VERIFICATION / CERTIFICATION REPORT

"EXPLOITATION OF THE BIOGAS FROM CONTROLLED LANDFILL IN SOLID WASTE MANAGEMENT CENTRAL – CTRS / BR.040"

IN

BRAZIL

(UNFCCC Registration Ref. No. 3464)

Monitoring Period:
4 June 2011 to 30 September 2011

REPORT NO. 2011-1592

REVISION NO. 01

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VERIFICATION / CERTIFICATION REPORT

Date of first issue: 5 November 2012	Project No.: PRJC-344687-2011-CCS-BRA
Approved by: Edwin Aalders	Organisational unit: DNV KEMA Energy & Sustainability Accredited Climate Change Services
Client: Consórcio Horizonte Asja	Client ref.: Enrico Roveda

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Summary:

DNV Climate Change Services AS (DNV) has performed the verification of the emission reductions reported for the project activity "Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040" in Brazil" (UNFCCC Registration Ref. No. 3464) for the period 4 June 2011 to 30 September 2011.

In our opinion, the GHG emission reductions reported for the project in the monitoring report (version 2) of 29 October 2012 are fairly stated.

The GHG emission reductions were calculated correctly on the basis of the approved monitoring methodology ACM0001 (version 11) and the monitoring plan contained in the Revised Project Design Document of 3 October 2012.

DNV Climate Change Services AS is able to certify that the emission reductions from the project activity "Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040" in Brazil during the period 4 June 2011 to 30 September 2011 amount to 81 709 tonnes of CO_2 equivalent.

Report No.: 2011-1592	S F	
Report title: "Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040" in Brazil		
Work carried out by: Juliana Scalon, Luis Filipe Tavares		
Work verified by: Felipe Lacerda Antunes		
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Indexing terms

Key words Climate Change Kyoto Protocol Validation Clean Development Mechanism	Service Area Verification Market Sector Process Industry

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Table of Content *Page*

Abbreviations

CAR	Corrective Action Request
CCEE	Electric Energy Commercialization Chamber
CDM	Clean Development Mechanism
CEF	Carbon Emission Factor
CEMIG	Electric Company of Minas Gerais State
CER	Certified Emission Reduction(s)
CH_4	Methane
CL	Clarification request
CO_2	Carbon dioxide
CO_{2e}	Carbon dioxide equivalent
DNA	Designated National Authority
DNV	Det Norske Veritas
FAR	Forward Action Request
FOD	First Order Decay
GHG	Greenhouse gas(es)
GWP	Global Warming Potential
INMETRO	National Institute on Metrology, Normalization and Industrial Quality
IPCC	Intergovernmental Panel on Climate Change
LFG	Landfill Gas
MP	Monitoring Plan
PDD	Project Design Document
PLC	Programmable Logic Controller
PS	Clean Development Mechanism Project Standard
UNFCCC	United Nations Framework Convention on Climate Change
VVS	Clean Development Mechanism Validation and Verification Standard

1 INTRODUCTION

Consórcio Horizonte Asja has commissioned DNV Climate Change Services AS (DNV) to carry out the verification and certification of emission reductions reported for the CDM project activity 3464 "Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040" in Brazil (the project) for the period 4 June 2011 to 30 September 2011. This report contains the findings from the verification and a certification statement for the certified emission reductions.

1.1 Objective

Verification is the periodic independent review and *ex post* determination by a Designated Operational Entity (DOE) of the monitored reductions in GHG emissions that have occurred as a result of the registered CDM project activity during a defined monitoring period.

Certification is the written assurance by a DOE that, during a specific period in time, a project activity achieved the emission reductions as verified.

The objective of this verification was to verify and certify emission reductions reported for the "Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040" for the period 4 June 2011 to 30 September 2011.

1.2 Scope

The scope of the verification is to verify that:

- The project activity has been implemented and operated in accordance with the registered PDD or any approved revised PDD;
- The monitoring plan complies with the monitoring methodology and the actual monitoring complies with the monitoring plan, including compliance with any guidance provided by the Board regarding deviations from the provisions of a registered plan and/or methodology;
- The data and calculation of GHG emission reductions have been assessed to correctly support the emission reductions being claimed.

The verification shall ensure that reported emission reductions are complete and accurate in order to be certified.

1.3 Description of the project activity

Project Parties:	Brazil (host). No Annex I identified.
Title of project activity:	Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040
UNFCCC registration No:	3464
Baseline and monitoring methodology	ACM0001 (version 11)
Sectoral scope(s):	13 - waste handling and disposal

Project Participants:	Consórcio Horizonte Asja and Asja Brasil Serviços para o meio Ambiente Ltda.from Brazil.
Location of the project activity:	Brazil, City of Belo Horizonte, State of Minas Gerais at Km 531 of Highway BR.040.
Project's crediting period:	4 June 2011 – 3 June 2021
Period verified in this verification:	4 June 2011 to 30 September 2011

The "Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040" was implemented with the objective to capture, flare and generate electricity with the landfill gas generated at the landfill of CTRS BR.040, at Belo Horizonte Municipality, in order to avoid emissions of methane to the atmosphere produced by the anaerobic decomposition of the dumped waste from the metropolitan area of Belo Horizonte and to avoid emissions of CO_2 by the electricity supplied to the local grid.

The project involves the construction of a LFG collection system consisting of vertical LFG extraction wells, centrifugal blower(s), and all other supporting mechanical and electrical subsystems and appurtenances necessary to collect the LFG. The facilities were supplied by Biotecnogas /37/ (enclosed flaring), Siemens and Rosemount /39/-/48/ (monitoring) and Jenbacher (electricity generators) /50/. The project started operations on 29 October 2009. The electricity generation started on 29 November 2010 and has a current installed capacity of 5.704 MW. Implementation of the project is according to the description in the revised PDD version 3 of 3 October 2012 /34/.

1.4 Methodology for determining emission reductions

The emission reductions are calculated using the methane actually destructed in an enclosed flare and in the electricity generators. The methane is determined by the direct and continuous measurement of the actual quantity LFG that was captured and sent to flare and electricity generation, the content of methane present in the LFG and the enclosed flare burning efficiency. The project emissions are determined by the amount of electricity consumed by the project activity in the LFG capturing and management system. Also, the emission reduction from the displacement of fossil fuel at the Brazilian Interconnected Grid is calculated with the direct measurement of the electricity generated with LFG sent to the grid.
DNV reviewed the project documentation; specifically the monitoring reports for the period 4 June 2011 to 30 September 2011 /1/ and the revised PDD dated 3 October 2012 /34/.

2 METHODOLOGY

DNV has assessed and determined that the implementation and operation of the project activity, and the steps taken to report emission reductions comply with the CDM criteria and relevant guidance provided by the Board.

The assessment involved a desk review of relevant documentation as well as an on-site visit(s). The verification of the emission reductions has assessed all factors and issues that constitute the basis for emission reductions from the project. These include:

i) The reading values /3/ of normalized total LFG flow, flare LFG flow and electricity generators flow (Nm^3/h) every hour (average of continuous monitoring) from the flow meters /5/ installed at Exploitation of the biogas from controlled landfill in solid waste

management central – CTRS / BR.040 and recorded in the PLC and supervisory system, for the period from 4 June 2011 to 30 September 2011. Flow meters provide normalized flows (0°C and 1 atm) using temperature probes /8/ /11/ /14/ and pressure sensors connected to the flow meter /6/ /7/ /9/ /10/ /12/ /13/;

ii) Calibration certificates of the LFG flow meters #78147, #78149 and #78151 /5/ issued on 12 September 2009. The meters are model Rosemount Annubar 285 /41/ and were calibrated by the manufacturer.

iii) Calibration certificates of the differential pressure transmitters model ABB type 264 DS serial number #6409016459 /6/, serial number #6409016458 /9/ and serial number #6409016454 /12/. The equipment were calibrated by Lamon Instrumentação Industrial Ltda /54/;

iv) Calibration certificates of the relative pressure probes ABB type 264 HS serial number #6409016561 for the flow meter $LFG_{total,y}$ /7/ and serial number #6409016558 for the flow meter $LFG_{flare,y}$ /10/. Both probes were calibrated by Lamon Instrumentação Industrial Ltda /54/;

v) Calibration certificate of the relative pressure probes SMAR type LD301M serial number #U305352 for the flow meter $LFG_{electricity,y}$ /13/. Calibration performed by the manufacturer SMAR;

vi) Calibration certificates of the temperature probes Ecil type Pt/100 serial number #10.28138181 /8/ for the $LFG_{total,y}$ flow meter, serial number #1037.157644 /11/ for the $LFG_{flare,y}$ flow meter, and serial number #1037.157655 for the $LFG_{electricity,y}$ flow meter /14/. The temperature probes were calibrated by the manufacturer Ecil;

vii) The reading values /3/ of methane fraction in the LFG (m^3CH_4/m^3LFG) every hour (average of continuous monitoring) from the gas analyser /15/ installed at Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040 and recorded in the PLC and supervisory system, for the period from 4 June 2011 to 30 September 2011;

viii) On-site monthly calibrations (zero check and span check) /15/ of the gas analyser Siemens Ultramat 23 serial number ULT 01 – N1 X 6-991 performed by the plant operator according to manufacturer specifications /40/;

ix) Quality certificates #2318/10 of the cylinder EGE8142 (CH_4 @60% and CO_2 @40%) issued on 6 September 2010 and #1125/11 of cylinder EGE8143 (N_2 @100%) issued on September 2010 /16/. The cylinders were provided and certified by Linde Gases Ltda /56/;

x) The reading values of CH_4 content (ppm) recorded every two minutes (average of continuous sampling) /3/ in the flare exhaust gas by the analyser Siemens Ultramat 23 serial number ULT 02 – N1X6-992 /39/ installed at Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040 and monitored by the PLC, from 4 June 2011 to 30 September 2011;

xi) The reading values of O_2 content (%) recorded every two minutes (average of continuous sampling) /3/ in the flare exhaust gas by the analyser Siemens Ultramat 23 serial number ULT 02 – N1X6-992 /39/ installed at Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040 and monitored by PLC, from 4 June 2011 to 30 September 2011;

xii) On-site monthly calibrations (zero check and span check) /18/ of the gas analyser Siemens Ultramat 23 serial number ULT 02 – N1X6-992 performed by the plant operator according to manufacturer specifications /40/;

xiii) Quality certificates #2391/10 of the cylinder EGE8114 (CH_4 @ 2 500 vpm) issued on 9 September 2010 and #1125/11 of cylinder EGE8143 (N_2 @100%) issued on September 2010 /19/. The cylinders were provided and certified by Linde Gases Ltda /56/;

xiv) The reading values of flare temperature (ºC) every two minutes (average of continuous monitoring) /3/ of the thermocouple Ecil serial number 0950.064353, calibrated on 24 May 2011 by Ecil, installed at Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040 and monitored by the PLC, from 4 June 2011 to 30 September 2011;

xv) Monthly invoices issued by CEMIG of electricity consumed by the project Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040 /26/;

xvi) Monthly report extracted from the online system of Electric Energy Commercialization Chamber - CCEE of the electricity generated with LFG exported to the grid by the project Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040 /29/;

xvii) Calibration certificates 852/2010 of electricity meter Scheneider ION 8600C serial number PT-0912A354-01 /27/ and certificate 734/2010 of meter ION8600 serial number PT-0912A361-01 /27/ of Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040 issued by CAM Endesa /55/;

xviii) Hourly spreadsheet calculation /2/ of hourly average of:

- LFG captured flow (Nm^3/h) and volume (Nm^3/d) and LFG flared flow (Nm^3/h);
- CH_4 content (%) on LFG flow;
- CH_4 content (ppm) in the flare exhaust gas;
- O_2 content (%) in the flare exhaust gas;
- flare destruction efficiency (%);
- effective net flare operational period (min) considering the temperature of flare operation above 500ºC;
- emission reduction calculations every hour;

xix) The applicability of constants used in the calculations, the CO_2 emission intensity of the electricity imported from the Brazilian Interconnected System /53/, and the average transmissions and distribution losses of 20% was applied in accordance with the monitoring plan.

