at any other solid waste disposal site (SWDS). In summary, it is sufficiently demonstrated in the final PDD for the 2nd crediting period /2/ that

	condition (d) of the above-quoted applicability criteria is sufficiently met.
2.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; (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."	Applicability condition (a) is fulfilled since, as confirmed by the validation team, the baseline scenario is confirmed to be directly identified as the release (free emission) of generated LFG into the atmosphere (with a small share of LFG being combusted in previously existing LFG venting/combusting drains). As the currently considered project design encompasses the utilization of collected LFG as fuel for electricity generation, condition (b) (i) is thus an applicable alternative. Although, while no on-site heat requirements at the Recreio landfill are identified in the description of the project design, the project design does not encompass generation of heat using LFG as fuel. Supply LFG for heat generation off-site is not considered either. Therefore, condition (b) (ii) is not an applicable alternative.
3. 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."	Condition (a) is not applicable as LFG captured by the project activity is not expected to displace fossil fuels in a kiln, air heater or glass melting furnace. Moreover no baseline and monitoring methodology other than the applied methodology /5/ is applied. Condition (b) is not applicable either as no changes on the operation of the Recreio landfill has so far occurred and are expected to occur as a result of the implementation and operation of the project activity (under both the initial and later changed project design configuration). As appropriately outlined in the final PDD /2/, with or without the implementation of the project activity, no recycling of the organic fraction of the waste, aerobic waste treatment or waste incineration are expected to occur. In fact, recycling of waste, waste aerobic treatment and waste incineration are not common practices in Brazil. During the performed validation assessment, Interviews were conducted with representatives of the project participant and it was confirmed that the project participant and CRVR S.A. do not intent or plan to change the operation or design of the Recreio landfill site under any aspect. Moreover, as claimed by the project participant and described in the final PDD /2/, the operational conditions and the previously conceived design of the Recreio landfill are not expected to change in the future. It is important to note that as per monitoring requirements for the monitoring parameter Management of the SWDS, 2nd 7-year crediting period, the design and operational conditions of the solid waste disposal site (SWDS) Recreio landfill will be annually monitored on the basis of different sources, including inter alia: - Original construction and operational design of the Recreio landfill; - Technical specifications and requirements for the management of the Recreio landfill; - Applicable local or national regulations dealing

	with management and operation of existing landfills. As required by applied methodology /5/, any occurred or planned relevant change in terms of management of the landfill is to be reported and justified as part of the monitoring process for the project activity.
4. The applicability conditions included in the tools referred to above also apply."	As confirmed by the validation team, demonstration of how applicability conditions for the following methodological tools to which applied methodology /5/ refers to (and that are applied by the project activity) are met is sufficiently demonstrated in Section B.2 of the final PDD /2/: - "Project emissions from flaring" (version 02.0.0) /10/ - "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" (version 1) /11/ - "Emissions from solid waste disposal sites" (version 06.0.1) /15/ - "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (version 02.0.0) /12/ - "Tool to calculate the emission factor for an electricity system" (version 04.0.0) /14/ - "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 02) /13/. - "Assessment of the validity of the original/current baseline and to update the baseline at the renewal of a crediting period for renewal of crediting period"/42/ in the final PDD /39/

Appendix 6:

Assessment of the determination of baseline emissions:
As established by applied methodology /5/ and as correctly outlined in Section B.6.1 of the final PDD/2/ in the particular case of the project activity (which does not encompass utilization of LFG as fuel for heat generation or as displacement of natural gas) baseline emissions are directly and correctly determined as follows:

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

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)

The determination of baseline emissions correctly applies the stepwise procedure which is established by the applied methodology /5/ as follows:

Baseline emissions of methane from the SWDS ($BE_{CH4,y}$):
Baseline emissions of methane from the Recreio landfill ($BE_{CH4,y}$)) are correctly determined based on the amount of methane that is captured in the project scenario and the amount of methane assumed as being captured and destroyed in the baseline scenario (absence of the project activity) in order to address regulatory, safety or health requirements.

In addition, the effect of methane oxidation in the top layer section of the landfill in the baseline scenario (absent in the project) is also correctly taken into account as required by the applied methodology /5/. $BE_{CH4,y}$ is calculated (in tCO_2e/yr) as follows:

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

OX_{top_layer} Fraction of methane in the LFG that would be oxidized in the top layer of the considered SWDS in the baseline (dimensionless). As outlined in Section B.6.2 of the final PDD /2/, OX_{top_layer} is correctly *ex-ante* determined as 10% (default values as per the applied meth /5/).
$F_{CH4,PJ,y}$ Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (in tCH_4/yr). $F_{CH4,PJ,y}$ is determined by following the stepwise approach of the applied meth /5/ as assessed below.
$F_{CH4,BL,y}$ Amount of methane in the LFG that would be flared in the baseline in year *y* (in tCH_4/yr). $F_{CH4,BL,y}$ is also determined by following the stepwise approach of the applied meth /5/ as assessed below.
GWP_{CH4} Global Warming Potential of CH_4. GWP_{CH4} is correctly ex-ante determined as 25 tCO_2e/tCH_4

Ex post determination of $F_{CH4,PJ,y}$:
During the 2nd 7-year renewable crediting period, $F_{CH4,PJ,y}$ will be determined (in tCH_4/year) as the sum of the quantity of methane flared and quantity of methane used as gaseous fuel in the project's electricity generation facility as follows. In accordance to the "Tool to determine the mass flow of greenhouse gas in a gaseous stream", the Amount of methane in the LFG which is used for electricity generation in year *y* ($F_{CH4,EL,y}$) and the Amount of methane in the LFG which is sent to the flare in year *y* ($F_{CH4,sent\_flare,y}$), are represented as $F_{i,t}$

$F_{CH4,PJ,y} = F_{CH4,flared,y} + F_{CH4,EL,y}$
Where:
$F_{CH4,EL,y}$ Amount of methane in the LFG which is used for electricity generation in year *y* (in tCH_4/yr)
$F_{CH4,flared,y}$ Amount of methane in the LFG which is destroyed by flaring in year *y* (in tCH_4/yr). $F_{CH4,flared,y}$ is determined as the difference between the amount of methane supplied to the flare and any methane emissions from the flare, as follows:

$F_{CH4,flared,y} = F_{CH4,sent\_flare,y} – (PE_{flare,y} / GWP_{CH4})$
Where:
$F_{CH4,sent\_flare,y}$ Amount of methane in the LFG which is sent to the flare 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)

Determination of $F_{CH4,EL,y}$ and $F_{CH4,sent\_flare,y}$:

As established by the applied meth /5/ and as correctly outlined in the final PDD /2/, both $F_{CH4,EL,y}$ and $F_{CH4,sent\_flare,y}$ are correctly determined by following applicable guidance of the "Tool to determine the mass flow of greenhouse gas in a gaseous stream" /12/. In the context of the application of such methodological tool for the determination of $F_{CH4,EL,y}$ and $F_{CH4,sent\_flare,y}$ the following set requirements are correctly regarded as applicable:

- The gaseous stream the tool shall be applied to is the LFG stream delivery pipeline to the electricity generation facility and to the high temperature enclosed flare(s). $F_{CH4,EL,y}$ is then calculated as the mass flow of methane to the electricity generation equipment *j*; $F_{CH4,sent\_flare,y}$ IS calculated as the mass flow of methane to the flare(s).
- CH_4 is the greenhouse gas for which the mass flow should be determined;
- The flow of the gaseous stream should be measured on continuous basis;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (applicable equations in the methodological tool);
- The mass flow should be calculated on an hourly basis for each hour *h* in year *y*;
- For the determination of $F_{CH4,EL,y}$, as also required by the applied methodology /5/, the working hours of the each element of project's electricity generation facility (each engine-generator set) will be monitored in a way to ensure that that no emission reduction are claimed for methane destruction during non-working hours of the considered engine-generator sets. This is taken into account by monitoring the hours that each engine generator set utilizing the LFG as gaseous fuel is operating in year *y* ($Op_{j,h,y}$).

