

MONITORING REPORT FORM (CDM-MR) *
Version 01 - in effect as of: 28/09/2010

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* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

MONITORING REPORT
Version 01, 05/12//2011

BRASCARBON Methane Recovery Project BCA-BRA-05, Brazil.

Reference number: 3455

Second Monitoring Period from 01/02/2011 to 31/10/2011

A.1. Brief description of the project activity:

The Project Activity consists of the construction of a new covered in-ground anaerobic reactor (digester) that will utilize the organic material currently treated in the wastewater opened lagoon, from the confined animal operations to produce biogas.

The equipment is based on in one ambient temperature storage covered cells (lagoon) with sufficient capacity to create an adequate Hydraulic Retention Time (HRT). The resulting biogas will be measured and destroyed through enclosed flaring system.

The expected result of this project is a significant reduction of GHG emissions compared to those emissions that would have occurred in the absence of the project and also promotion of sustainable swine production farms, bringing environmental and social benefits, moving from a high-GHG animal waste management system practice to anaerobic digester with capture and combustion of resulting biogas.

This project proposes to apply the Methane Recovery methodology identified in Section III.D, of the Indicative Simplified Baseline and Monitoring Methodologies for Small-Scale CDM Project Activity Categories, to swine confined feed operations located in the state of Mato Grosso do Sul, Brazil.

The start of the first construction is 03/03/2008 for Fazenda Água Branca (Água Limpa), Fazenda Bela Vista, Fazenda Cachoeira, Fazenda Santa Catarina, Granja Serra Dourada and Granja Capivara. All sites included in the PDD and the relevant dates of the project implementation for each site are described in the Section B1, because this project activity is making of 18 different sites. The start of crediting period is 21/08/2010 for all farms.

The total estimated emission reduction over the 7 years project period as documented in the PDD is 369.699 tonnes of CO₂ equivalent.

A.2. Project Participants

Name of Party involved (host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	Brascarbon Consultoria, Projetos e Representação Ltda.	No
Portugal	Luso Carbon Fund	No

A.3. Location of the project activity:

Table A1. Detailed physical location and identification of project site.