Verification team

Role	***Last Name***	***First Name***	***Country***	***Type of involvement***					
				Desk review	Site visit	Reporting	Supervision of work	Technical review	TA 13.1 competence
Team leader after 12 November 2012 (Verifier)	Scalon	Juliana	Brazil	✓	✓	✓	✓		✓
Team leader until 12 November 2012 (Verifier)	Tavares	Luis Filipe	Brazil	✓	✓	✓			✓
Technical reviewer	Antunes	Felipe	Brazil					✓	✓

Duration of verification

Monitoring report publication:	24 October 2011
Desk review:	25 October 2011 to 25 November 2011
On-site assessment:	28 November 2011
Reporting, calculation checks and QA/QC:	22 December 2011 to 4 December 2012

2.1 Desk review

In addition to the monitoring report /1/ (version 1 dated 7 October 2011 and version 2 dated 29 October 2012), DNV reviewed:

- The registered PDD for the project activity (version 2a of 25 November 2009) /32/ and revised PDD (version 3 dated 3 October 2012) /34/;
- Baseline and monitoring methodology ACM0001, version 11 /63/;
- The validation report, SGS Report CDM VAL 2246 Rev 3.4, 14 March 2011 /33/.

Besides the above mentioned documents, DNV also assessed other additional documents that were required to assess the accuracy of the emission reduction calculations presented in the monitoring report /4/-/29/.

A list of key documents is given in the reference section of this report.

2.2 On-site assessment

On 28 November 2011 DNV performed on-site assessments. During the on-site assessment DNV carried out:

- An assessment of the implementation and operation of the registered project activity is as per the registered PDD available at the time for the project activity (version 2a of 25 November 2009) /32/;
- A review of information flows for generating, aggregating and reporting the monitoring parameters from the supervisory system /3/ and plant logbooks /17/ /18/ /26/ and the emission reduction calculation spreadsheets /4/;
- Interviews with relevant personnel to determine whether the operational and data collection procedures are implemented in accordance with the monitoring plan in the PDD /68/-/72/;
- A cross check between information provided in the monitoring report /1/, supervisory records /4/, third party services /5/-/14/ and /16/-/21/, logbooks and purchase/invoice records /18/ /26/ /29/;
- A check of the monitoring equipment including calibration performance /5/-/14/ and observations of monitoring practices against the requirements of monitoring plan /32/.

The verification of the emission reductions has assessed all factors and issues that constitute the basis for emission reductions from the project. Based on the recommendations of Executive Board's "Validation and Verification Standard" 02.0 /60/, the DNV team has for this assignment decided to check all factors and issues with the same emphasis.
The information provided in the monitoring report was assessed by:

- Verifying that the project was implemented as described in the revised PDD /34/;
- Verifying the compliance of actual monitoring at project site with the monitoring plan included in the revised PDD /34/ as well as the monitoring methodology ACM0001(version 11) /63/.
- Verifying the performance of the programmable logic controller (PLC) records /3/, assess the spreadsheets calculation /2/, calibration certificates /7/-/14/. These relevant documents are required for emission reduction calculations to assure that the data provided in the monitoring report is reliable and that operation and maintenance of the monitoring equipment is correct.
- Assessing of raw data and calculations from the PLC and supervisory system against the records provided by the project participant by sampling. The supervisory system records data continuously and aggregates hourly in order to perform the calculations of emission reduction for each hour, as per the monitoring plan. Since DNV could not check the calculations in the files extracted from the system /4/ during site visit because the formulas do not appear, the project participant has provided the main table /30/ with formulas and algorithms used to build-up the supervisory system (provided by the supplier Biotecnogas /37/). DNV has assessed each formula against the monitoring plan and methodology ACM0001 version 11 and the calculations by sampling, transferring the raw data extracted from the supervisory system to the main table and cross-checking the results. The record of each parameter is done by the system every two minutes but data is aggregated automatically hourly. Considering the hourly records of each parameter in the monitoring period from 4 June 2011 to 30 September 2011 (119 days), the total sample size is 2 856 line records. Sampling procedure was based on the American Military Standard and tables for Inspection by Attributes (MIL-STD-105E) /52/ Level II, single sample for normal inspection. Since data size is higher than 1 200, the sample size should be 100. The sampling was done during site visit, where 5 days of each month of the monitoring period were chosen

randomly by DNV, drawing a sample size of 480 records checked /4/, surpassing the 100 sample size determined by the standard. No error was identified when cross-checking the results /4/ and /30/;

- Interviewing of Melina Uchida /68/ Miguel Cinquantini /69/ Alexandre Augusto Lima /70/, Juderlei Souza de Aguiar /71/ and Karine Nogueira /72/, involved in the project to assure that they are aware of the monitoring procedures.

2.3 Closing out of verification findings

The objective of this phase of the verification was to resolve any issues which needed be clarified prior to DNV's conclusion that i) the project activity has been implemented and operated in accordance with the registered PDD or any approved revised PDD, ii) the monitoring plan complies with the monitoring methodology and the actual monitoring complies with the monitoring plan and iii) the data and calculation of GHG emission reductions are correct.

A corrective action request (CAR) is issued, where:

i. Non-conformities with the monitoring plan or methodology are found in monitoring and reporting and has not been sufficiently documented by the project participants, or if the evidence provided to prove conformity is insufficient;
ii. Modifications to the implementation, operation and monitoring of the registered project activity has not been sufficiently documented by the project participants;
iii. Mistakes have been made in applying assumptions, data or calculations of emission reductions which will impair the estimate of emission reductions;
iv. Issues identified in a FAR during validation to be verified during verification have not been resolved by the project participants.

A clarification request (CL) shall be raised if information is insufficient or not clear enough to determine whether the applicable CDM requirements have been met.

A forward action request (FAR) is issued for actions if the monitoring and reporting require attention and/or adjustment for the next monitoring period.

The verification identified four CARs, six CLs and no FARs. The CARs and CLs were satisfactorily addressed by the project participants by among other revising the monitoring (please refer to Appendix A for further details). In addition to the changes made to the monitoring report as a result of the verification findings, the following changes to the monitoring report (version 2 dated 29 October 2012) were made compared to the initial version of the monitoring report received for verification (version 1 dated 7 October 2011):

- Addressing the post registration changes and the version 3 of 3 October 2012 and
- Update the monitoring report template to the VVS track.

3 VERIFICATION FINDINGS

This section summarises the findings from the verification of the emission reductions reported for the "Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040" for the period 4 June 2011 to 30 September 2011.

3.1 Remaining issues, CARs, FARs from previous validation / verification

This is the first verification of the project. There was no FAR identified during the project validation /33/.

3.2 Post registration changes

The post registration changes described in Appendix B were identified by DNV during this verification. These post registration changes were assessed by DNV.

For post registration changes not requiring prior approval by the CDM EB in accordance with Appendix 1 to the CDM Project Standard /61/, the assessment of the changes (in the form of a DNV's assessment opinion on the changes /36/) is submitted together with the revised PDD (version 3 of 3 October 2012 /34/) for acceptance by the CDM EB as part of the request for issuance for this monitoring period.

For post registration changes requiring prior approval by the CDM EB in accordance with Appendix 1 to the CDM Project Standard /61/, the changes obtained approval by the CDM EB prior to the request for issuance for this monitoring period. This is not the case for this type of post registration change that does not affect adversely the project's internal rate of return.

The assessment of compliance with the project description and the monitoring plan contained in the PDD, as described in the following sections, is based on the revised PDD (version 3 of 3 October 2012).

3.3 Project implementation

As part of the site visit DNV was able to confirm that the project implementation is in accordance with the project description contained in the PDD (version 3 of 3 October 2012 /34/).

The LFG flow is measured through a flow meter and adjusted automatically to m^3 at 0ºC and 1.013 bar in accordance with the methodology ACM0001 (version 11) for each pipeline section: $LFG_{total,y}$, $LFG_{flare,y}$ and $LFG_{electricity,y}$. Flow meters provide normalized flows using temperature probes /8/ /11/ /14/ and pressure sensors connected to the flow meter /6/ /7/ /9/ /10/ /12/ /13/.

The CH_4 content of LFG is continuously sampled in the same section i.e. pipe section before split to the flare and electricity generators, and measured automatically every 2 minutes. A set of thermocouples are installed at 2 places on the flare. Such thermocouples are used to manage the inlet dampers in order to control optimum flare conditions according to the LFG flow entering in the flare, and therefore to ensure that the temperature inside the flare remains above at least 500ºC /38/. The calibration certificates presented in the monitoring report are from the thermocouple in the highest position (80% of the flare height), since the thermocouple installed closest to the flame (the lower point) is only to monitor the flame

temperature (always above 850°C with presence of flame) and therefore the management of inlet dampers. The thermocouple at 80% of the flare height is therefore the one used for monitoring the parameter flare temperature.

The CH_4 content of the flare exhaust gas is continuously sampled by a gas analyser and the flare efficiency is calculated by the supervisory system according to the "*Tool to determine project emissions from flaring gases containing methane*" version 1 /64/.

All monitoring is carried out through the supervisory system provided by Biotecnogas /37/ which collects and control parameters and automatically sends the measurement results to data logger. All information is submitted to a local back-up every six months and stored in separated archives /59/.

During this site visit, DNV was able to confirm the landfill area, where the trenches and vertical wells were installed in order to collect the LFG generated. The landfill is closed with appropriate cover over the waste mass with compacted soil. Most part of the landfill surface area has already vegetation.
The project's capture and flaring station has the operation license and the electricity generation authorization are up to date /31/.

3.4 Information (data and variables) provided in the monitoring report that is different from that stated in the registered PDD

The emission reductions are based on the figures provided in the monitoring report /1/ and they were compared to the data and variables stated in the revised PDD /34/ with regards to:

- Total methane captured by the project ($MD_{project,y}$): The amount estimated in the revised PDD is based on the potential of LFG generation in the quality and quantity of landfilled waste and the capture efficiency of the LFG in the waste mass. The quantity of methane captured by the project activity for equivalent 119 days in the year 2011 is in the revised PDD /34/ stated to be 3 296 tCH_4 (note that figures for year 2011 in the PDD are considering the crediting period start date, therefore, 211 days from 4 June 2011 to 31 December 2011). The amount of methane captured during monitoring period of 4 June 2011 to 30 September 2011 was 3 952 tCH_4, 19.9% higher than estimated /35/;
- Methane content in the LFG. In order to estimate the CERs in the revised PDD, the methane content in the LFG was presumed to be 50%. However, during the monitoring period of 4 June 2011 to 30 September 2011, the average methane content was about 53.09%, 4.2% higher;
- Temperature of the flare: No difference in the flare temperature was detected. The flare is subject to regular maintenance in order to maintain favourable burning conditions. The methane destruction efficiency is directly related to the flare temperature. In order to estimate the CERs in the revised PDD /34/, the flare efficiency was considered 99%. During the monitoring period of 4 June 2011 to 30 September 2011, the average flare efficiency remained above 99%.
- Number of engines working hours: In the CERs estimations of the revised PDD, the engines working hours was defined as 8 100 hours per year. Considering 119 days of the monitoring period of 4 June 2011 to 30 September 2011, the engine working hours is 2 640 hours. The average actual worked hours of each engine from 4 June 2011 to 30 September 2011 was 2 608 hours (considering the four engines), i.e., 1.2% lower.

Therefore, no difference was observed between the estimated and the actual engine worked hours.

- Quantity of electricity generated: The amount of electricity generated with LFG estimated in the revised PDD is 13 118 MWh equivalent for 119 days. The actual amount of electricity generated during the monitoring period of 4 June 2011 to 30 September 2011 was 10 398 MWh, 20.7% less than estimated. This is mostly due to the assumed 38.9% electrical efficiency of the engine used in the revised CER estimation spreadsheet /35/. According to the engine's technical data sheet /51/, 38.9% is the engine efficiency considering 75% of capacity load and 60% of methane content in the LFG. Considering that the methane content had an average of 53.09% during the monitored period of 4 June 2011 to 30 September 2011, it is possible to assume that the actual engine's electrical efficiencies are below the efficiency established in the manufacturer specifications and therefore, producing less energy than expected.