As confirmed by validation team applicable guidance of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" /12/ was correctly applied to determine parameter $F_{CH4,EL,y}$.

Use of applicable guidance of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream /12/ for determining $F_{CH4,EL,y}$ and $F_{CH4,sent\_flare,y}$:

As confirmed by validation team, applicable guidance of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" /12/ is correctly applied to determine parameter $F_{CH4,sent\_flare,y}$ and $F_{CH4,EL,y}$ as follows:

Use of Option A, B, C or D:

The following potential measurement options of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" /12/ are considered for the determination of $F_{CH4,sent\_flare,y}$ and $F_{CH4,EL,y}$:

Considered methodological approaches for the determination of $F_{CH4,sent\_flare,y}$ and $F_{CH4,EL,y}$ as per the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"

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

As correctly outlined in the final PDD /2/, depending on project conditions and installed instruments/equipment, Option A, B, C or D will be selected *ex-post*. The decision of the PP to select the calculation option *ex-post* (as reflected in the final PDD /2/) is deemed reasonable and acceptable by taking into account the selection of Option A, B, C or D will depend on project's aspects and monitoring equipment installed along the crediting period.

Thus, along the crediting period, depending on project conditions and equipment installed either Option A, B, C or D will be followed as assessed below:

<u>*Option A*</u>

$F_{CH4,t} = V_{t,db,j} * v_{CH4,t,db} * \rho_{CH4,t}$

Where:

$F_{CH4,t}$ Mass flow of greenhouse gas *i* (*i* = CH_4) in the gaseous stream (LFG) in time interval *t* (in kg gas/h)

$V_{t,db,j}$ Volumetric flow of LFG stream in time interval *t* on a dry basis for *j*

$v_{CH4,t,db}$ Volumetric fraction of methane in the gaseous stream (LFG) in time interval *t* ona dry basis (in m^3 gas *i*/m^3 dry gas)

$\rho_{CH4,t}$ Density of methane in the gaseous stream in time interval *t* (kg gas *i*/m^3 gas *i*).
$\rho_{CH4,t}$ will be determined as follows:

$\rho_{CH4,t} = P_t * MM_{CH4} / R_u * T_t$

Where:

P_t Absolute pressure of the gaseous stream (LFG) in time interval *t* (in Pa)

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

MM_{CH4} Molecular mass of greenhouse gas *i* (*i* = *CH_4*) (in kg/kmol)

R_u Universal ideal gases constant (in Pa.m^3/kmol.K)

<u>*Option B*</u>

$F_{CH4,t}$ is determined by using the equations listed above under <u>*Option A*</u> by converting the measured volumetric flow from wet basis to dry basis as follows:

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

Where:

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

$V_{t,wb}$ Volumetric flow of the gaseous stream (LFG) 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 (LFG) 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 as follows:

$v_{H2O,t,db} = (m_{H2O,t,db} * MM_{t,db}) / (MM_{H2O})$

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 *Option B* is selected, the absolute humidity of the gaseous stream ($m_{H2O,t,db}$) will be determined using Option 2 of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" /12/ for the "*Determination of the absolute humidity of the gaseous stream"* as follows:

Option 2: Simplified calculation without measurement of the moisture content

This considered calculation 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 as follows:

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

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 using the following equation:

$$MM_{t,db} = \Sigma_i (v_{i,t,db} * MM_k)$$
Where:
$v_{k,t,db}$ Volumetric fraction of gas *k* in the gaseous stream in time interval *t* on a dry basis (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).

In accordance with the simplification given in the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" /12/ it is appropriately indicated in the final PDD /2/ that only the volumetric fraction of CH_4 ($v_{CH4,t,db}$) will be monitored and the difference to 100% will be considered as pure nitrogen.

Option C

$$F_{CH4,t} = V_{t,wb,n} * v_{CH4,t,wb} * \rho_{CH4,n}$$
Where:

$F_{CH4,t}$ Mass flow of greenhouse gas methane in the gaseous stream in time interval *t* (in kg gas/h)
$V_{t,wb,n}$ Volumetric flow of the gaseous stream (LFG) in time interval *t* on a wet basis at normal conditions (in m^3 wet gas/h)
$v_{CH4,t,wb}$ Volumetric fraction of methane in the gaseous stream (LFG) in time interval *t* on a wet basis (in m^3 gas /m^3 wet gas)
$\rho_{CH4,n}$ Density of methane in the gaseous stream at normal conditions (in kg gas *i* /m^3 wet gas *i*).

Parameter $\rho_{CH4,n}$ will be determined as follows:

$$\rho_{CH4,n} = P_n * MM_{CH4} / R_u * T_n$$
Where:
P_n Absolute pressure at normal conditions (in Pa)
T_n Temperature at normal conditions (in K)
MM_{CH4} Molecular mass of methane (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:

$V_{t,wb,n} = V_{t,wb,j} *(T_n / T_t) * (P_t / P_n)$

Where:

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

$V_{t,wb,j}$ Volumetric flow of LFG stream in time interval *t* on a wet basis for *j* (where *j* is the LFG delivery pipeline to each item of electricity generation and LFG delivery pipeline to the flare) (in m^3 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)

Option D

The mass flow of methane $F_{i,t}$ ($i = CH_4$) is determined using equations 14 and 15 as outlined in the final PDD /2/. The volumetric flow of the LFG in time interval *t* on a dry basis for *j* (where *j* is the LFG delivery pipeline to each item of electricity generation and LFG delivery pipeline to the flare ($V_{t,db,j}$) is determined by converting the mass flow of the gaseous stream to a volumetric flow as follows:

$V_{t,db,j} = M_{t,db,j} / \rho_{t,db}$

Where:

$V_{t,db,j}$ Volumetric flow of LFG stream in time interval *t* on a dry basis for *j* (where *j* is the LFG delivery pipeline to each item of electricity generation and LFG delivery pipeline to the flare) (in m^3 dry gas/h)