Farm / Site	Brascarbon ID	Address	Town / State	Contact	Phone	GPS Coord
Lote 28 e 27	BCA-039MS1-05	BR 163 toward Coxim - Assentamento Campanário	São Gabriel do Oeste - MS	Hilário Valentini e Valderi Valentin	+55 67 8424-8682	S 19,2836 W 54,6264
Lote 55 e 54	BCA-034MS1-05	BR 163 toward Coxim - Assentamento Campanário	São Gabriel do Oeste - MS	Antenor Barbosa de Oliveira Roque Luiz Busanello	+55 67 9962 2063	S 19,2911 W 54,6051
Lote 71	BCA-037MS1-05	BR 163 toward Coxim - Assentamento Campanário	São Gabriel do Oeste - MS	Airton José Borgmam	+55 67 9915-7335	S 19,2736 W 54,5942
Lote 82	BCA-038MS1-05	BR 163 toward Coxim - Assentamento Campanário	São Gabriel do Oeste - MS	João Ferreira dos Santos	+55 67 9962-1715	S 19,2714 W 54,5900
Lote 101	BCA-035MS1-05	BR 163 toward Coxim - Assentamento Campanário	São Gabriel do Oeste - MS	Leonildo Gama da Silva	+55 67 9936-7840	S 19,2683 W 54,5650
Lote 105	BCA-036MS1-05	BR 163 toward Coxim - Assentamento Campanário	São Gabriel do Oeste - MS	Vanderlei Carlos Shimit	+55 67 9934-0227	S 19,2644 W 54,5628
Fazenda Bela Vista	BCA-040MS1-05	BR163 - Km 609 – country Road to Ponto Alto - left side	São Gabriel do Oeste - MS	Jair Antonio Borgman	+55 67 3295 5031	S 19,4414 W 54,5622
Fazenda Cachoeira	BCA-042MS1-05	BR163 - Km 609 – country Road to Ponto Alto - left side	São Gabriel do Oeste - MS	Valdir Scotton	+55 67 9962 1494	S 19,4364 W 54,5589
Fazenda Dragão	BCA-032MS1-05	BR 163 - toward Cuiaba left	São Gabriel do Oeste - MS	Antonio Macari	+55 67 9611 8958	S 19,1547 W 54,7625
Fazenda Sorgatto	BCA-046MS1-05	BR 163 - Km 604 – toward south – right side 8 km from São Gabriel.do Oeste	São Gabriel do Oeste - MS	João Carlos Sorgatto	+55 67 9996 9990	S 19,4658 W 54,5256
Fazenda Bambú - Quinhão A	BCA-051MS1-05	Ponte Vermelha – District of São Gabriel do Oeste	São Gabriel do Oeste - MS	Ari Fernando Grando	+55 67 3295 1097	S 20,2939 W 54,6383
Fazenda Folleto	BCA-052MS1-05	Old BR163 - toward Ponto Alto	São G. do Oeste - MS	Jose Jorge Foletto	+55 67 9905 7306	S 19,5383 W 54,5208
Faz Rodeio – Gleba C	BCA-031MS1-05	Chácara Bairro jardim Gramado - Road to Cuiabá – left side	São G. do Oeste - MS	Alídio Biazus	+55 67 3295 1304	S 19,3772 W 54,6128
Fazenda Água Branca	BCA-030MS1-05	BR 163 - Km 592 – countryside – toward C. Grande -left	São G. do Oeste - MS	Delcio Guzzi	+55 67 9969 3706	S 19,5492 W 54,4331
Granja Serra Dourada	BCA-041MS1-05	BR163 - Km 609 – country Road to Ponto Alto right side	São G. do Oeste - MS	Rainer Josef Ruiz de Goehr	+55 67.8122-35661	S 19,2647 W 54,5642
Granja Capivara	BCA-043MS1-05	BR163 - Km 609 – Country Road to Ponto Alto left	São G. do Oeste - MS	Zélio Antonio Pessato	+55 67 3295 1242	S 19,4269 W 54,5483
Fazenda Santa Catarina	BCA-047MS1-05	BR163 - Km 594 – country Road to Ponto Alto	São G. do Oeste - MS	Cooasgo	+55 67 3295 1201	S 19,5600 W 54,3197
Faz Ponte Vermelha	BCA-068MS1-05	BR 163 - KM 586 – Road to Area da Ponte Vermelha - 3 km right	São G. do Oeste - MS	Valdinei Viviam	+55 67 3295 5345	S 19,4753 W 54,4061

A.4. Technical description of the project

The technology used is an anaerobic digestion process in which microorganisms break down biodegradable material in the absence of oxygen. The process is widely used to treat wastewater sludge and organic wastes because it provides volume and mass reduction of the input material.

As part of an integrated waste management system, anaerobic digestion reduces the emission of the greenhouse gas into the atmosphere. Anaerobic digestion is a renewable energy source because the process produces a methane and carbon dioxide, rich biogas, suitable for energy production helping replace fossil fuels. The nutrient-rich solids left after digestion can be used as fertilizer also (Figure 1).

The digestion process begins with bacterial hydrolysis of the input materials in order to break down insoluble organic polymers such as carbohydrates and make them available for other bacteria. Acidogenic bacteria then convert the sugars and amino acids into carbon dioxide, hydrogen, ammonia, and organic acids. Acetogenic bacteria then convert these resulting organic acids into acetic acid, along with additional ammonia, hydrogen, and carbon dioxide. Methanogenic bacteria finally are able to convert these products to methane and carbon dioxide.

The equipment is based on in one ambient temperature storage covered cells (lagoon) with sufficient capacity to create an adequate Hydraulic Retention Time (HRT). The cell will use a single-piece liner affixed to a reinforced outer concrete frame. The outer cover consists of a synthetic vinyl membrane or High Density Polyethylene (HDPE)-, which is also fastened to the frame. The liner and cover will be sealed together with bolts and iron plate frame.

The system also includes a biogas collector piping, from the digester to the flare system.

The flare is enclosed and controlled by a data logger CLP –Controller Logic Programmable – where the combustion temperature is stored every one minute in the system.