The resulted emission reduction verified for the period 4 June 2011 to 30 September 2011 is 81 709 tCO_2e, 19.6% higher than the emission reduction estimated in the revised PDD /34/ (68 336 tCO_2e). The higher emission reduction verified is due to the higher methane captured by the project and the methane content higher than the average estimated in the revised PDD. The possible reasons for that performance above the estimations can be due to a LFG collection efficiency above 85%, as admitted in the revised PDD /34/ and a waste composition different from what was informed by the municipality to the project participant. This information is not under project participant control, and it is not possible to monitor anymore since the landfill is closed. Moreover, the tool used for the methane estimations is based on the First Order Decay (FOD) Model also used by the IPCC in the National Greenhouse Gas Inventories, Volume 5, Chapter 3 /67/. According to IPCC, the FOD model presents uncertainties on the amount of methane estimated and the distribution of this amount over the years (Chapter 3.7). Since the project Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040 has only few years of operation, so far it is not possible to attribute the differences observed due to amounts or to distribution of the methane estimated over the years. Moreover, since DNV could not identify during site visit any anomalies in the management system and in the equipment used for methane captured under the project, the differences are reasonable and most probably due to uncertainties of the FOD model.

3.5 Compliance of monitoring plan with monitoring methodology

DNV is able to confirm that the monitoring plan contained in the revised PDD (version 3 of 3 October 2012) /34/ is in accordance with the approved methodology applied by the project activity, i.e. ACM0001 (version 11) /63/.

3.6 Compliance of monitoring with the monitoring plan

The monitoring has been carried out in accordance with the monitoring plan contained in the revised PDD of 3 October 2012.

DNV is able to confirm that the monitoring plan and the applied methodology ACM0001 version 11 have been properly implemented and followed by the project participants.

For all parameters stated in the monitoring plan of the revised PDD of 3 October 2012, the applied methodology and relevant CDM Executive Board decisions have been adequately applied, including:

- The reading values /3/ of normalized total LFG flow, flare LFG flow and electricity generators flow (Nm^3/h) every hour (average of continuous monitoring) from the flow meters /5/ installed at Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040 and recorded in the PLC and supervisory system, for the period from 4 June 2011 to 30 September 2011;
- The reading values /3/ of methane fraction in the LFG (m^3CH_4/m^3LFG) every hour (average of continuous monitoring) from the gas analyser /15/ installed at Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040 and recorded in the PLC and supervisory system, for the period from 4 June 2011 to 30 September 2011;
- The reading values of CH_4 content (ppm) recorded every two minutes (average of continuous sampling) /3/ in the flare exhaust gas by the analyser Siemens Ultramat 23 serial number ULT 02 – N1X6-992 /39/ installed at Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040 and monitored by the PLC, from 4 June 2011 to 30 September 2011;
- The reading values of O_2 content (%) recorded every two minutes (average of continuous sampling) /3/ in the flare exhaust gas by the analyser Siemens Ultramat 23 serial number ULT 02 – N1X6-992 /39/ installed at Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040 and monitored by the PLC, from 4 June 2011 to 30 September 2011
- The reading values of flare temperature (ºC) every two minutes (average of continuous monitoring) /3/ of the thermocouple Ecil serial number 0950.064353, calibrated on 24 May 2011 by Ecil, installed at Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040 and monitored by the PLC, from 4 June 2011 to 30 September 2011;
- Monthly invoices issued by CEMIG of electricity consumed by the project Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040 /26/;
- Monthly report extracted from the online system of Electric Energy Commercialization Chamber - CCEE of the electricity generated with LFG exported to the grid by the project Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040 /29/;

The applicability of constants used in the calculations, the CO_2 emission intensity of the electricity imported from the Brazilian Interconnected System /53/, and the average transmissions and distribution losses of 20% was applied in accordance with the monitoring plan.

The below tables describe for each parameter, which is to be measured according to the monitoring plan, how DNV has verified that i) the actual monitoring complies with the monitoring plan and that ii) data have been assessed to correctly support the emission reductions being claimed.

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	$LFG_{total,y}$ – Total amount of landfill gas captured at normal temperature and pressure
Measuring frequency:	Continuously
Reporting frequency:	Aggregated hourly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes.
Type of monitoring equipment:	The flow meter normalizes the flow using pressure sensors and temperature probe connected to the equipment. • Flow meter Rosemount Annubar, model 285 /41/. Serial number 78147 installed on plant commissioning /22/. • Differential pressure transmitter ABB type 264 DS serial number 6409016459 installed on plant commissioning /22/. • Relative pressure probe ABB type 264 HS serial number 6409016561 installed on plant commissioning /22/. • Temperature probe Ecil type Pt-100 serial number 1028.138141 installed on 4 June 2011 /25/.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	The PDD does not state accuracy for the flow meter neither for the pressure sensor and temperature probes. The accuracy of each equipment is: • Flow meter: +/- 0.25% /41/; • Differential and relative pressure sensors: +/- 0.075% /42/ /43/; • Temperature probe: 0.15°C + 0.002* t where t is the measured temperature /48/. The meters types are designed for LFG and therefore reflects good practise in the monitoring of LFG flow measurements.
Calibration frequency /interval:	The flow meter manufacturer recommends calibration each 10 years /41/. For the temperature and pressure meters, the calibration is yearly, as recommended by the manufacturers /44/ /45/.
Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The PDD addresses periodical calibration as recommended by the manufacturer. The calibration frequencies are recommended by the manufacturers. Considering the stable operation of LFG flow meter with respect concentration, temperature and flow, the equipment is not

	submitted to operation' stress and the calibration (every 12 months) for the pressure sensors and thermocouple are considered adequate with this use of equipment.
Company performing the calibration:	Rosemount (manufacturer), Lamon /54/ and Ecil (manufacturer).
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes.
Is(are) calibration(s) valid for the whole reporting period?	Yes. • Flow meter #78147 – calibration on 12 September 2009 /5/; • Differential pressure transmitter ABB #6409016459. Calibrations /6/: - C-0177/10 on 14 July 2010 by Lamon; - P00266 on 13 July 2011 by Lamon. • Relative pressure probe ABB #6409016561. Calibration #00141 on 23 March 2011 by Lamon /7/; • Temperature probe Ecil #1028.138141. Calibration #2212/11 on 31 March 2011 by Ecil /8/.
If applicable, has the reported data been cross-checked with other available data?	The $LFG_{total,y}$ was compared with the sum of $LFG_{flare,y}$ and $LFG_{electricity,y}$ for the monitoring period. The $LFG_{total,y}$ is 6.22% higher than the sum of the pipelines flows. DNV has observed that the CERs claimed were calculated with the flow of each pipeline section instead of the total, because the $LFG_{total,y}$ resulted in higher flows than the sum of the LFG in the pipeline sections ($LFG_{flare,y}$ and $LFG_{electricity,y}$) for the entire monitoring period. Therefore, the difference observed did not impact the resulted CERs.DNV has checked the flow meters of flare and electricity pipeline sections. Both flow meters are calibrated and are commissioned for correct flows and therefore not submitted to stress. Also, a cross-check was performed between information provided in the monitoring report /1/ and supervisory records /4/.
How were the values in the monitoring report verified?	The raw data and calculations from the PLC and supervisory system against the records provided by the project participant were verified by sampling /4/.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC	The PLC and supervisory system have complete traceable procedures, and recorded data cannot be manipulated. The calculations of CERs are

processes in place?	performed hourly by the supervisory system and results are aggregated daily and monthly for the purpose of performance analysis of the project.
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Not applicable

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	$LFG_{flare,y}$ – Amount of landfill gas flared
Measuring frequency:	Continuously
Reporting frequency:	Aggregated hourly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes.
Type of monitoring equipment:	The flow meter normalizes the flow using pressure sensors and temperature probe connected to the equipment. • Flow meter Rosemount Annubar, model 285 /41/. Serial number 78149 installed on plant commissioning /22/. • Differential pressure transmitter ABB type 264 DS serial number 6409016458 installed on plant commissioning /22/. • Relative pressure probe ABB type 264 HS serial number 6409016558 installed on 7 December 2010 /23/. • Temperature probe Ecil type Pt-100 serial number 1037.157644 installed on 23 December 2010 /24/.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	The PDD does not state accuracy for the flow meter neither for the pressure sensor and temperature probes. The accuracy of each equipment is: • Flow meter: +/- 0.25% /41/; • Differential and relative pressure sensors: +/- 0.075% /42/ /43/; • Temperature probe: 0.15°C + 0.002* t where t is the measured temperature /48/. The meters types are designed for LFG and therefore reflects good practise in the monitoring of LFG flow measurements.

Calibration frequency /interval:	The flow meter manufacturer recommends calibration each 10 years /41/. For the temperature and pressure meters, the calibration is yearly, as recommended by the manufacturers /44/ /45/.
Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The PDD addresses periodical calibration as recommended by the manufacturer. The calibration frequencies are recommended by the manufacturers. Considering the stable operation of LFG flow meter with respect concentration, temperature and flow, the equipment is not submitted to operation' stress and the calibration (every 12 months) for the pressure sensors and thermocouple are considered adequate with this use of equipment.
Company performing the calibration:	Rosemount (manufacturer), Lamon /54/ and Ecil (manufacturer).
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes.
Is(are) calibration(s) valid for the whole reporting period?	Yes. • Flow meter #78149 – calibration on 12 September 2009 /5/; • Differential pressure transmitter ABB #6409016458. Calibrations /9/: - C-0176/10 on 14 July 2010 by Lamon; - P00263 on 13 July 2011 by Lamon. • Relative pressure probe ABB #6409016558. Calibration #00142 on 23 March 2011 by Lamon /10/; • Temperature probe Ecil #1037.157644. Calibration #8618/10 on 14 December 2010 by Ecil /11/.
If applicable, has the reported data been cross-checked with other available data?	A cross-check was performed between information provided in the monitoring report /1/ and supervisory records /4/.
How were the values in the monitoring report verified?	The raw data and calculations from the PLC and supervisory system against the records provided by the project participant were verified by sampling /4/.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The PLC and supervisory system have complete traceable procedures, and recorded data cannot be manipulated. The calculations of CERs are performed hourly by the supervisory system and results are aggregated daily and monthly for the purpose of performance analysis of the project.

In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Not applicable

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	$LFG_{electricity,y}$ – Amount of landfill gas combusted in power plant
Measuring frequency:	Continuously
Reporting frequency:	Aggregated hourly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes.
Type of monitoring equipment:	The flow meter normalizes the flow using pressure sensors and temperature probe connected to the equipment. • Flow meter Rosemount Annubar, model 285 /41/. Serial number 78151 installed on plant commissioning /22/. • Differential pressure transmitter ABB type 264 DS serial number 6409016454 installed on plant commissioning /22/. • Relative pressure probe SMAR type LD301M serial number U305352 installed on 4 June 2011 /25/. • Temperature probe Ecil type Pt-100 serial number 1037.157655 installed on 4 June 2011 /25/.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	The PDD does not state accuracy for the flow meter neither for the pressure sensor and temperature probes. The accuracy of each equipment is: • Flow meter: ±0.25% /41/; • Differential and relative pressure sensors: ±0.075% /42/ /47/; • Temperature probe: 0.15°C + 0.002* t where t is the measured temperature /48/. The meters types are designed for LFG and therefore reflects good practise in the monitoring of LFG flow measurements.
Calibration frequency /interval:	The flow meter manufacturer recommends calibration each 10 years /41/. For the temperature and pressure meters, the calibration is yearly, as recommended by the

	manufacturers /44/ /45/ /46/.
Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The PDD addresses periodical calibration as recommended by the manufacturer. The calibration frequencies are recommended by the manufacturers. Considering the stable operation of LFG flow meter with respect concentration, temperature and flow, the equipment is not submitted to operation' stress and the calibration (every 12 months) for the pressure sensors and thermocouple are considered adequate with this use of equipment.
Company performing the calibration:	Rosemount (manufacturer), Lamon /54/, SMAR (manufacturer) and Ecil (manufacturer).
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes.
Is(are) calibration(s) valid for the whole reporting period?	Yes. • Flow meter #78151 – calibration on 12 September 2009 /5/; • Differential pressure transmitter ABB #6409016454. Calibrations /12/: - C-0179/10 on 14 July 2010 by Lamon; - 00265 on 13 July 2011 by Lamon. • Relative pressure probe SMAR #U305352. Calibration on 12 May 2011 by SMAR /13/; • Temperature probe Ecil #1037.157655. Calibration #8616/10 on 14 December 2010 by Ecil /14/.
If applicable, has the reported data been cross-checked with other available data?	A cross-check was performed between information provided in the monitoring report /1/ and supervisory records /4/.
How were the values in the monitoring report verified?	The raw data and calculations from the PLC and supervisory system against the records provided by the project participant were verified by sampling /4/.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The PLC and supervisory system have complete traceable procedures, and recorded data cannot be manipulated. The calculations of CERs are performed hourly by the supervisory system and results are aggregated daily and monthly for the purpose of performance analysis of the project.
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been	Not applicable

estimated as stipulated by Appendix 1 to the CDM Project Standard?	