$M_{t,db,j}$ Mass flow of the LFG stream in time interval *t* on dry basis for *j* (where *j* is the LFG delivery pipeline to each item of electricity generation and LFG delivery pipeline to the flare) (in kg/h)

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

$\rho_{t,db}$ shall be determined as follows:

$\rho_{t,db} = P_t * MM_{t,db} / R_u * T_t$

Where:

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

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

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

Determination of $PE_{flare,y}$ (in the context of the determination of $F_{CH4,flared,y}$):

As outlined in the final PDD /2/, $PE_{flare,y}$ is determined using the methodological approaches of the latest version of the "Project emissions from flaring" /10/. Project emissions from flaring the residual gas ($PE_{flare,y}$) are determined based the flare efficiency ($\eta_{flare,m}$) and the mass flow of methane to the flare ($F_{CH4,RG,m}$). As correctly described in the final PDD /2/, the 3-step approach for determining project emissions from flaring through continuous monitoring of following parameters will be used as per the applicable guidance of the tool "Project emissions from flaring" /10/. The application of this methodological tool encompasses the following steps:

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

This first step indicates that the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" /12/ is used to determine the mass flow of methane in the residual gaseous stream in minute *m* ($F_{CH4,m}$). Furthermore, $F_{CH4,m}$ shall be used to determine the mass of methane in kilograms fed to the flare in minute *m* ($F_{CH4,RG,m}$).

The following requirements are correctly considered:

- The gaseous stream tool 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*.

STEP 2: Determination of the flare efficiency

The efficiency of combustion in the flare in minute *m* is determined as the average of two measurements of the flare efficiency made in year *y* ($\eta_{flare,calc,y}$), based on monitored data as per Option B.1: Biannual measurement of the flare efficiency, as follows:

$\eta_{flare,calc,y} = 1 - ½ \sum (F_{CH4,EG,t} / F_{CH4,RG,t})$

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 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* when the flare efficiency is measured (minimum of one hour and separated by at least six months)

$F_{CH4,EG,t}$ is to be measured according to an appropriate national or international standard. $F_{CH4,RG,t}$ is calculated according to Step 1 and consists of the sum of methane flow in the minutes m that make up the time period *t.* As per applicable guidance of Step 1, the parameter $F_{CH4,RG,t}$ 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.*

As an alternative to this approach, default values may be applied (in case determining of the methane destruction efficiency of the flare (flare efficiency - $\eta_{flare,m}$) is not available) as per Option A: Default value. In case of flare efficiency being determined on the basis of the use of default values (Option A: Default value), minute values for the calculation parameter $\eta_{flare,m}$ will be selected as 90% if the following two conditions are met in order to demonstrate that the flare is operating:

- The temperature of the flare ($T_{EG,m}$) and the flow rate of the residual gas to the flare ($F_{RG,m}$) is within the manufacturer's specifications for the flare ($SPEC_{flare}$) in minute *m*.
- The flame is detected in minute *m* ($Flame_m$).

Otherwise, the adopted default value for the parameter $\eta_{flare,m}$ is 0%.

The determination of minute values for the calculated parameter $\eta_{flare,m}$ should correctly takes into account whether the manufacturer's specifications for the correct operation of the flare equipment are met. Both approaches are in accordance with the methodological tool "Project emissions from flaring" /10/.

STEP 3: Calculation of project emissions from flaring

According to the applicable guidance of the tool "Project emissions from flaring" /4/, Project emissions from flaring ($PE_{flare,y}$) are calculated as the sum of emissions for each minute *m* in year *y* as follows:

$$PE_{flare,y} = GWP_{CH4} * \sum_{m=1}^{525600} F_{CH4,RG,m} * (1- \eta_{flare,m}) * 10^{-3}$$

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)

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

As assessed by the validation team, the application of the 3-step approach is correctly outlined in the final PDD /2/.

Ex ante determination of $F_{CH4,PJ,y}$:

As established by the applied meth /5/, the *ex-ante* estimation of emission reductions for the whole 2nd 7-year renewable crediting period are calculated based on the application of the multi-phased first order decay (FOD) model as per applicable guidance of the "Emissions from solid waste disposal sites" /15/. In accordance to the applied meth /5/, in the particular context of the *ex-ante* estimations of emission reductions to be achieved by the project activity, $F_{CH4,PJ,y}$ is determined (in tCO_2e) as follows:

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

Where:

$F_{CH4,PJ,y}$ Amount of methane in the LFG which is flared and/or used in the project activity in year *y* (in tCH_4/yr)

$BE_{CH4,SWDS,y}$ Amount of methane in the LFG that is generated from the SWDS in the baseline scenario in year *y* (in tCO_2e/yr). $BE_{CH4,SWDS,y}$ was determined using the methodological tool "Emissions from solid waste disposal sites" (version 06.0.1) /15/. Application A "The CDM project activity mitigates methane emissions from a specific existing SWDS" is selected. The calculation of values for $BE_{CH4,SWDS,y}$ correctly takes into account the different types of waste *j* with respectively different decay rates k_j and different fractions of degradable organic carbon (DOC_j). By correctly applying the multi-phased FOD model, in the context of the *ex-ante* estimation of emission reduction, baseline emissions of methane are calculated based on the actual and projected waste streams $W_{j,x}$ disposed in each year *x.*

η_{PJ} Efficiency of the LFG capture system that will be installed in the project activity. η_{PJ} is correctly *ex-ante* determined as 0.9280 (92.80%).

Determination of $F_{CH4,BL,y}$:
As required by the applied meth /5/, the amount of methane assumed as being captured and destroyed in the baseline scenario ($F_{CH4,BL,y}$) (absence of the project activity) due to eventually applicable regulatory or contractual requirements, or to address eventually existent applicable safety and other concerns (which are collectively referred to as "*requirement*" under this step) is correctly determined by following the applicable approach through selection of one of the four cases of the applied CDM baseline and monitoring methodology as outlined in the table below:

Cases for the determination of $F_{CH4,BL,y}$ as per ACM0001 (version 15.0):

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

Source: ACM0001 (version 15.0) /5/

Assessment of the existence of regulatory or contractual and non-regulatory or non-contractual requirements to destroy methane (as per the applicable definition of "requirement" of the applied meth*:*

Non-existence of regional or national regulatory or contractual requirements related to LFG management in the region of the project site:

As confirmed by the validation team, from the time the Recreio landfill was built until nowadays there has been no applicable legally binding regional or national obligation to capture and destroy the LFG at this landfill. However, by taking into account the applicable definition of "*requirement*" as per the applied meth /5/ it is correctly assumed by the project participants that, for the particular case of the determination of $F_{CH4,BL,y}$ for the project activity, a non-regulatory and non-contractual requirement to destroy methane indeed exists. As per the design and construction of the Recreio landfill, its currently valid operational licensing requirements as well as per the day-to-day MSW disposal practice at this particular landfill site, a non-defined share of LFG is assumed to be required to be destroyed by combustion in the LFG venting/combustion drains in the baseline scenario in order to address odors concerns as per the design of the landfill. As argued by the representative of the project participants, venting of LFG through the existing LFG venting/combustion drains would be enough to address safety concerns: reduction of pressure and volume of LFG in the inner section of the landfill in order to minimize the risk and explosions, fire and instability in the landfill. As per the applied methodological approach for the determination of $F_{CH4,BL,y}$ of the applied meth besides of legal requirements, any other existing non-regulatory or non-contractual requirement to destroy LFG in the landfill (e.g. design requirements in order to address safety and/or odor concerns) is to be regarded as an "*existing requirement to destroy methane*".