This system will record every each minute the combustion temperature to determinate the flare efficiency according to the specification of the flare. A thermocouple installed in the flare is connected to the PLC to register the combustion temperature.

The sparking system in the flare is automatic. Every one second the system sparks.

The biogas flow rate will be also controlled by a CLP where every each minute the system records the flow rate.

The sparking system, the PLC and the control panel are powered by a 12 volts battery charged by solar cells.

A derivation pipe will be installed before the flare and after the flow meter, for future proposals, to supply biogas to the electricity generators, for in site electricity supply where no claims for emissions reductions by the electricity generation will be requested during the entire project activity but rather by the emissions reductions of the biogas destroyed in the generators..

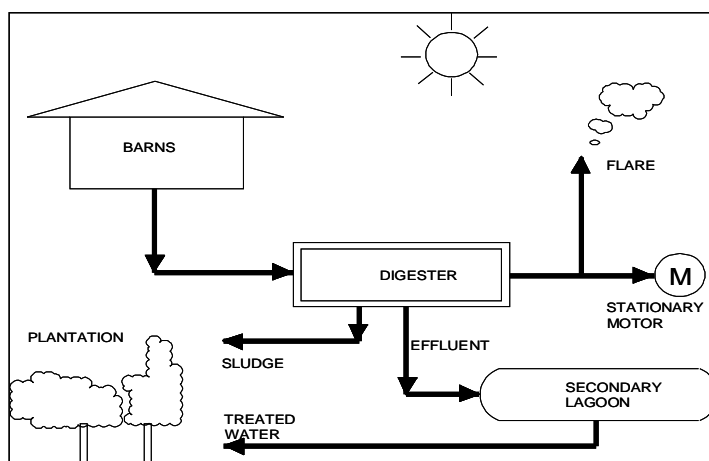
The treated effluent is discharged to the open lagoons where it is aerated as per the design of the original lagoon system.

The treated water can be then recycled and sent back to the farm proposals, or used for irrigation by the use of biogas pumps or electrical stationary pumps supplied by the biogas electricity generator.

No electricity will be consumed from the grid. The technical parts that will be powered by energy will be supplied by solar cells. The energy will be stored in 12 volts batteries.

The sludge from the digesters will be spread aerobically in the surface of the pasture or plantation as fertilizer in a depth less than 0,30 meters. The sludge will be pumped by a portable biogas pump.

Figure 1. Flowchart of the treatment system



A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

The approved baseline and monitoring methodology is:

☐ Type III. D (reference AMS-III.D - Version 14 – “*Methane recovery in animal manure management systems*”).

A.6. Registration date of the project activity:

Registration date: 21/08/2010.

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

The crediting period is from 21/08/2010 to 20/08/2017 (renewable).

A.8. Name of responsible person(s)/entity(ies):

Responsible for completing the CDM-Monitoring Report Form	
Name Contact	Information Contact
Technical Responsibility Luiz Lasas	2064 Ibirapuera Avenue – ZIP CODE 04028-001 São Paulo - SP, Brazil Phone: +55 11 5523 7059 e-mail: luiz.lasas@brascarbon.com.br
Responsible for preparation of Monitoring Report David Vanni Jacob	2064 Ibirapuera Avenue – ZIP CODE 04028-001 São Paulo - SP, Brazil Phone: +55 11 5523 7059 e-mail: david.jacob@brasilm.com.br

SECTION B. Implementation of the project activity
B.1. Implementation status of the project activity

The project implementation started on 03/03/2008, where the construction activity started.

This project is making of 18 sites (farms) where each phase of the project implementation as so as the construction, start-up and continuous operation, was concluded in different dates which can be found in the table below:

Table B1. Relevant dates of project implementation.