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	$w_{CH4,y}$ – methane fraction in the landfill gas
Measuring frequency:	Continuously on dry basis
Reporting frequency:	Aggregated hourly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes.
Type of monitoring equipment:	Gas analyser Siemens Ultramat 23 serial number ULT 01-N1X 6-991 /39/. Standard gas cylinders used for calibration: • EGE8142 (CH_4 @60% and CO_2 @40%) installed on 18 October 2010 until the end of the monitoring period /17/; • EGE8143 (N_2 @100%) installed on 13 January 2011 until the end of the monitoring period /17/.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	The PDD does not determine the analyser accuracy. The accuracy of the Ultramat 23 is ±1% for CH_4 and ±0.5% for O_2 /39/. This is according to the manufacturer's specifications /39/.
Calibration frequency /interval:	The manufacturer indicates calibration every 6 months. However, the project participant performs calibration on site every month following the calibration instructions given by the manufacturer /40/.
Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The monitoring plan determines that calibration will be performed according to the calibration protocol. The calibration periodicity of 1 month surpasses the recommendations of the manufacturer (6 months).
Company performing the calibration:	Project participant.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes.
Is(are) calibration(s) valid for the whole reporting period?	Yes. Field registries of each calibration dated: 30 May 2011, 28 June 2011, 25 July 2011, 22 August 2011, 19 September 2011 /15/.
If applicable, has the reported data been	A cross-check was performed between

cross-checked with other available data?	information provided in the monitoring report /1/ and supervisory records /4/.
How were the values in the monitoring report verified?	The raw data and calculations from the PLC and supervisory system against the records provided by the project participant were verified by sampling /4/
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The PLC and supervisory system have complete traceable procedures, and recorded data cannot be manipulated. The calculations of CERs are performed hourly by the supervisory system and results are aggregated daily and monthly for the purpose of performance analysis of the project.
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Not applicable

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	Operation of the energy plant
Measuring frequency:	Continuously
Reporting frequency:	Hourly and aggregated daily and monthly.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes.
Type of monitoring equipment:	Run meter of the LFG generators.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	Not applicable.
Calibration frequency /interval:	Not applicable.
Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	Not applicable.
Company performing the calibration:	Not applicable.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not applicable.

Is(are) calibration(s) valid for the whole reporting period?	Not applicable.
If applicable, has the reported data been cross-checked with other available data?	Number of hours worked was cross checked with estimations in the revised PDD.
How were the values in the monitoring report verified?	Number of engines' worked hours are directly recorded in by the PLC and are monitored by the supervisory system..
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The PLC and supervisory system have complete traceable procedures, and recorded data cannot be manipulated. The calculations of CERs are performed hourly by the supervisory system and results are aggregated daily and monthly for the purpose of performance analysis of the project.
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Not applicable

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	EL_{LFG} – Net amount of electricity generated using landfill gas
Measuring frequency:	Continuously
Reporting frequency:	Monthly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment:	Electricity meters Schneider model ION8600C serial numbers #PT-0912A354-01 and #PT-0912A361-01 /58/.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	The PDD does not determine the accuracy. The accuracy of the equipment is 0.2S /58/.The accuracy complies with manufacturer's specifications and IEC 62053-22 normative (see meter datasheet for further info /58/).
Calibration frequency /interval:	According to the INMETRO normative, the electricity meters only need initial calibration /57/.
Is the calibration interval in line with the monitoring plan? If the monitoring plan	The monitoring plan does not determine the calibration interval. Moreover, the electricity

does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	meters are owned and controlled by CEMIG, and therefore, project participant cannot manipulate. The meters are tamper proof.
Company performing the calibration:	CAM Endesa /55/.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes.
Is(are) calibration(s) valid for the whole reporting period?	Yes. Calibration certificates of main and back-up electricity meters /27/: • Certificate 852/2010 of electricity meter Schneider ION 8600C serial number PT-0912A354-01 issued by CAM Endesa on 27 January 2010 and; • Certificate 734/2010 of meter ION8600C serial number PT-0912A361-01 issued by CAM Endesa on 26 January 2010.
If applicable, has the reported data been cross-checked with other available data?	The monthly invoices /28/ were cross checked with the monthly report extracted from the online system of Electric Energy Commercialization Chamber - CCEE of the electricity exported to the grid by the project /29/.
How were the values in the monitoring report verified?	The quantity of electricity exported to the grid is declared in the monthly invoices issued to CEMIG. The values in the monitoring report are checked against such invoices.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The monthly invoices are controlled by the project participant Consórcio Horizonte Asja, in the company's account system.
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Not applicable

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	EL_{PR} – total amount of electricity imported to meet the requirements of the project
Measuring frequency:	Continuously
Reporting frequency:	Monthly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes

Type of monitoring equipment:	Electricity meters Schneider model ION8600C serial numbers #PT-0912A354-01 and #PT-0912A361-01. Meters measure both current directions, input and output.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	The PDD does not determine the accuracy. The accuracy of the equipment is 0.2S /58/. The accuracy complies with manufacturer's specifications and IEC 62053-22 normative (see meter datasheet for further info /58/)
Calibration frequency /interval:	According to the INMETRO normative, the electricity meters only need initial calibration /57/.
Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The monitoring plan does not determine the calibration interval. Moreover, the electricity meters are owned and controlled by CEMIG, and therefore, project participant cannot manipulate. The meters are tamper proof.
Company performing the calibration:	CAM Endesa /55/.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes.
Is(are) calibration(s) valid for the whole reporting period?	Yes. Calibration certificates of main and back-up electricity meters /27/: • Certificate 852/2010 of electricity meter Schneider ION 8600C serial number PT-0912A354-01 issued by CAM Endesa on 27 January 2010 and; • Certificate 734/2010 of meter ION8600C serial number PT-0912A361-01 issued by CAM Endesa on 26 January 2010.
If applicable, has the reported data been cross-checked with other available data?	The monthly invoices of electricity consumption /26/ provide the amount of electricity imported from the grid.
How were the values in the monitoring report verified?	The quantity of electricity exported to the grid is declared in the monthly invoices issued to CEMIG. The values in the monitoring report are checked against such invoices.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC	The monthly invoices are controlled by the project participant Consórcio Horizonte Asja, in the company's account system.

processes in place?	
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Not applicable

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	$CEF_{elecy,BL,y}$ – Carbon emission factor for electricity
Measuring frequency:	Annually
Reporting frequency:	Annually
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes.
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	NA
Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	NA
Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is(are) calibration(s) valid for the whole reporting period?	NA
If applicable, has the reported data been cross-checked with other available data?	The carbon emission factor of the Brazilian Interconnected Grid System is made available by the Brazilian DNA /53/.
How were the values in the monitoring report verified?	The carbon emission factor of the Brazilian Interconnected Grid System is made available by the Brazilian DNA /53/.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The values are transferred from the DNA's internet website to the main emission reduction calculation spreadsheet. Internal audits are performed to verify the

	correct use of the emission factor /59/.
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Not applicable

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	$PE_{EC,y}$ – Project emissions from electricity consumption by the project activity during the year y.
Measuring frequency:	Calculated as per the "*Tool to calculate baseline, project and/or leakage emissions from electricity consumption*" version 1 /65/.
Reporting frequency:	Monthly. The calculation is performed monthly according to the electricity consumed during the month.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes.
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	NA
Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	NA
Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is(are) calibration(s) valid for the whole reporting period?	NA
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	Values are calculated following the "*Tool to calculate baseline, project and/or leakage emissions from electricity consumption*" version

	1. The main source of information is the calculations provided in the emission reduction calculation spreadsheet /2/.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Internal audits are performed to verify the correct use of the tool and values /59/
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Not applicable

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	TDL_y – average technical transmission and distribution losses for providing electricity to source j in year y.
Measuring frequency:	Use of default value.
Reporting frequency:	Yearly.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	NA
Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	NA
Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is(are) calibration(s) valid for the whole reporting period?	NA
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring	Values were verified against the default value

report verified?	in the "*Tool to calculate baseline, project and/or leakage emissions from electricity consumption*" version 1 /65/.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	NA
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	NA

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	$EF_{CM,y}$ – Combined margin emission factor required to evaluate CO_2 emissions due to the power consumption of the project activity imported from the National Grid.
Measuring frequency:	Annually
Reporting frequency:	Annually
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes.
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	NA
Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	NA
Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is(are) calibration(s) valid for the whole reporting period?	NA
If applicable, has the reported data been cross-checked with other available data?	The carbon emission factor of the Brazilian Interconnected Grid System is made available

	by the Brazilian DNA /53/.
How were the values in the monitoring report verified?	The carbon emission factor of the Brazilian Interconnected Grid System is made available by the Brazilian DNA /53/.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The values are transferred from the DNA's internet website to the main emission reduction calculation spreadsheet. Internal audits are performed to verify the correct use of the emission factor /59/.
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Not applicable

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	$fv_{i,h}$ – volumetric fraction of component *i* in the residual gas in the hour h were *i* is the CH_4.
Measuring frequency:	Continuously
Reporting frequency:	Aggregated hourly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes.
Type of monitoring equipment:	Gas analyser Siemens Ultramat 23 serial number ULT 01-N1X 6-991 /39/. Standard gas cylinders used for calibration: • EGE8142 (CH_4 @60% and CO_2 @40%) installed on 18 October 2010 until the end of the monitoring period; • EGE8143 (N_2 @100%) installed on 13 January 2011 until the end of the monitoring period.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	The PDD does not determine the analyser accuracy. The accuracy of the Ultramat 23 is ±1% for CH_4 and ±0.5% for O_2 /39/. This is according to the manufacturer's specifications /39/.
Calibration frequency /interval:	The manufacturer indicates calibration every 6 months. However, the project participant performs calibration on site every month following the calibration instructions given by the manufacturer /40/.

Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The monitoring plan determines that calibration will be performed according to the calibration protocol. The calibration periodicity of 1 month surpasses the recommendations of the manufacturer (6 months).
Company performing the calibration:	Project participant.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes.
Is(are) calibration(s) valid for the whole reporting period?	Yes. Field registries of each calibration dated: 30 May 2011, 28 June 2011, 25 July 2011, 22 August 2011, 19 September 2011 /15/.
If applicable, has the reported data been cross-checked with other available data?	A cross-check was performed between information provided in the monitoring report /1/ and supervisory records /4/.
How were the values in the monitoring report verified?	The raw data and calculations from the PLC and supervisory system against the records provided by the project participant were verified by sampling /4/
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The PLC and supervisory system have complete traceable procedures, and recorded data cannot be manipulated. The calculations of CERs are performed hourly by the supervisory system and results are aggregated daily and monthly for the purpose of performance analysis of the project.
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Not applicable

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	$t_{O2,h}$ – volumetric fraction of O_2 in the exhaust gas of the flare in the hour h
Measuring frequency:	Continuously
Reporting frequency:	Aggregated hourly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes.
Type of monitoring equipment:	Gas analyser Siemens Ultramat 23 serial number ULT 02-N1X6-992 /39/. Standard gas cylinders used for calibration: • EGE8114 (CH_4 @ 2 587 vpm) installed on 17 December 2010 until the end of

	the monitoring period /20/; • EGE8143 (N_2 @100%) installed on 13 January 2011 until the end of the monitoring period /20/.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	The PDD does not determine the analyser accuracy. The accuracy of the Ultramat 23 is ±1% for CH_4 and ±0.5% for O_2 /39/. This is according to the manufacturer's specifications /39/.
Calibration frequency /interval:	The manufacturer indicates calibration every 6 months. However, the project participant performs calibration on site every month following the calibration instructions given by the manufacturer /40/.
Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The monitoring plan determines that calibration will be performed according to the calibration protocol. The calibration periodicity of 1 month surpasses the recommendations of the manufacturer (6 months).
Company performing the calibration:	Project participant.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes.
Is(are) calibration(s) valid for the whole reporting period?	Yes. Field registries of each calibration dated: 30 May 2011, 28 June 2011, 25 July 2011, 22 August 2011, 19 September 2011 /18/.
If applicable, has the reported data been cross-checked with other available data?	A cross-check was performed between information provided in the monitoring report /1/ and supervisory records /4/.
How were the values in the monitoring report verified?	The raw data and calculations from the PLC and supervisory system against the records provided by the project participant were verified by sampling /4/
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The PLC and supervisory system have complete traceable procedures, and recorded data cannot be manipulated. The calculations of CERs are performed hourly by the supervisory system and results are aggregated daily and monthly for the purpose of performance analysis of the project.
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been	Not applicable

estimated as stipulated by Appendix 1 to the CDM Project Standard?	

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	$fv_{CH4,FG,h}$ – concentration of methane in the exhaust gas of the flares in dry basis at normal conditions in the hour h.
Measuring frequency:	Continuously
Reporting frequency:	Aggregated hourly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes.
Type of monitoring equipment:	Gas analyser Siemens Ultramat 23 serial number ULT 02-N1X6-992 /39/. Standard gas cylinders used for calibration: • EGE8114 (CH_4 @ 2 587 vpm) installed on 17 December 2010 until the end of the monitoring period /20/; • EGE8143 (N_2 @100%) installed on 13 January 2011 until the end of the monitoring period /20/.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	The PDD does not determine the analyser accuracy. The accuracy of the Ultramat 23 is ±1% for CH_4 and ±0.5% for O_2 /39/. This is according to the manufacturer's specifications /39/.
Calibration frequency /interval:	The manufacturer indicates calibration every 6 months. However, the project participant performs calibration on site every month following the calibration instructions given by the manufacturer /40/.
Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The monitoring plan determines that calibration will be performed according to the calibration protocol. The calibration periodicity of 1 month surpasses the recommendations of the manufacturer (6 months).
Company performing the calibration:	Project participant.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes.
Is(are) calibration(s) valid for the whole reporting period?	Yes. Field registries of each calibration dated: 30 May 2011, 28 June 2011, 25 July 2011, 22 August 2011, 19 September 2011 /18/.

If applicable, has the reported data been cross-checked with other available data?	A cross-check was performed between information provided in the monitoring report /1/ and supervisory records /4/.
How were the values in the monitoring report verified?	The raw data and calculations from the PLC and supervisory system against the records provided by the project participant were verified by sampling /4/
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The PLC and supervisory system have complete traceable procedures, and recorded data cannot be manipulated. The calculations of CERs are performed hourly by the supervisory system and results are aggregated daily and monthly for the purpose of performance analysis of the project.
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Not applicable

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	T_{flare} – temperature in the exhaust gas of the enclosed flares.
Measuring frequency:	Continuously
Reporting frequency:	Aggregated hourly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment:	Thermocouple Ecil type S (up to 1 600 °C) /49/ serial number 0950.064353 installed on 4 June 2011 /25/.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	The monitoring plan does not determine the thermocouple accuracy. The equipment used has an accuracy of ±1.5°C or 0.25% of the temperature (whichever in the greatest) /49/. This kind of thermocouple is indicated for enclosed flares operation.
Calibration frequency /interval:	Annually.
Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	Yes. The monitoring plan establishes yearly calibration or replacement in case of failure.
Company performing the calibration:	Ecil (manufacturer)

Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes.
Is(are) calibration(s) valid for the whole reporting period?	Yes. Calibration certificate #3504/11 performed on 24 May 2011 /21/.
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	The raw data and calculations from the PLC and supervisory system were checked against the records provided by the project participant which were verified by sampling /4/. The supervisory system only records the values when temperature is above 500°C for more than 40 minutes in one hour /34/.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The PLC and supervisory system have complete traceable procedures, and recorded data cannot be manipulated. The calculations of CERs are performed hourly by the supervisory system and results are aggregated daily and monthly for the purpose of performance analysis of the project.
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Not applicable

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	$PE_{flare,y}$ – project emissions from flaring of the residual gas stream in year y.
Measuring frequency:	Calculated as per the "*Tool to determine project emissions from flaring gases containing methane*" version 1 /64/.
Reporting frequency:	Calculated hourly.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes.
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's	NA

specification?	
Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	NA
Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is(are) calibration(s) valid for the whole reporting period?	NA
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	Values are calculated following the "*Tool to determine project emissions from flaring gases containing methane*" version 1. The main source of information is the calculations provided in the emission reduction calculation spreadsheet /2/.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Internal audits are performed to verify the correct use of the tool and values /59/.
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Not applicable

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	$fv_{CH4,RG,h}$ – methane fraction in the landfill gas.
Measuring frequency:	Continuously
Reporting frequency:	Aggregated hourly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes.
Type of monitoring equipment:	Gas analyser Siemens Ultramat 23 serial number ULT 01-N1X 6-991 /39/. Standard gas cylinders used for calibration: • EGE8142 (CH_4 @60% and CO_2 @40%) installed on 18 October 2010 until the end of the monitoring period; • EGE8143 (N_2 @100%) installed on 13

	January 2011 until the end of the monitoring period.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	The PDD does not determine the analyser accuracy. The accuracy of the Ultramat 23 is ±1% for CH_4 and ±0.5% for O_2 /39/. This is according to the manufacturer's specifications /39/.
Calibration frequency /interval:	The manufacturer indicates calibration every 6 months. However, the project participant performs calibration on site every month following the calibration instructions given by the manufacturer /40/.
Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The monitoring plan determines that calibration will be performed according to the calibration protocol. The calibration periodicity of 1 month surpass the recommendations of the manufacturer (6 months).
Company performing the calibration:	Project participant.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes.
Is(are) calibration(s) valid for the whole reporting period?	Yes. Field registries of each calibration dated: 30 May 2011, 28 June 2011, 25 July 2011, 22 August 2011, 19 September 2011 /15/.
If applicable, has the reported data been cross-checked with other available data?	A cross-check was performed between information provided in the monitoring report /1/ and supervisory records /4/.
How were the values in the monitoring report verified?	The raw data and calculations from the PLC and supervisory system against the records provided by the project participant were verified by sampling /4/
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The PLC and supervisory system have complete traceable procedures, and recorded data cannot be manipulated. The calculations of CERs are performed hourly by the supervisory system and results are aggregated daily and monthly for the purpose of performance analysis of the project.
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Not applicable

	Assessment/ Observation
Data / Parameter: (as in monitoring plan):	$FV_{RG,h}$ – volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h
Measuring frequency:	Continuously
Reporting frequency:	Aggregated hourly
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes.
Type of monitoring equipment:	The flow meter normalizes the flow using pressure sensors and temperature probe connected to the equipment. • Flow meter Rosemount Annubar, model 285 /41/. Serial number 78149 installed on plant commissioning /22/. • Differential pressure transmitter ABB type 264 DS serial number 6409016458 installed on plant commissioning /22/. • Relative pressure probe ABB type 264 HS serial number 6409016558 installed on 7 December 2010 /23/; • Temperature probe Ecil type Pt-100 serial number 1037.157644 installed on 23 December 2010 /24/.
Is accuracy of the monitoring equipment as stated in the monitoring plan? If the monitoring plan does not specify the accuracy of the monitoring equipment, does the accuracy of the monitoring equipment comply with local/national standards, or as per the manufacturer's specification?	The PDD does not state accuracy for the flow meter neither for the pressure sensor and temperature probes. The accuracy of each equipment is: • Flow meter: +/- 0.25% /41/; • Differential and relative pressure sensors: +/- 0.075% /42/ /43/; • Temperature probe: 0.15°C + 0.002* t where t is the measured temperature /48/. The meters types are designed for LFG and therefore reflects good practise in the monitoring of LFG flow measurements.
Calibration frequency /interval:	The flow meter manufacturer recommends calibration each 10 years /41/. For the temperature and pressure meters, the calibration is yearly, as recommended by the manufacturer.
Is the calibration interval in line with the monitoring plan? If the monitoring plan does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The PDD addresses periodical calibration as recommended by the manufacturer. The calibration frequencies are recommended by the manufacturers. Considering the stable operation of LFG flow meter with respect concentration,

	temperature and flow, the equipment is not submitted to operation' stress and the calibration (every 12 months) for the pressure sensors and thermocouple are considered adequate with this use of equipment.
Company performing the calibration:	Rosemount (manufacturer), Lamon /54/ and Ecil (manufacturer).
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes.
Is(are) calibration(s) valid for the whole reporting period?	Yes. • Flow meter #78149– calibration on 12 September 2009 /5/; • Differential pressure transmitter ABB #6409016458. Calibrations /9/: - C-0176/10 on 14 July 2010 by Lamon; - P00263 on 13 July 2011 by Lamon. • Relative pressure probe ABB #6409016558. Calibration #00142 on 23 March 2011 by Lamon /10/; • Temperature probe Ecil #1037.157644. Calibration #8618/10 on 14 December 2010 by Ecil /11/.
If applicable, has the reported data been cross-checked with other available data?	A cross-check was performed between information provided in the monitoring report /1/ and supervisory records /4/.
How were the values in the monitoring report verified?	The raw data and calculations from the PLC and supervisory system against the records provided by the project participant were verified by sampling /4/.
Does the data management ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The PLC and supervisory system have complete traceable procedures, and recorded data cannot be manipulated. The calculations of CERs are performed hourly by the supervisory system and results are aggregated daily and monthly for the purpose of performance analysis of the project.
In case project participants have temporarily not monitored the parameter, has either i) a deviation been approved by the CDM EB or ii) has the parameter been estimated as stipulated by Appendix 1 to the CDM Project Standard?	Not applicable

3.7 Assessment of data and calculation of emission reductions

The emission reduction calculations are based on the figures sourced from the PLC and supervisory system historical records for the following parameters:

- Flow of LFG to the flare and to electricity generators;
- Methane content in the LFG collected and sent to the flare and electricity generation;
- Methane content in the flare exhaust gas in order to calculate the flare efficiency;
- Oxygen content in the flare exhaust gas in order to calculate the flare efficiency;
- Net flare operational period calculated on the basis of the flare temperature in order to calculate the flare efficiency;
- Net amount electricity delivery to the Brazilian Interconnected Grid System.

The baseline emissions (BE_y) are calculated as per the ACM0001, version 11 /63/, considering the methane captured and destructed by the project activity. The actual methane capture and destructed is calculated using the measurements of the LFG flows ($LFG_{flare,y}$ and $LFG_{electricity,y}$) and the methane fraction in the LFG ($w_{CH4,y}$) measured by a gas analyser. These data are transferred into a master Excel hourly spreadsheet used to calculate the methane destructed by the project activity considering the methane density of 0.0007168 tCH_4/m^3CH_4 at 0°C and 1 atm as established by ACM0001, version 11 /63/. The methane density of 0.0007168 tCH_4/m^3CH_4 stated in the revised PDD /34/ corresponds to the International Standard temperature and pressure (0°C and 1 atm). The flows were normalized by the flow meters to International Standard temperature and pressure (0°C and 1 atm) by the flow meters and supervisory system.