Due to that, in the particular context the project activity, it is thus correctly assumed that a non-regulatory requirement to destroy methane indeed exists.

The following disclaimer is thus confirmed to be appropriately added in the final PDD /2/:

"Requirement to destroy methane: YES".

By taking this assumption into account, Case 1 and Case 3 (*Requirement to destroy methane? = No*) from the cases above-summarized are thus automatically regarded as not applicable cases for the determination of $F_{CH4,BL,y}$. This is deemed reasonable and correct.

Thus, in the context of the assessment of the valid cases, the remaining possibly valid alternatives (cases) (after the confirmation of existence of non-regulatory and non-contractual requirements to destroy methane due to safety and odor concerns) are thus Case 2 and Case 4 (*Requirement to destroy methane? = Yes*).

Assessment of existence of "LFG capture and destruction system" at the Recreio landfill (as per the applicable definition of "existing LFG capture and destruction" of the applied meth*):*
In the context of the completion of the final PDD applying ACM0001 (version 15.0), it is correctly assumed that, under the baseline scenario (absence of the project), destruction of very small share of generated methane would occur through combustion of LFG in pre-project LFG venting/combustion drains that would still being existent (and in additional LFG venting/combustion drains that would otherwise be implemented under the baseline scenario as part of the forecasted expansion of the area of this landfill). By taking into operation the construction and design of the Recreio landfill, during the pre-project scenario (period from year 2001 until December 2007 – when the project activity initiated its operations) combustion of small share of generated LFG in conventional venting/combustion drains indeed occurred (in order to address the existing operational requirement of destroying methane for addressing odor concerns). Thus it is reasonably assumed that, under the baseline scenario, the pre-project existent set of LFG venting/combustion drains would be kept and would even eventually be expended (addition of new similar drains as a result of forecasted growth of surface with disposed MSW at the Recreio landfill). This conventional and inefficient solution is correctly acknowledged to be an existent *LFG capture destruction system* as outlined in the final PDD /2/. It is assumed that in the baseline scenario, LFG would be combusted occasionally in the landfill through the pre-project existent conventional LFG venting/combustion drains. Combustion would occur whenever the amount and pressure of LFG were sufficiently high in order to allow combustion on a continuous basis. By taking into account the definition of "*existing LFG capture system*" and "*existing LFG capture and destruction system*" as per the applied meth /5/, it is thus assumed that there were an "*existing LFG capture system*" at the Recreio landfill (prior to the implementation of the project activity) that would be kept in case the project activity were not implemented (baseline scenario). Furthermore, while combustion of small fraction of generated LFG in passive (conventional) venting/combustion drains represents destruction of methane, it is thus also correctly assumed that there were an "*existing LFG capture and destruction system*" at the Recreio landfill prior to the implementation of the project activity. Therefore, like Case 1 and Case 3, Case 2 (*Existing LFG capture and destruction system? = No*) is correctly demonstrated not to be an applicable case either. As per the applied methodology /5/, "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 the applied methodology, "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."*

The following disclaimer is thus confirmed to be appropriately added in the final PDD /2/:

"Existing LFG capture and destruction system: YES".

Thus, the only remaining case applicable for the project activity in terms of "*existence of LFG capture and destruction system*" is Case 4 (*Requirement to destroy methane? = Yes and Existing LFG capture and destruction system? = Yes*).

Assessment of LFG management at the Recreio landfill prior to the implementation of the project activity (which corresponds to the identified baseline scenario for the project activity): As confirmed by the validation team through review of the previously issued Validation Report /8/ for the project activity and Validation Opinion Report for post-registration changes /42/, prior to the registration of the project activity and its implementation at the Recreio landfill as part of the operation of the landfill during the period from year 2001 (when the landfill started its operations) to year 2007 (when the project activity was implemented and started operating), whenever any existent drain was not lid, LFG used to be thus freely emitted into the atmosphere through the drains and through the surface of the landfill. Based on declarations provided by the PP typically only a very small share of generated LFG had been combusted in the existent LFG venting/combustion

drains during this period prior to the implementation of the project activity. This situation is due to the following reasons:

It is reasonable to assume that the design of the pre-project venting/combustion drains was somehow rudimentary and it did not allow continuous combustion of LFG under the typical operational circumstances of the landfill where pressure of LFG leaving the drains were not enough high to allow continuous combustion under the typical whether conditions of the site. As appropriately emphasized by the interviewed representative of the PP such drains were not conceived for continuous combustion of LFG under adverse climate (wind, temperature) and low LFG gradient pressure conditions. Due to aspects and conditions such as the diameter of the LFG venting/combustion drains, pressure of LFG in the drains, influence of wind and other climate aspects (e.g. rain), as well as the typical MSW disposal operational conditions at the Recreio landfill (where landfill working staff were not required ever to attempt ensuring to have LFG continuously combusted in the existing venting/combustion drains), there was no practice or attempt to have LFG being continuously and systematically combusted in such existent drains within the pre-project scenario. As explained by PP, the LFG venting/combustion drains (e.g. regular checking whether the drains are lid) were never systematically monitored at the Recreio landfill in the pre-project scenario due to other working priorities. Moreover, as also declared by the representatives of the project participant, in some of the pre-project drains, the pressure of LFG used to be too low, thus making it difficult to keep the drain lid and constantly combusting LFG at that time

Thus, although since the time encompassing the period from year 2001 to 2007, there has been no legal requirement to destroy methane in the Recreio landfill, it is however assumed that in the absence of the proposed CDM project activity (baseline scenario), sporadic combustion of LFG through the existent LFG venting/combustion drains (and additional similar drains that would otherwise be installed) would remain occurring along the period to be encompassed by the 2nd 7-year crediting period in order to address a non-regulatory requirement for the design and operation of the landfill. It is also noteworthy that, as acknowledged in the final PDD /2/, the project would not have any incentive or demand to under the baseline scenario to convert such existing somehow rudimentary LFG venting/combustion drains into an appropriate and efficient LFG flaring system. Based on its sectoral expertise, the validation team also confirms that non-continuous combustion or even complete venting of LFG through conventional LFG venting/combustion drains has been a practice in several others landfills and dump sites in Brazil and other countries in Latin America (where no legal requirements for destruction of LFG exists). As appropriately outlined in the final PDD /2/, combustion of LFG in conventional LFG venting/combustion drains in order to address odors or safety requirements is not an legal requirement however, in some cases, such as the case of the Recreio landfill, combustion of LFG in in conventional LFG venting/combustion drains for this purpose is to be regarded as a non-regulatory requirement.