Farm/Site Name	Brascarbon ID	Start Construction	Finish Construction	Start-up and Tests	Monitoring Start Date
Lote 28 e 27	BCA-039MS1-05	10/11/2008	13/04/2009	25/05/2009	01/07/2009
Lote 55 e 54	BCA-034MS1-05	10/11/2008	13/04/2009	25/05/2009	01/07/2009
Lote 71	BCA-037MS1-05	10/11/2008	13/04/2009	25/05/2009	01/07/2009
Lote 82	BCA-038MS1-05	10/11/2008	13/04/2009	25/05/2009	01/07/2009
Lote 101	BCA-035MS1-05	10/11/2008	13/04/2009	25/05/2009	01/07/2009
Lote 105	BCA-036MS1-05	10/11/2008	13/04/2009	25/05/2009	01/07/2009
Fazenda Bela Vista	BCA-040MS1-05	03/03/2008	02/03/2009	06/04/2009	18/06/2009
Fazenda Cachoeira	BCA-042MS1-05	03/03/2008	02/03/2009	06/04/2009	01/06/2009
Fazenda Dragão	BCA-032MS1-05	24/11/2008	27/04/2009	01/06/2009	08/07/2009
Fazenda Sorgatto	BCA-046MS1-05	24/11/2008	27/04/2009	01/06/2009	11/07/2009
Fazenda Bambú - Quinhão	BCA-051MS1-05	09/03/2009	10/08/2009	21/09/2009	29/10/2009
Fazenda Folleto	BCA-052MS1-05	24/11/2008	27/04/2009	01/06/2009	01/07/2009
Faz Rodeio – Gleba C	BCA-031MS1-05	24/11/2008	27/04/2009	01/06/2009	16/07/2009
Fazenda Água Branca	BCA-030MS1-05	03/03/2008	02/03/2009	06/04/2009	09/06/2009
Granja Serra Dourada	BCA-041MS1-05	03/03/2008	02/03/2009	06/04/2009	17/08/2009
Granja Capivara	BCA-043MS1-05	03/03/2008	02/03/2009	06/04/2009	07/06/2009
Fazenda Santa Catarina	BCA-047MS1-05	03/03/2008	02/03/2009	06/04/2009	01/03/2009
Faz Ponte Vermelha	BCA-068MS1-05	24/11/2008	27/04/2009	01/06/2009	01/07/2009

During the monitoring period there were no special events such as overhaul times, downtimes of equipment, exchange of equipment, etc, neither situations or issues resulting from these events that would have impact on the applicability of the methodology used.

B.2. Revision of the monitoring plan

Brascarbon revised the monitoring plan considering the efficiency 90% for the hour with all temperature measurements above or equal to 500° Celsius (like adopted in the PDD), 50% efficiency for the hour with any parameter of flare operation is out of the range of manufacturer specifications and 0% efficiency for the hour with any temperature measurement below 500° Celsius.

It was considered by Brascarbon the conditions above to be according to the methodology AMS.III-D version 14 to demonstrate the emissions reduction calculation for the respective hour.

B.3. Request for deviation applied to this monitoring period

No request for deviation has been submitted for the project activity for this monitoring period up to date.

B.4. Notification or request of approval of changes

No notification or request of approval of changes has been requested for the project activity up to date.

SECTION C. Description of the monitoring system

Table C1. Monitoring plan followed by Brascarbon in order to achieve certified emissions reductions process.