In order to monitor continuously the flare efficiency, the concentration of methane in the exhaust gas of the flare in dry basis at normal conditions ($fv_{CH4,FG,h}$) and the volumetric fraction of O_2 in the exhaust gas of the flare ($t_{O2,h}$) were measured by the gas analyser connected at 80% of the flare height. Calculations of the flare destruction efficiency were according to the "*Tool to determine project emissions from flaring gases containing methane*" version 1 /64/. Applying the tool, the volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h ($FV_{RG,h}$) is measured with a flow meter. The methane flow rate in the exhaust gas is also calculated considering the density of the residual gas (LFG) at normal conditions ($\rho_{RG,n,h}$), the molecular mass of each gas component (methane and oxygen measured by the gas analyzer). The remaining parts of the LFG are considered as nitrogen (N_2), as per recommendation of the tool. Therefore, the flare efficiency ($\eta_{flare,h}$) is calculated hourly, considering the mass flow rate of methane in the residual gas and the methane flow rate in the exhaust gas. Calculations and constants are correctly applied as demonstrated in the spreadsheet with the emission reduction calculation /2/. The project emissions from flaring of the residual gas stream in year y ($PE_{flare,y}$) are finally hourly calculated as per the tool and according to the monitoring plan, considering the flare efficiency and the volumetric flow rate of the residual gas in dry basis at normal conditions in the hour h ($FV_{RG,h}$).

The adjustment factor is calculated according to the revised PDD version 3 of 3 October 2012 /34/, considering the amount of methane destroyed by the project activity ($MD_{project,y}$) and the amount of methane generated ($MD_{PR,y}$). The project participant considered as $MD_{PR,y}$ the highest value between $MD_{total,y}$ and the sum of $MD_{flare,y}$ and $MD_{electricity,y}$. The lowest value was used as $MD_{project,y}$.

The project emissions (PE_y) are calculated with the electricity consumed, measured by electricity meter (main and back-up) installed at the project site. DNV has assessed the electricity consumption on the monthly invoices issued by the distribution company CEMIG /26/. No discrepancy was found in the data.

The emission reduction (ER_y) by the electricity displacement is calculated with the electricity delivered to the grid, measured by the same electricity meter (main and back-up) by CEMIG. Meters are controlled by the electric company and are tamped proof. DNV has checked the electricity delivered to the grid against the monthly invoices issued by Consórcio Horizonte Asja to the buyer CEMIG /28/.

The carbon emission factor for electricity ($CEF_{elecy,BL,y}$) is calculated by the Brazilian DNA Interministerial Commission on Climate Change for the National Interconnected System for the year 2011 and is 0.1988 tCO_2/MWh /53/.

The emission reductions are the difference of baseline and project emissions and GWP of 21 as established by ACM0001, version 11 /63/. No leakage is applicable under the methodology.

The emission reductions for the period have been analysed against the estimated CERs in the PDD /34/ and the actual verified emission reductions are higher than the estimated emission reductions as stated in the table below.

Year	Revised PDD	Monitoring Report	Difference
2011 (4 June 2011 to 30 September 2011)	68 336	81 709	+19.6%

All reported and verified data were found to be consistent, i.e. data in the monitoring report (version 2) of 29 October 2012. It has been verified by DNV on-site that data collected and calculated are complete. These evidences enable DNV to verify the resulting emission reductions of 81 709 tCO_2e for the period from 4 June 2011 to 30 September 2011.

As confirmed above, the input data for calculation and calculation process and result are complete and transparent, and DNV is able to confirm the accuracy.

3.8 Quality of evidence to determine emission reductions

DNV was able to confirm that the calculations are based on the authentic historical records from the PLC and supervisory system provided by Biotecnogas /3/ and also the monthly systematic and periodical monitoring of the electricity generation and consumption by the project /26/ /28/. The spreadsheet presented with calculations of these figures /3/ and the spreadsheet /2/ used to calculate the certified emission reductions (CER) calculations and all figures were tracked, checked and found to be consistent.

The monitoring information is stored on server computer on site, and the spreadsheets are stored on server of Asja Brasil Serviços para o meio Ambiente Ltda. (project participant), both with regular and systematic back-up /59/.

3.9 Management system and quality assurance

The monitoring and calculations are carried out through the PLC and supervisory system unit, which apart from several other parameters include the following as the main:

- The LFG flow in Nm^3 (total, flare and electricity pipelines),
- CH_4 content of LFG, including the monthly calibration with certified standard gas,
- The flare temperature at 80% of flare height, which is considered in order to determine the hours where the temperature was above 500°C;
- The CH_4 and O_2 content in the flare exhaust gas;
- The electricity consumed and also delivered to the grid by the project activity.

These figures are registered continuously and recorded hourly, and stored in the supervisory system server, controlled password. In addition, these are stored as databases copies on local computer and safety copies on CD, stored on server of Asja Brasil Serviços para o meio Ambiente Ltda.

The CERs calculation through the methane capture and destruction is performed by the supervisory system. No information is manipulated by the plant operator neither the project participants.

The CERs due to energy consumption and/or displacement by the supply of electricity to the grid is calculated by Consórcio Horizonte Asja monthly using the electricity consumption and generation from the invoices /26/ /28/.

As the recordings of the field measurements are carried out automatically by the equipment and supervised by the Biotecnogas system unit which has several alarms to site operator and automatic actions (such as stop the operation of unit). The operation is considered safe, and the monitoring is considered reliable. In addition, as verified, the electronic handling of records, the calculation, the monitoring and reporting are deemed to be consistent and in line with established procedures /59/.

4 CERTIFICATION STATEMENT

DNV Climate Change Services AS (DNV) has performed the verification of the emission reductions that have been reported for the CDM project activity 3464"Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040" in Brazil for the period 4 June 2011 to 30 September 2011.

The project participants are responsible for the collection of data in accordance with the monitoring plan and the reporting of GHG emissions reductions from the project activity.

It is DNV's responsibility to express an independent verification statement on the reported GHG emission reductions from the project activity. DNV does not express any opinion on the selected baseline scenario or on the validated and registered PDD.

DNV conducted the verification on the basis of the baseline and monitoring methodology ACM0001 (version 11), the monitoring plan contained in the revised PDD (version 3 of 3 October 2012). The verification included i) checking whether the provisions of the monitoring methodology and the monitoring plan were consistently and appropriately applied and ii) the collection of evidence supporting the reported data.

DNV's verification approach draws on an understanding of the risks associated with reporting of GHG emission data and the controls in place to mitigate these. DNV planned and performed the verification by obtaining evidence and other information and explanations that DNV considers necessary to give reasonable assurance that reported GHG emission reductions are fairly stated.

In our opinion the GHG emissions reductions reported for the project activity for the period 4 June 2011 to 30 September 2011 are fairly stated in the monitoring report (version 2) dated 29 October 2012.

The GHG emission reductions were calculated correctly on the basis of the approved baseline and monitoring methodology ACM0001 (version 11) and the monitoring plan contained in the PDD (version 3 of 3 October 2012).

DNV Climate Change Services AS is able to certify that the emission reductions from the CDM project activity 3464 "Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040" in Brazil during the period 4 June 2011 to 30 September 2011 amount to 81 709 tonnes of CO_2 equivalent.

Rio de Janeiro and Oslo, 4 December 2012

Juliana Scalon
CDM Verifier
DNV Rio de Janeiro, Brazil

Edwin Aalders
Approver,
DNV Climate Change Services AS

5 REFERENCES

5.1.1 Documentation provided by the project participants

/1/ Consórcio Horizonte Asja: *CDM monitoring report for project activity 3464 "Exploitation of* the biogas from controlled landfill in solid waste management central – CTRS / BR.040*" for the monitoring period 4 June 2011 to 30 September 2011*, Version 1 dated 7 October 2011 and version 2 dated 29 October 2012 .

/2/ Consórcio Horizonte Asja Emission reductions calculations with hourly flow of LFG sent to flare and electricity generators (Nm^3/h), number of hours of the energy plant operation, average CH_4 content (%) in the LFG flow, average CH_4 content (ppm) in the exhaust gas, average O_2 content (%) in the exhaust gas, flare efficiency. Dated 14 November 2012.

/3/ Consórcio Horizonte Asja: Hourly report spreadsheets of the emission reductions calculations extracted from the PLC system for each day from 4 June 2011 to 30 September 2011 with calculation of hourly aggregated total flow of LFG sent to flare and electricity generators (Nm^3/h), number of hours of the energy plant operation, average CH_4 content (%) in the LFG flow, average CH_4 content (ppm) in the exhaust gas, average O_2 content (%) in the exhaust gas, and flare efficiency calculations.

/4/ Consórcio Horizonte Asja: Hourly spreadsheets extracted from the PLC system for days 4/7/11/23 June 2011, 1/10/4/21/31 July 2011, 6/9/13/18/20 August 2011 and 1/7/18/20/30 September 2011 during site visit for sampling assessment of all recorded data cross-checked with the main table with formulas contained in the supervisory system.

/5/ Emerson Process Management: Calibration / conformity certificates of total LFG flow meters serial numbers 78147, 78149 and 78151 carried on by the manufacturer, issued on 12 September 2009.

/6/ Lamon Instrumentação Industrial Ltda: Calibration certificate of the differential pressure transmitter ABB type 264 DS serial number 6409016459. Calibrations:

- C-0177/10 on 14 July 2010 by Lamon;
- P00266 on 13 July 2011 by Lamon.

/7/ Lamon Instrumentação Industrial Ltda : Calibration certificate of the relative pressure probe ABB type 264 HS serial number 6409016561. Calibration #00141 on 23 March 2011 by Lamon.

/8/ Ecil Temperatura Industrial: Calibration certificate of temperature probe Ecil type Pt-100 serial number 10.28138141. Calibration #2212/11 on 31 March 2011 by Ecil.

/9/ Lamon Instrumentação Industrial Ltda : Calibration certificates of differential pressure transmitter ABB type 264 DS serial number 6409016458. Calibrations:

- C-0176/10 on 14 July 2010 by Lamon;
- P00263 on 13 July 2011 by Lamon.

/10/ Lamon Instrumentação Industrial Ltda : Calibration certificate of relative pressure probe ABB type 264 HS serial number 6409016558. Calibration #00142 on 23 March 2011 by Lamon.

/11/ Ecil Temperatura Industrial : Calibration certificate of temperature probe Ecil type Pt-100 serial number 1037.157644. Calibration #8618/10 on 14 December 2010 by Ecil.

/12/ Lamon Instrumentação Industrial Ltda: Calibration certificates of differential pressure transmitter ABB type 264 DS serial number 6409016454. Calibrations:

- C-0179/10 on 14 July 2010 by Lamon;
- 00265 on 13 July 2011 by Lamon.

/13/ SMAR: Calibration certificate of relative pressure probe SMAR type LD301M serial number U305352. Calibration on 12 May 2011 by SMAR.

/14/ Ecil Temperatura Industrial: Calibration certificate of temperature probe Ecil type Pt-100 serial number 1037.157655. Calibration #8616/10 on 14 December 2010 by Ecil.

/15/ Consórcio Horizonte Asja: On-site calibrations of the gas analyser Siemens Ultramat 23 ULT 01 – N1 X 6-991 performed monthly by the plant operator, for the parameter w_{CH4}, according to manufacturer specifications. Field registries of each calibration dated: 30 May 2011, 28 June 2011, 25 July 2011, 22 August 2011, 19 September 2011.

/16/ Linde Gases Ltda: Quality certificate of cylinders used for gas analyser on-site calibration :

- #2318/10 of the cylinder EGE8142 (CH_4 @60% and CO_2 @40%) issued on 6 September 2010 and;
- #1125/11 of cylinder EGE8143 (N_2 @100%) issued on September 2010

/17/ Consórcio Horizonte Asja: On-site calibrations of the gas analyser Siemens Ultramat 23 ULT 01 – N1 X 6-991 performed monthly by the plant operator, for the parameter w_{CH4}, proving the start of utilization of cylinder EGE8142 on 18 October 2010 and cylinder EGE8143 on 13 January 2011.