In summary, the validation team is of the opinion that, as presented in the final PDD /2/, Case 4 is correctly selected as the applicable case for the determination of $F_{CH4,BL,y}$.

Application of methodological guidance valid for Case 4:

As correctly outlined in the final PDD /2/, under Case 4, the following is applicable as per ACM0001 (version 15.0) /5/ for the determination of $F_{CH4,BL,y}$:

"(…)

$F_{CH4,BL,y}$ shall be determined based on information in contract of regulation requirements and data related to the existing LFG capture system, as follows:

$F_{CH4,BL,y} = max\{F_{CH4,BL,R,y}; F_{CH4,BL,sys,y}\}$
Where:
$F_{CH4,BL,R,y}$ Amount of methane in the LFG which is flared in the baseline due to arequirement in year y (in tCH_4/yr)
$F_{CH4,BL.sys,y}$ Amount of methane in the LFG that would be flared in the baseline in year y for the case of an existing LFG capture system (in tCH_4/yr)

$F_{CH4,BL,R,y}$ and $F_{CH4,BL.sys,y}$ shall be determined according to the respective procedures for Case 2 and Case 3 (...)".

As also outlined in the final PDD /2/, by applying the applicable guidance of the applied meth /5/ for Case 2 (in the context of application of Case 4) for the particular case of LFG management at the Recreio landfill, the default and conservative value of LFG destruction rate of 20% is assumed by taking into account the existing non-regulatory and non-contractual requirement for addressing safety odor concerns and the way such requirements were addressed under the pre-project scenario (partial combustion of LFG which is vented

through the drains under a undefined quantity). As confirmed by the validation team, prior to the implementation of the project activity, for the assumed non-regulatory and non-contractual requirement, there was no amount or percentage of LFG that were specified to be destroyed. As per the applied methodology /5/, : "*This default value of 20% is based on assuming a situation in which: the efficiency of the LFG capture system in the project is 50%; the efficiency of the LFG capture system in the baseline is 20%; and, the amount captured in the baseline is flared using an open flare with a destruction efficiency of 50% (consistent with the default value provided in the .Tool to determine project emissions from flaring gases containing methane).*"
Thus, as per Case 2, $F_{CH4,BL,R,y}$ is determined (in tCH_4) as follows:

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

$F_{CH4,PJ,capt,y}$ Amount of methane in the LFG which is captured in the project activity in year *y* (in tCH_4). Since, the revised project design encompasses LFG collection and flaring and utilization of collected LFG (utilization of collected LFG as fuel for electricity), $F_{CH4,PJ,capt,y}$ is thus regarded as equal to the amount of methane supplied to the flare(s) ($F_{CH4,sent\_flare,y}$) + Amount of methane in the LFG which is used for electricity generation ($F_{CH4,EL,y}$).

As also outlined in the final PDD /2/, by applying the applicable guidance of the applied meth /5/ for Case 3 in the particular context of the Recreio landfill prior to the implementation of the project activity, since there were no monitored or historic data on the amount of methane that was captured in the year prior to the implementation of the project situation then $F_{CH4,BL.sys,y}$ is determined (in tCH_4) as follows:

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

Since, in the case of the Recreio landfill, $F_{CH4,PJ.,y}$ is equal to $F_{CH4,flared.,y} + F_{CH4,EL,y}$ $F_{CH4,BL.sys,y}$ is thus determined as follows:

$F_{CH4,BL.sys,y} = 0.2 * (F_{CH4,flared,y} + F_{CH4,EL,y})$

By comparing the aplicable guidance for Case 2 and Case 3 (both in the context of application of guidance for Case 4), the following relevant aspect is appropriately outlined in the final PDD /2/:
"(…)
By comparing the aplicable guidance for Case 2 and Case 3 (both in the context of application of guidance for Case 4), the following is relevant:
*While the term "0.2 * $F_{CH4,PJ,capt,y}$" > "0.2 * $F_{CH4,PJ,y}$ " (by considering the equation valid for the determination of $F_{CH4,PJ,y}$), it is thus fair and correct to assume that $F_{CH4,BL,R,y} > F_{CH4,BL,sys,y}$.*
Thus, the following is applicable for the determination of $F_{CH4,BL,y}$ by following the guidance for Case 4:

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

Where: In accordance with applicable guidance of the applied meth*, $F_{CH4,PJ,capt,y}$ is assumed as the sum of the amount of methane that is sent to the flare(s) and/or engine-generator sets in year y (as determined in Step A.1, however by not taking into account the working hours of the engine-generator sets and flare(s) efficiency in the particular case of its utilization for the determination of $F_{CH4,BL,y}$).*
(…)"

In summary, $F_{CH4,BL,y}$ is determined as follows:

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

As per applicable guidance of the applied meth /5/, $F_{CH4,PJ,capt,y}$ is to be determined as the sum of the amount of methane that is sent to all installed high temperature enclosed flares and to all the engine-generator sets in year *y*, however by not taking into account the working hours of the power generation and flaring equipment and also not taking into account the applicable values for flare efficiency in the particular case of its utilization for the determination of $F_{CH4,BL,y}$. The following explanative disclaimer is added in the final PDD/2/:

"In the particular case of the determination of $F_{CH4,BL,y}$ for project activity, while for a given monitoring period, $F_{CH4,PJ,capt,y}$ is thus equal to accumulated value for amount of methane in the LFG which is destroyed by flaring in year y (in tCH_4) ($F_{CH4,flared,y}$) for the period in question being calculated without considering/monitoring 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.»

Assessment of determination of baseline emissions associated with electricity generation ($BE_{EC,y}$):
Baseline emissions associated with electricity generation ($BE_{EC,y}$) is correctly determined by applying "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" /11/ as follows:

$BE_{EC,y} = \sum_j (EC_{BL,k,y} * EF_{EL,k,y} * (1 + TDL_{k,y})$

Where:
$BE_{EC,y}$ Baseline emissions associated with electricity generation in year y (in tCO_2/yr).
$EC_{BL,k,y}$ Net amount of electricity generated using LFG in year y (MWh/yr).
$EF_{EL,k,y}$ Emission factor for electricity generation for source *k* in year *y* (tCO_2/MWh).
$TDL_{k,y}$ Average technical transmission and distribution losses for providing electricity to source *j* in year *y.*
k Sources of electricity generated identified in the selection of the most plausible baseline scenario.

The CO_2 emission factor $EF_{EL,k,y}$ to be determined *ex-post* by applying the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" /11/ and Option A.1 was correctly chosen. Due to the definition of related parameters as per the applied methodology /5/, scenario A applies as the electricity end users would be supplied with electricity sourced by the same power grid (i.e. the National Electricity Grid of Brazil) which will be the same electricity grid connected to the project activity's new electricity generation facility (using LFG as gaseous fuel). The validation team thus confirms that Option A.1 is correctly selected. In accordance applicable guidance of the applied meth /5/, the parameter $EF_{EL,k,y}$ is correctly defined as "Combined margin CO_2 emission factor" ($EF_{grid,CM,y}$).

Ex-post determination of $EF_{grid,CM,y}$: As outlined in the final PDD /2/, the parameter $EF_{grid,CM,y}$ will be determined *ex-post* in accordance with applicable guidance of the "Tool to calculate the emission factor for an electricity system" /14/. The *dispatch data analysis OM* method is appropriately selected as the calculation method. The selection of this approach is in accordance with guidance and definitions previously set by the Brazilian Ministry of Science, Technology and Innovation (MCTI) /38/, which holds the Comissão Interministerial da Mudança Global do Clima (CIMGC) (the DNA of Brazil).

As correctly outlined in the final PDD /2/, for the 2nd 7-year renewable crediting period, $EF_{grid,CM,y}$ is determined *ex-post* (in tCO_2/MWh) by following the applicable stepwise procedure as per the latest version of the "Tool to calculate the emission factor for an electricity system" /14/, where the following formulae is applied:

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

Where:
$EF_{grid,OM,y}$ Operating margin CO_2 emission factor in year *y* (in tCO_2/MWh)
$EF_{grid,BM,y}$ Build margin CO_2 emission factor in year y (in tCO_2/MWh)
w_{OM} Weighting of operating margin emissions factor (%)
w_{BM} Weighting of build margin emissions factor (%)

The weighting factors for build and operating margin (w_{BM} and w_{OM}) were correctly *ex-ante* selected as per applicable guidance of the "Tool to calculate the emission factor for an electricity system" /14/. $EF_{grid,OM,y}$ is calculated ex-post by applying calculation guidance of the methodological tool applicable for *dispatch data analysis OM*. Under this calculation method, data for the year in which the project activity consumes grid electricity is considered for determining emission factor annually during monitoring. As per this method $EF_{grid,OM,y}$ is determined based on the grid-connected electricity generation units that are actually dispatched at the margin during each hour *h*. $EF_{grid,OM,y}$ is calculated (in tCO_2/MWh) as the dispatch data analysis operating margin CO_2 emission factor in year *y* ($EF_{grid,OM-DD,y}$). The operating margin emission factor will be determined *ex-post* as follows:

$$EF_{grid,OM-DDy} = \frac{\sum_h EG_{PJ,h} \cdot EF_{EL,DD,h}}{EG_{PJ,y}}$$

Where:
$EF_{grid,OM-DD,y}$ Dispatch data analysis operating margin CO_2 emission factor in year *y* (in tCO_2/MWh)
$EG_{PJ,h}$ Electricity displaced by the project activity in hour *h* of year *y* (in MWh)
$EF_{EL,DD,h}$ CO_2 emission factor for grid power units in the top of the dispatch order in hour *h* in year *y* (in tCO_2/MWh)
$EG_{PJ,y}$ Total electricity displaced by the project activity in year *y* (in MWh)
h Hours in year *y* in which the project activity is displacing grid electricity
y Year in which the project activity is displacing grid electricity

For the determination of annual values for the Build margin CO_2 emission factor ($EF_{grid,BM,y}$) for the 2nd 7-year crediting period, the choice of the project participants is Option 1. The build margin emissions factor is the generation-weighted average emission factor (in tCO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \cdot EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:

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

Determination of Project Emissions:

As also considered in the previously issued version of the PDD applicable for the first crediting period /3/, the only emission sources to be accounted as project emissions in year *y* (PE_y) are summarized as follows:

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

Where:

$PE_{EC,y}$ Project emissions due to the consumption of electricity by the project activity.
$PE_{FC,y}$ Project emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year *y*.

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

In the particular case of the project activity, $PE_{EC,y}$ is determined as follows:

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

Where:

$PE_{EC,grid,y}$ Project emissions from consumption of grid electricity due to the project activity in year *y.*

$PE_{EC,grid,y}$ is correctly outlined in the final PDD /2/ as being determined (in tCO_2/yr) based on monitoring ex-post of records of amount of grid-sourced electricity that is consumed by the project activity (by following applicable guidance and monitoring requirements of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" /11/). *Ex-post* determined annual values for CO_2 emission factor for consumed grid electricity (by following applicable guidance and monitoring requirements of the "Tool to calculate the emission factor for an electricity system" /14/) will also be considered. *Ex-ante* determined value of the Average technical transmission and distribution losses in the National Grid of Brazil in year *y* ($TDL_{grid,y}$) (by also following the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" /11/) is also considered as per the following calculation formulae:

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

Where:

$EC_{PJ,grid,y}$ Quantity of grid-sourced electricity consumed by the project activity in year *y* (in MWh/yr). $EC_{PJ,grid,y}$ will be monitored (based on measurements) during the remaining share of the 1st 7-year renewable crediting period.
$TDL_{grid,y}$Average technical transmission and distribution losses in the National Grid of Brazil in year *y.* $TDL_{grid,y}$ is correctly *ex-ante* determined as 20% in accordance with Scenario A (Option A1) of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" /11/.
$EF_{EL,grid,y}$ Emission factor for grid electricity generation in year *y* (in tCO_2/MWh).

$PE_{EC,captive,y}$ Project emissions from consumption of electricity generated by a captive off-grid electricity generator fuelled by fossil fuel (diesel) in year *y.* Emissions arising from diesel consumption by the installed

off-grid captive electricity generator will be monitored *ex-post* by applying approaches/options B2 or B4 as presented in the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" /11/. The final PDD /2/ correctly outlines that as per Option B2 of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" /11/, $PE_{EC,captive,y}$ is calculated as follows:

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

Where:
$EC_{PJ,captive,y}$ Quantity of electricity sourced by the captive electricity generator (fuelled by Diesel) and consumed by the project activity in year *y*. $EC_{PJ,captive,y}$ will be measured and monitored in MWh/year.
$EF_{EL,captive,y}$ CO_2 emission factor for electricity sourced by the captive off-grid electricity generator in year *y* (tCO_2/MWh). By following Option B2 of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" /11/, $EF_{EL,captive,y}$ is *ex-ante* determined as 1.3 tCO_2/MWh.
$TDL_{captive,y}$ Average technical transmission and distribution losses for electricity sourced by the captive electricity generator in year *y*. In accordance with the applicable provisions of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" /11/, as a simplification, $TDL_{captive,y}$ is *ex-ante* determined as zero as correctly presented in Section B.6.2 of the final PDD /2/.