/18/ Consórcio Horizonte Asja: On-site calibrations of the gas analyser Siemens Ultramat 23 ULT 02 – N1 X 6-992 performed monthly by the plant operator, for the parameter $fv_{CH4,FG,h}$, according to manufacturer specifications. Field registries of each calibration dated: 30 May 2011, 28 June 2011, 25 July 2011, 22 August 2011, 19 September 2011.

/19/ Linde Gases Ltda: Quality certificate of cylinders used for gas analyser on-site calibration :

- #2391/10 of the cylinder EGE8114 (CH_4 @ 2 500 vpm) issued on 9 September 2010 and;
- #1125/11 of cylinder EGE8143 (N_2 @100%) issued on September 2010.

/20/ Consórcio Horizonte Asja: On-site calibrations of the gas analyser Siemens Ultramat 23 ULT 02 – N1 X 6-992 performed monthly by the plant operator, for the parameter $fv_{CH4,FG,h}$, proving the start of utilization of cylinders EGE8114 on 17 December 2010 and EGE8143 on 13 January 2011.

/21/ Ecil Temperatura Industrial: Calibration certificate of thermocouple Ecil serial number 0950.064353. Calibration #3504/11 on 24 May 2011 by Ecil.

/22/ Consórcio Horizonte Asja: Field operation registry of equipment installation on plant commissioning, dated 12 September 2009:

- Flow meter serial number 78147;

- Flow meter serial number 78149;
- Flow meter serial number 78151;
- Differential pressure transmitter serial number 6409016459;
- Differential pressure transmitter serial number 6409016458
- Relative pressure probe serial number 6409016561;
- Differential pressure transmitter serial number 6409016454.

/23/ Consórcio Horizonte Asja: Field operation registry of installation of relative pressure probe ABB type 264 HS serial number 6409016558. Dated 7 December 2010.

/24/ Consórcio Horizonte Asja: Field operation registry of installation of temperature probe Ecil type Pt-100 serial number 1037.157644. Dated 23 December 2010.

/25/ Consórcio Horizonte Asja: Field operation registry of equipments exchange. 4 June 2011.

/26/ CEMIG Distribuição S.A.: Monthly invoices from June to September 2011 of electricity consumption by the project Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040.

/27/ CAM Endesa: Calibration certificates of main and back-up electricity meters:

- Certificate 852/2010 of electricity meter Schneider ION 8600C serial number PT-0912A354-01 issued by CAM Endesa on 27 January 2010 and;
- certificate 734/2010 of meter ION8600C serial number PT-0912A361-01 issued by CAM Endesa on 26 January 2010.

/28/ Consórcio Horizonte Asja: Monthly invoices from June to September 2011 of electricity sold to CEMIG by the project Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040

/29/ Consórcio Horizonte Asja: Online report of electricity exported to the grid by the project Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040. The reports are obtained at the website Câmara de Comercialização de Energia Elétrica – CCEE, through a dedicated interface with the electricity producer.

/30/ Consórcio Horizonte Asja: *Main table build up for the supervisory system* used to transfer and check the hourly spreadsheets extracted from the PLC system for days 4/7/11/23 June 2011, 1/10/4/21/31 July 2011, 6/9/13/18/20 August 2011 and 1/7/18/20/30 September 2011 for sampling assessment of all recorded data.

/31/ Belo Horizonte Municipal Secretary on Environment: *Operation license for the project* Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040. Dated 18 May 2011 and valid until 18 May 2016.

5.1.2 Other project documents or documents used by DNV to verify the information provided by the project participants

/32/ Consórcio Horizonte Asja: *Registered CDM-PDD for project activity "*Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040, version 2a of 25 November 2009

/33/ SGS United Kingdom Ltd: *Validation Report of the* Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040. SGS Report

CDM.VAL 2246 Rev 3.4, 14 March 2011.

/34/ Consórcio Horizonte Asja: *Revised Project Design Document of the* Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040, version 3 of 3 October 2012.

/35/ Consórcio Horizonte Asja: *Revised CER calculation spreadsheet of* Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040.

/36/ DNV Climate Change Services AS: Assessment opinion on post registration changes. Dated 26 October 2012.

/37/ Biotecnogas: *Flaring and supervisory system*. Last assessed on 3 April 2012.
http://www.biotecnogas.it/index4.asp?link=attivitaoperative.asp

/38/ Biotecnogas: *Enclosed flare technical specifications*. July 2009.

/39/ Siemens: *Gas Analyser Ultramat 23 – technical specifications*:
http://www.automation.siemens.com/w1/automation-technology-ultramat-23-19005.htm
Last accessed on 3 April 2012.

/40/ Siemens: *Gas Analyser Ultramat 23 – operating instructions for the monthly calibration*. Edition 03/2005.

/41/ Emerson Process Management: *Flow meter Rosemount Annubar 285 technical specifications*:
http://www2.emersonprocess.com/siteadmincenter/PM%20Rosemount%20Documents/00813-0100-4028.pdf
Last accessed on 13 November 2012.

/42/ ABB: *Differential pressure transmitter model 264DS technical data sheet*:
http://www.abb.com/product/seitp330/4004ec2b84b8a793c1256d3300281991.aspx

/43/ ABB: *Gauge pressure transmitter model 264HS technical data sheet*:
http://www.abb.com.br/product/seitp330/5da483590220ff4ac1256d330037d6e7.aspx

/44/ ABB: *Recommendations on the calibration frequency of* d*ifferential pressure transmitter and Gauge pressure transmitter calibration frequency*. Dated 24 March 2010.

/45/ Ecil Temperatura Industrial: *Recommendation on the calibration frequency of temperature probes and thermocouples*. Dated 11 August 2010.

/46/ SMAR: *Recommendations on the calibration frequency of* g*auge pressure transmitter calibration frequency*. Dated 29 November 2012.

/47/ SMAR: *Technical data sheet for LD301M series of relative pressure probe*. Available at:
http://www.smar.com/en/products//Pressure-Transmitter/LD300Series.asp

/48/ Ecil Temperatura Industrial: *Temperature probe model pt-100 Class A data sheet*.

/49/ Ecil Temperature Industrial: *Thermocouple type S data sheet and technical information*. Available at:

http://www.ecil.com.br/temperatura-industrial/pirometria/termopares/termopar-tipo-s/

/50/ GE Jenbacher: *LFG electricity generators*: http://www.ge-energy.com/products_and_services/products/gas_engines_power_generation/index.jsp Last accessed on 3 April 2012.

/51/ GE Jenbacher: *technical specifications of 1.426 MW LFG energy generator*.

/52/ US Department of Defense: *American Military Standard and tables for Inspection by Attributes (MIL-STD-105E)*. 10 May 1989.

/53/ Interministerial Commission on Global Climate Change: *CO_2 emission intensity of the Interconnected Grid System (SIN) of Brazil*, 2011. Available at: http://www.mct.gov.br/index.php/content/view/333605.html#ancora

/54/ INMETRO: *Accreditation certificate #0103* for Lamon Instrumentação Industrial Ltda. Dated 22 March 2011. Valid until 1 January 2013.

/55/ INMETRO: *Accreditation certificate #334* for CAM Endesa. Dated 16 June 2006. Valid until 1 January 2013.

/56/ Contagem Environmental Secretary: Certificate #17/06 for Linde Gases Ltda for mixture, test, commercialization and transport of cylinder gases. Date 2 October 2006 and valid until 2 October 2012..

/57/ INMETRO: *Normative directive #431* regarding the calibration instructions of electricity meters. Dated 4 December 2007.

/58/ Schneider Electric: *Technical brochure of electricity meter model ION 8600C*. Available at: http://products.schneider-electric.us/support/technical-library/?event=detail&oid=09008926804d32b2&cat=0b008926804d02f5

/59/ Consórcio Horizonte Asja: *Management manual of* Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040

5.1.3 Methodologies, tools and other guidance by the CDM Executive Board

/60/ CDM Executive Board: *Clean Development Mechanism Validation and Verification Standard,* version 02.0

/61/ CDM Executive Board: *Clean Development Mechanism Project Standard,* version 01.0

/62/ CDM Executive Board: *Clean Development Mechanism Project Cycle Procedure,* version 01.0

/63/ CDM Executive Board: *Baseline and monitoring methodology ACM0001, "Consolidated Baseline and Monitoring Methodology for Landfill Gas Project Activities*", version 11

/64/ CDM Executive Board: "*Tool to determine project emissions from flaring gases containing methane*", version 1, EB28 annex 13.

/65/ CDM Executive Board: "*Tool to calculate baseline, project and/or leakage emissions from electricity consumption*", version 1, EB39 annex 7.

/66/ CDM Executive Board: *Guidelines for Completing the Monitoring Report Form*. Version 1. EB 54, Annex 34.

/67/ IPCC: 2006 *Guidelines for National Greenhouse Gas Inventories*, Volume 5, Chapter 3.

5.1.4 Persons interviewed during the verification

/68/ Melina Uchida – Asja Brasil Serviços Ltda

/69/ Miguel Cinquantini - Asja Brasil Serviços Ltda

/70/ Alexandre Augusto Lima - Consórcio Horizonte Asja

/71/ Juderlei Souza de Aguiar- Local Project Manager - Consórcio Horizonte Asja

/72/ Karine Dias Nogueira - Asja Brasil Serviços Ltda

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APPENDIX A

CORRECTIVE ACTION REQUESTS, CLARIFICATION REQUESTS AND FORWARD ACTION REQUESTS

Corrective action requests

CAR ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CAR 1	The net amount of electricity generated using landfill gas (EL_{LFG}) and the total amount of electricity imported to meet the requirements of the project (EL_{PR}) are measured with two electricity meters (main and back-up), as could be verified during site visit. Therefore, the monitoring report is not completed according to "*Validation and Verification Standard*", paragraph 234 and 236 and the "*Guidelines for Completing the Monitoring Report Form*", EB 54, Annex 34.	The project participant included the information required for the parameters EL_{LFG} and EL_{PR} into the monitoring report, in the section D.2. Once the equipment does not require periodic calibration (attached documents) and its maintenance is a responsibility of the electricity buyer CEMIG, the project participants did not include the validity of the last calibration in the monitoring report.	DNV has revised the documentation send by the project participant. Regarding the calibration, according to the INMETRO normative, the electricity meters only need initial calibration /57/ or if the meter is violated or moved to another place. Also, the electricity meters are owned and controlled by CEMIG, and therefore, project participant cannot manipulate. The meters are tamper proof. Information in the monitoring report is complete for the parameters EL_{LFG} and EL_{PR}. Therefore this CAR is closed.
CAR 2	The amount of methane collected by the project activity ($MD_{project}$) during the monitored period (119 days) stated in the registered PDD is 3 103 tCH_4 and the actual amount of methane captured by the project activity was 3 919 tCH_4. This represents 20.8% more. It is stated in the monitoring report that the capture efficiency was improved during the time and that the electricity generators operated more time than expected in the PDD. However no further information is provided regarding the differences of methane captured and energy generated against the PDD in order to justify the over generation of CERs.	The over generation of CERs is due to the increase in the output power of the project activity, with the addition of one engine of 1.426 MW of capacity, totalizing 5.704 MW against the 4.500 MW stated in the registered PDD. The PDD was revised as a post registration change. Also, the methane capture by the project is above the revised ex-ante estimative.	A process of post registration change is undergoing by the project participant and DNV. Regarding the methane captured by the project, this is possibly due to imprecisions associated to the estimation model. Besides the higher methane content than the average estimated in the revised PDD, the possible reasons for that performance above the estimations can be due to a LFG collection efficiency above 85%, as admitted in the revised PDD /34/, and a waste composition different from what was informed by the municipality to the project participant. This information is not under project participant control, and it is not possible to monitor anymore since the landfill is closed. Moreover,

CAR ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
			the tool used for the methane estimations is based on the First Order Decay (FOD) Model also used by the IPCC in the National Greenhouse Gas Inventories, Volume 5, Chapter 3 /67/. According to IPCC, the FOD model presents uncertainties on the amount of methane estimated and the distribution of this amount over the years (Chapter 3.7). Since the project Exploitation of the biogas from controlled landfill in solid waste management central – CTRS / BR.040 has only few years of operation, so far it is not possible to attribute the differences observed due to amounts or to distribution of the methane estimated over the years. Moreover, since DNV could not identify during site visit any anomalies in the management system and in the equipment used for methane captured under the project, the differences are reasonable and most probably due to uncertainties of the FOD model. Also, DNV has assessed the changes to the project activity and the increase in the installed capacity of electricity generation does not affect the adversely the additionality. Therefore this CAR is closed.
CAR 3	The monitoring report is not as per the "Guidelines for completing the monitoring report form (CDM-MR)", EB 54, Annex 34, regarding the calculations and results in the section E, equipment specifications, calibrations and third party calibrations.	The calculations applying actual values were made hourly and results are available only in the hourly report spreadsheet attached to the monitoring report as a document, due to the quantity of data. Anyway, monthly aggregated results were included into the Monitoring Report, in the section E, for illustrative purposes.	DNV has assessed the monitoring report version 2 of 29 October 2012 is completed as per the EB 54, Annex 34 regarding value of monitored parameters, calibrations, dates and third party calibrations. Therefore this CAR is closed.