As also earlier considered in the PDD/3/ applicable for the first crediting period /3/, Option B4 of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" /11/, indicates that $PE_{EC,captive,y}$ is calculated based on the rated capacity of the installed captive off-grid electricity generator and by assuming a CO_2 emission factor of 1.3 tCO_2/MWh for electricity generated by the captive off-grid electricity generator (which is assumed as being operation of 8,760 hours per year) as follows:

$$PE_{EC,captive,y} = 11{,}400\ tCO_2/MWh * PP_{CP,Diesel\text{-}generator}$$

Where:
$PP_{CP,Diesel\text{-}generator}$ Rated capacity of the installed captive off-grid electricity generator (fuelled by Diesel) (in MW)

Determination of project emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation, in year y ($PE_{FC,y}$):
Project emissions from consumption of fossil fuels due to the project activity, for purpose other than electricity generation ($PE_{FC,y}$) is reflected in the particular case of the project activity as project emissions due to the consumption of Liquefied Petroleum Gas (LPG) for igniting the flare right after its planned or unplanned interruptions of operation. Thus, the following equations are correctly included in the final PDD /2/:

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

Where:
$PE_{LPG,y}$ Project emissions due to the consumption of Liquefied Petroleum Gas by the project activity in year *y* (in tCO_2/year). $PE_{LPG,y}$ is correctly determined as per applicable guidance of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (version 2) /13/ as follows:

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

Where:
$FC_{LPG,y}$ Quantity of LPG consumed (in ton LPG)
$COEF_{LPG,y}$ 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" /13/ as follows:

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

Where:
$NCV_{LPG,y}$ Net calorific value of the fuel LPG (in GJ/ton LPG)
$EF_{CO2,LPG,y}$ CO_2 emission factor of fuel LPG (in tCO_2/GJ LPG)

Determination of Leakage emissions:

In accordance with the applied meth /5/, leakage emissions are not considered for the determination of emission reductions to be achieved by the project activity. As part of its assessment, the validation team

confirms that, as highlighted in the final PDD /2/, it was not identified project emission or leakage which would contribute to more than 1% of the emission reductions to be achieved by the project activity other than the ones covered by the applied meth /5/.

Ex-ante estimation of emission reductions:
The *ex-ante* estimation of emission reductions (as calculated in the emission reductions calculation spreadsheet /4/ and summarized in the final PDD /2/) was assessed by the validation team. The performed assessment included checking of input parameters and formulas contained in the spreadsheet cells for estimating baseline and project emissions along the 2nd 7-year renewable crediting period. The validation team was also able to confirm that all assumptions and data used for estimating GHG emission reductions to be achieved by the project activity are listed in the final PDD /2/. Furthermore, formulas, parameters and values are complete, accurate and transparent.

For the project activity baseline emissions generated from waste disposal at the SWDS ($BE_{CH4,y}$) and baseline emissions associated with electricity generation ($BE_{EC,y}$) are estimated to be on the average 481,466 tCO_2e and 25,589 tCO_2e per year, respectively, over the selected 7-year crediting period. The *ex-ante* estimated project emissions (PE_y) determined as 256 tCO_2e per year.

Emission reductions (ER_y) to be achieved by the project activity were *ex-ante* estimated as the difference of ex-ante estimation of baseline emissions and ex-ante estimation of project emissions. ER_y are estimated to be (on the average) 506,798 tCO_2e per year over the selected 7-year renewable crediting period. Detailed calculation of *ex-ante* estimation of both baseline and project emissions, as provided in the emission reduction calculation spreadsheet /4/ which is enclosed to the final PDD/2/, can be reproduced using data and parameter values provided in the final PDD /2/ and supporting files submitted to the validation team. The selection and determination of all used factors and parameters are deemed reasonable and acceptable. In summary, the GHG calculations are complete and transparent, and data accuracy has been verified.

It is however noteworthy that the forecasted emission reductions over the 2nd 7-year renewable crediting period are deemed within reasonable limits. Based on assessment of other similar registered CDM project activities (also involving LFG collection and destruction/utilization), the validation team highlights that methane generation and collection efficiency of LFG in landfills (as typically forecasted through the application of the FOD model in the context of the applied methodology) has an inherent high uncertainty level (of almost 50% in some cases) and hence the amount of emission reductions, which will be determined on the basis of *ex-post* monitoring, might significantly vary from the forecasted amount.

Summary of ex-ante determination of emission reductions:
As reported in the final PDD /2/, ex-ante annual estimates of emission reduction to be achieved by the project activity during the 2nd 7-year renewable crediting period are as follows:

Year	Emission reductions (tCO_2e)
2014 (from 1st December 2014 to 31st December 2014)	27,833
2015	393,696
2016	450,545
2017	487,032
2018	519,364
2019	548,136
2020	573,848
2021 (from 1st January 2021 to 30th November 2021	547,134
Total	**3,547,588**
Annual average	506,798

Appendix 7:

Parameter	Assessment of measuring/ recording frequency
Management of the SWDS	The design and operational conditions of the Recreio landfill will be annually monitored on the basis of different sources such as: - Original design of the landfill vis-a-vis eventual changes; - Technical specifications for the management of the Recreio landfill vis-a-vis eventual related eventual changes; - Applicable local or national regulations As required by the applied methodology /5/, the design and operational conditions of the Recreio landfill should be demonstrated not to be modified in order to ensure that no practice to increase methane generation have occurred prior or after the implementation of the project activity. As established by the applied meth /5/, any change in the management of the landfill after the implementation of the project activity will be justified by referring to technical or regulatory specifications.
Volumetric flow of LFG stream in time interval *t* on a wet basis ($V_{t,wb,j}$) for *j* (where *j* is the LFG delivery pipeline to each item of electricity generation and LFG delivery pipeline to the flare(s))	Continuous measurements will be recorded/ reported at least with an every-minute frequency. Calibration events in related monitoring instruments will be performed with frequency established as per manufacturer specifications/requirements. As appropriately outlined in the final PDD/2/, the parameter $V_{t,wb,j}$ 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" is selected and applied. The selection of the determination option of the methodological tool depends on installed instrument equipment and project conditions that are yet to be confirmed.
Volumetric flow of LFG stream in time interval *t* on a dry basis ($V_{t,db,j}$) for *j* (where *j* is the LFG delivery pipeline to each item of electricity generation and LFG delivery pipeline to the flare(s))	Continuous measurements will be recorded/ reported at least with an every-minute frequency. Calibration events in related monitoring instruments will be performed with frequency established as per manufacturer specifications/requirements. As appropriately outlined in the final PDD/2/, the parameter $V_{t,db,j}$ will be monitored in case Option A of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" are selected and applied. The selection of the determination option of the methodological tool depends on installed monitoring instruments/equipment and project conditions during the 2nd 7-year crediting period. As appropriately outlined in the final PDD/2/, currently installed monitoring instruments/equipment and project conditions may change along the 2nd 7-year crediting period
Mass flow of the LFG stream in time interval *t* on dry basis ($M_{t,db,j}$) for *j* (where *j* is the LFG delivery pipeline to each item of electricity generation and LFG delivery pipeline to the flare(s))	Continuous measurements will be recorded/ reported at least with an every-minute frequency. Calibration events in related monitoring instruments will be performed with frequency established as per manufacturer specifications/requirements. As appropriately outlined in the final PDD/2/, the parameter $M_{t,db,j}$ will be monitored if Option D of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" is selected and applied. The selection of the determination option of the methodological tool depends on installed monitoring instruments/equipment and project conditions during the 2nd 7-year crediting period. As appropriately outlined in the final PDD/2/, currently installed monitoring instruments/equipment and project conditions may change along the 2nd 7-year crediting period.
Volumetric fraction of CH_4 in the collected LFG in time interval *t* on a dry basis ($v_{CH4,t,db}$).	Continuous measurements will be recorded/reported with an every-minute frequency. Calibration frequency as per manufacturer specifications. 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 T_t and P_t may not be required. If the applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted, these parameters shall be monitored