CAR ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
		The project participants included in the monitoring report the values of the parameters, for the monitoring period, in the section D.2. Also, the project participants included in the monitoring report the name of the companies which have done the calibration of the equipments. Those names are in the section D.2.	
CAR 4	The formula used for the determination of the mass flow rate of the residual gas that is flared (step 1) is not according to the "*Tool to determine project emissions from flaring gases containing methane*", version 1.	The project participants corrected the formula used for the determination of the mass flow rate of the residual gas that is flared, presented in the hourly report spreadsheet. This correction increases the final value of CERs in 0.002 tCO_2.	DNV has assessed the hourly report containing the flare efficiency calculations /2/, and the error was corrected. Therefore this CAR is closed.

Clarification requests

CL ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CL 1	The actual start date for the operation of the electricity generation is not informed along the monitoring report.	The actual start date for the operation of the electricity generation is the 29/11/2010. The Project Participants updated the Monitoring Report correcting the information.	DNV has assessed the monitoring report version 2 of 29 October 2012 and the date was inserted in the proper sections of the monitoring report. Therefore this CL is closed.
CL 2	No evidence is presented in the monitoring report regarding the calibration records of the differential pressure sensors for the entire monitoring period (4 June 2011 to 30 September 2011) for the following parameters: • $LFG_{total,y}$ – Total amount of landfill gas captured at normal temperature and pressure;	The project participants updated the monitoring report, including the calibration records required. The information were included in the section D.2, in the parameters $LFG_{total,y}$, $LFG_{flare,y}$ and $LFG_{electricity,y}$.	DNV has assessed the monitoring report version 2 of 29 October 2012 and the information regarding the differential pressure sensors was inserted in the proper sections of the monitoring report. Therefore this CL is closed.

CL ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
	• $LFG_{flare,y}$ – Amount of landfill gas flared; • $LFG_{electricity,y}$ – Amount of landfill gas combusted in power plant.		
CL 3	It is not indicated in the MR the correct accuracy and correspondent evidence for the following equipment: • Gas analyzer Siemens Ultramat 23 serial number ULT 01 – N1 X 6-991; • Gas analyzer Siemens Ultramat 23 serial number ULT 02 – N1X 6 992; • Thermocouple Ecil serial number 0950.064353; • Temperature probe Ecil Pt-100 serial number 1037.157655.	The project participants updated the monitoring report, including the correct accuracy of the cited equipment, in the section D.2.	DNV has assessed the monitoring report version 2 of 29 October 2012 and the information regarding the accuracies was inserted in the proper sections of the monitoring report. The gas analyser accuracy is ±1% for CH_4 and ±0.5% for O_2 /39/, the temperature probe is 0.15°C + 0.002* t where t is the measured temperature /48/ and the thermocouple is ±1.5°C or 0.25% of the temperature (whichever in the greatest) /49/. Therefore this CL is closed.
CL 4	It is not demonstrated the calculation of the destruction efficiency of the system used in the project activity (ε_{PR}) and the results obtained for the adjustment factor AF_y for the monitored period.	The project participants updated the monitoring report, explaining how the calculation of the destruction efficiency was done and included a table with values of AF in the monitoring period. Those information are in the Section E.1, in the Step 2 and Step 3.	DNV has assessed the monitoring report version 2 of 29 October 2012 and the calculations of the destruction efficiency is correctly demonstrated in the MR. Therefore this CL is closed.
CL 5	It is not clear the actual application of the average value of the last 7 days in the monitoring plan, monitored data and in the hourly data reports provided in the current monitoring period, as per the Annex 4 of the PDD.	During this monitoring period, there was no failure in the system, so it was not necessary to calculate any average value of the last 7 days or to apply any other correction to the data registered. For this reason the project participants decided to remove the information from this monitoring report.	DNV has assessed the recorded data in the hourly reports from the supervisory system and in the field records during site visit /3/. No failure of the system has occurred and therefore the average of the last 7 days was not used during the period from 4 June 2011 to 30 September 2011. Therefore this CL is closed.

CL ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CL 6	Project participant is requested to evidence that no calibration is required for the flow meter, as per the manufacturer specifications.	According to the flow meter manufacturer specifications, for this equipment type a calibration is required each 10 years. Therefore, no calibration was required in this monitoring period, since all flow meters installed in the plant were last calibrated in the 12 September 2009. This information was updated into the monitoring report.	DNV has assessed the documents provided by the project participant. The Rosemount Annubar flow meters are basically a metal plate with sensing hole which by their design, are not submitted to operation stress. The flow meter normalizes the flow using pressure sensors and temperature probe connected to the equipment, which are the ones that are submitted to the most part of operation stress and require yearly calibration. In this sense, the flow meter manufacturer recommends calibration only each 10 years /41/. Therefore this CL is closed.

Forward action requests from previous verification

FAR ID	Forward action request	Summary of how FAR has been addressed in this reporting period	Assessment of how FAR has been addressed
	No FAR was identified in the validation.		

Forward action requests from this verification

FAR ID	Forward action request	Response by Project Participants
	No FAR was identified during verification.	

APPENDIX B

POST REGISTRATION CHANGES

Type of post registration change	**Description of post registration change***	**Is prior approval by CDM EB required**?**	**In case prior approval by CDM EB is required, when was post registration change approved?**
Corrections	Not applicable	☐ Yes ☐ No	Not applicable
Temporary deviations from the registered monitoring plan and/or monitoring methodology	Not applicable	☐ Yes ☐ No	Not applicable
Permanent changes from the registered monitoring plan or applied methodology	Not applicable	☐ Yes ☐ No	*Not applicable*
Changes to the project design of a registered project activity	In the registered PDD dated 25 November 2009 /32/, the output power of the project activity is stated to be 4.5 MW, planned to be invested in 2009. The designed capacity was an indicative energy generation with an installed capacity to be implemented through a first phase of 0.5 MW and a second phase of 4.0 MW. However, the project has been implemented using the following equipment and according to the following schedule: • On November 2010, three generators of 1.426 MW each were installed, totalling 4.278 MW of capacity, and thus within the installed capacity of 4.5 MW described in the registered PDD; • On September 2011 one more generator set of 1.426 MW of installed capacity was implementing, resulting in a total installed capacity of 5.704 MW. Since the landfill was closed on December 2007, the LFG production trend is to decrease, and therefore, there will not be enough LFG to run the four generators in the near future. Therefore, the fourth LFG generator installed is planned to be removed and sold again in January 2013, so that the total installed capacity will be gain the original installed capacity of 4.278 MW with three LFG generators of 1.426 MW each. Nonethelss, the project activity has currently an actual installed capacity of 5.704 MW as verified by DNV during the site visit. The revised PDD, version 3 dated 3 October 2012 /34/, correctly describes the actual installed capacity, the corrected electricity generation and the future plans for the overall installed capacity of the project.	☐ Yes ☒ No	*Not applicable*

Type of post registration change	Description of post registration change*	Is prior approval by CDM EB required**?	In case prior approval by CDM EB is required, when was post registration change approved?
	DNV checked and verified complementary data and related information used to explain the changes made in the project activity and the impact of such changes in the project's implementation, emission reductions, additionality, project's scale and applicability and application of baseline methodology. The revised PDD /34/ and the calculations provided in the revised spreadsheet /35/clearly and transparently identify the changes from the project activity as described in the registered project design document /32/. The changes made in the revised PDD are related to the installation of an additional 1.426 MW generation unit. The justification and assumptions made in the calculations are considered reasonable and acceptable. The changes in the project design do not affect negatively the project activity operation however it affects the amount of emissions reductions expected by the project activity. The changes do neither impact adversely the additionality of the project nor the applicability/application of ACM0001, version 11 /63/. Hence, it is DNV's opinion that the changes to the project activity do not raise any concerns with regard to i) additionality, ii) scale of the CDM project activity and/or iii) applicability and application of baseline methodology.		

* For further details refer to the "Post-registration changes request form" (F-CDM-PRC) and DNV's assessment opinion on the changes

** Refer to Appendix 1 Appendix 1 to the CDM Project Standard /8/

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APPENDIX C

CURRICULA VITAE OF THE VERIFICATION TEAM MEMBERS

Juliana Scalon

Ms. Juliana Scalon holds a Bachelor Degree in Civil Engineering having an overall experience of around 12 years. Prior to joining DNV having 5.5 years of experience in waste handling and disposal service industry, covering technical operation and environment aspects of landfills and gas management, and 5 years of experience in CDM consultancy services, responsible for the development of several Project Design Documents for landfill gas projects, project management on CDM projects of renewables, transport, and the development of greenhouse gas inventories for chemical industry.

She works in DNV in the team for validation and verification of CDM projects/JI and other 3rd party validation/verification services.

Her qualification, industrial experience and experience in CDM demonstrate her sufficient sectoral competence in waste handling and disposal.

Luis Filipe Tavares

Mr. Luis Filipe Tavares holds a Technician's Degree in Chemistry and Bachelor's Degree in Metallurgical Engineering, having an overall experience of thirty tree years.

Prior to joining DNV having around twenty tree years' experience in steel production industry covering utilities (water, steam, wastewater treatment), environment control (atmosphere emissions, water emission and waste dumping).

His experience also covers the development of nitrification biological wastewater station as well as other activities as head of Utilities and Environmental Laboratory control.

He has also been actively involved in implementation of Management Systems such as ISO 9001 standard on coke oven department of steel industry as well as the ISO 140001 standard in all steel plant (the second steel company certified in the world) for more than three years.

He start on DNV as ISO 9001, ISO 14001 and OHSAS lead auditor, certifying numerous management systems during 7 years.

He has experience of around 8 years in validation and verification of numerous CDM projects in DNV, both in Brazil & South America.

His qualification, industrial experience and experience in CDM demonstrate his sufficient sectoral competence in Iron and Steel; Metal production; Oil and Gas industry, CMM recovery and use; Generation from renewable energy sources; Waste handling and disposal and Animal waste management.

Felipe Antunes

Felipe Antunes holds a Master's Degree in Production Engineering (Quality) and a Post Graduate Diploma in Environmental Management and Industrial Waste Management and Treatment. Possesses an International experience of more than 10 years in the field of quality

and environmental auditing, working two years as the responsible of the QMS of Rede Metrológica RS and since 1999 as a QMS and EMS auditor in DNV.

He has experience of more than 3 years in validation and verification of numerous CDM projects in DNV, both in South America & abroad. He has also been actively involved in Management System Audits such as ISO 9001, ISO 140001 and OHSAS 18001 standards in various industrial sectors for more than 10 years in DNV.

His qualification and experience in CDM demonstrate him sufficient sectoral competence in energy generation from renewable energy sources, waste handling and disposal, and animal waste management.

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