	continuously in order to assure that the applicability condition is indeed met). As appropriately outlined in the final PDD/2/, the parameter $v_{CH4,t,db}$ will be monitored in case Option A, B or D of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" are selected. The selection of the determination option of the methodological tool depends on installed monitoring instruments/equipment and project conditions during the 2nd 7-year crediting period. As appropriately outlined in the final PDD/2/, currently installed monitoring instruments/equipment and project conditions may change along the 2nd 7-year crediting period.
Volumetric fraction of CH_4 in time interval *t* on a wet basis ($v_{CH4,t,wb}$).	Continuous measurements will be recorded/reported with an every-minute frequency. Calibration frequency as per manufacturer specifications. 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 T_t and P_t may not be required. If the applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted, these parameters shall be monitored continuously in order to assure that the applicability condition is indeed met). As appropriately outlined in the final PDD/2/, the parameter $v_{CH4,t,wb}$ will be monitored if Option C the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" is selected. Moreover, as also appropriately outlined in the final PDD/2/ this parameter may be monitored if Option A, B or D the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" is selected. The selection of the determination option of the methodological tool depends on installed monitoring instruments/equipment and project conditions during the 2nd 7-year crediting period. As appropriately outlined in the final PDD/2/, currently installed monitoring instruments/equipment and project conditions may change along the 2nd 7-year crediting period
Temperature of the LFG stream in time interval *t* (T_t) Pressure of the LFG stream in time interval *t* (P_t) Saturation pressure of H_2O at temperature T_t in time interval *t* ($p_{H2O,t,Sat}$)	Continuous measurements will be recorded/reported with an every-minute frequency. Calibration frequency as per manufacturer specifications. 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 T_t and P_t may not be required. If the applicability condition related to the gaseous stream flow temperature being below 60ºC is adopted, these parameters shall be monitored continuously in order to assure that the applicability condition is indeed met).
Quantity of grid electricity consumed by the project activity in year *y* ($EC_{PJ,grid,y}$)	Continuous measurements will be aggregated manually or automatically. Accumulated measurement records will be recorded and reported at least with an every-month frequency. Measurement records will be cross-checked against available electricity consumption receipts/invoices issued by the local electricity distribution company.
Net amount of electricity generated using LFG by the project activity in year *y* ($EC_{BL,y)}$	Continuous measurements will be aggregated manually or automatically. Accumulated measurement records will be reported with at least every-month frequency. Measurement records will be cross-checked against available electricity selling receipts/invoices.
Operation margin CO_2 emission factor in year *y* = Dispatch data analysis operating margin CO_2 emission factor in year y ($EF_{grid,OM,y} = EF_{grid,OM-DD,y}$)	To be calculated by following applicable guidance of the "Tool to calculate the emission factor for an electricity system" /14/.

Operation of the equipment that consumes the LFG (engine-generator sets of the electricity generation facility) ($Op_{j,h}$)	For each equipment unit *j* promoting utilization of LFG (each engine-generator set of the project's new electricity generation component), it will be monitored if each equipment (element) of the electricity generation facility is operating in hour *h. S*uch monitoring will be on the basis of continuous monitoring of the amount of electricity generated by each element.
Mass flow of methane in the exhaust gas of the flare on a dry basis at reference conditions in the time period *t* ($F_{CH4,EG,t}$)	Measured in accordance 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 required in the case of enclosed flares and if the project participant select Option B.1 to determine flare efficiency.
Temperature in the exhaust gas of the enclosed flare in minute *m* ($T_{EG,m}$)	Measured by appropriate temperature measurement equipment with an every-minute frequency. Measurements outside the operational temperature specified by the manufacturer may indicate that the flare is not functioning correctly and may require maintenance. Flare manufacturers must provide suitable monitoring ports for the monitoring of the temperature of the flare. These would normally be expected to be in the middle third of the flare. Where more than one temperature port is fitted to the 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 specifications for temperature.
Flame detection of flare in the minute *m* ($Flame_m$)	Detection of flame in the flare recorded with an every-minute frequency as a minute that the flame was on, otherwise recorded as a minute that the flame was off.
Maintenance events completed in year *y* as monitored by the project participants ($Maintenance_y$)	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.
Total investment to implement the project and total cost to operate the project (CAPEX and OPEX)	Total investment value will be calculated by project participants based on documentation from equipment suppliers, construction contractors and maintenance contracts. Operational costs will be calculated based on internal records. As established by the applied methodology /5/, reported values will be audited by professional, independent financial auditors. The information provided for CAPEX will indicate the investment made: (i) in the collection and flaring system; (ii) in the new electricity generation facility and its connection to the National Electricity Grid of Brazil. The information supplied for OPEX shall indicate the costs for: (i) staff and maintenance involved in the operation of the collection and flaring system; and (ii) staff and maintenance involved in the operation of new electricity generation facility.
Tariff of the electricity exported	Value in accordance with valid power purchase agreement (PPA). Values in Brazilian Real will be converted and also reported in Euros.
Quantity of LPG consumed by the project activity in year *y* ($FC_{LPG,y}$)	Continuous measurements of quantity of LPG by the project activity will be monitored with frequency not lower than once a month. LPG purchasing receipts may be used for crosschecking of valid measurement records.
Net calorific value of the fuel LPG in year y ($NCV_{LPG,y}$)	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. Any future revision of the IPCC Guidelines will be taken into account. 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.
CO_2 emission factor of fuel LPG in year *y* ($EF_{CO2,LPG,y}$)	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). Appropriate net calorific value (NCV) for LPG may be used for converting energy basis data into mass basis data. 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.
Quantity of electricity generated in captive diesel backup generator during the year *y* ($EC_{PJ,captive,y}$)	Periodic calibration events will be performed in a frequency as per instrument specifications and/or instrument manufacturer's recommendations. Instrument will be subject to a regular maintenance and testing regime in accordance to appropriate national / international standards/requirements and/or best practice. Measurement records will be crosschecked against available diesel consumption receipts/invoices issued by the diesel supplying company.
Quantity of fuel Diesel combusted by the captive off-grid electricity generator ($FC_{Diesel,y}$)	Measurements by Flow meters or volume meters. As an alternative measurements will be based on records of an integrated electronic system of the generator, which shows the percentage of stored fuel Monitoring will be made weekly, recording the operating hours and the percentage of fuel load of equipment, considering the specific fuel consumption specified by the equipment manufacturer.
Quantity of electricity generated in captive diesel backup generator during the year *y* ($EG_{Diesel-Generator,y}$)	Measurements will be aggregated manually or automatically. Accumulated measurement records will be reported at with at least every-month frequency.

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Document information

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