ID	DATA	Data Type	Data Unit	Data Variable	Frequency	Measured(m) Calculated(c) Estimated(e) Documented(d)	Proportion of the data to be monitored	How will the data be archived?	For how long is archived data to be kept?	Comment
1	T f	Temp	°C	Flare Temperature	Every 1 minute	M	100%	electronic	Project duration +5years	Use for flare efficiency
2	Site Inspection	Document	----	----	Annually	D	100%	electronic	Project duration +5years	General Site Inspection
3	N _{LT,y}	Number	-	Nr, Of heads	Monthly	M	100%	electronic	Project duration +5years	Used to quantify the methane generation potential
4	BG _{burnt,y}	Volume	m ³	Biogas produced	Monthly	M	100%	electronic	Project duration +5years	This parameter measures the instantaneous and cumulative biogas flow rate.
5	w _{CH4,y}	Fraction	%	Methane content	TBD(*)	M	100%	electronic	Project duration +5years	Concentration in wet basis
6	T _{biogas}	Temp	°C	Biogas Temperature	Monthly	M	100%	electronic	Project duration +5years	Use to biogas density calculation
7	D _{CH4}	Mass	Ton/m ³	Density	Monthly	C	100%	electronic	Project duration +5years	Density
8	FE	Efficiency	%	Temperature	Monthly	C	100%	electronic	Project duration +5years	Calculated according to the flare burning temperature and the flare specification.
9	QDM	Supervision	--	---	Every Batch Disposed	E	100%	electronic	Project duration +5years	Sludge disposed outside project boundary
10	W site	Mass	kg	Average Animal weight	Quarterly	D	100%	electronic	Project duration +5years	Yearly methane potential generation
11	ER _{y,estimated}	Mass	Ton	CO ₂ e	Annually	C	100%	electronic	Project duration +5years	Yearly methane potential generation
12	FFR	-----	---	Feed Formulation	Monthly	D	100%	electronic	Project duration +5years	Feed Formulation Rations
13	P biogas	Pressure	mbar	Biogas Pressure	Monthly	M	100%	electronic	Project duration +5years	Feed Formulation Rations
14	Genetic Source	Document	-----	genetic	Annually	D	100%	electronic	Project duration +5years	Genetic Source
15	MS% i,y	fraction	%	Manure handled	Annually	E	100%	electronic	Project duration +5years	General Site Inspection
16	FV _{RG,h}	volume	m ³ /h	volume	Monthly	M	100%	electronic	Project duration +5years	Volume of residual gas
17	fV _{CH4,RG}	fraction	%	Methane content	TBD(*)	M	100%	electronic	Project duration +5years	Volumetric methane fraction of the residual gas
18	TM _{RG,h}	mass	Kg/h	Mass flow rate	Monthly	M	100%	electronic	Project duration +5years	Total mass flow rate of the residual gas
19	N day,y	number	days	days	Monthly	M	100%	electronic	Project duration +5years	Nr. Of days animal is alive
20	N p,y	number	heads	Nr of heads	Monthly	M	100%	electronic	Project duration +5years	Nr. Of heads per category annually
21	E	KWh	Kw	power	When used	M	100%	electronic	Project duration +5years	Electricity consumed in the project activity

(*) TBD: to be determinate to attend 95% confidence level

The monitoring plan will concentrate on ensuring the emission reductions are accurately accounted within the project boundary.

Brascarbon introduce some formularies to facilitate the monitoring system of the parameters described in the table above – Monitoring Plan.

A list of the formularies utilized to the monitoring control can be found in the files at Brascarbon and available for verification.

The monitored data are described below:

-Flare Temperature (Tf): The monitored flare temperature is registered every minute and stored in the programmable logic control system – PLC. A “THERMOCOUPLE” installed in the flare measures and sends the temperature information to the PLC. The data is stored in the PLC and recovered by down loading the file through a pen drive connection. The file data is recovered monthly to calculate the Flare Efficiency.

The thermocouple is calibrated periodically according to the supplier requirements and followed by Brascarbon.

Formulary 01.001 concerns about the temperature monitoring process for each farm during the monitoring period. The flare temperature monitoring procedure, developed by BRASCARBON, was verified by DOE during verification process. Documents to prove the monitoring control process are available at BRASCARBON office and copies of all documentation were sent to DOE.

-Site Inspection: This annual procedure establishes the basic conditions for site and digester inspections in terms of lay-out, considering changes in the process flow which can compromise the biogas production and the residual water treatment. Also it controls if the site regulation where the digester is located is in conformity with legal requirements, when applicable. All sites were inspected during verification period and no changes were observed. The Site inspection information was registered in formulary 02.001 and presented to DOE during verification process.

- Average number of animals ($N_{LT,y}$, $N_{day,y}$ and $N_{p,y}$): To calculate the average number of animals per category LT in the year y ($N_{LT,y}$) the operational procedure has the form 03.002 in the operational procedure POP 3 (average number of animals) where it takes into account of the number of days the animal is alive in the year y ($N_{day,y}$) and the number of animals produced per category LT in the year y ($N_{p,y}$).

The days of animals alive and the total animal produced is also monitored with the same procedure and the form 03.002.

The formula used to the calculation is:

$$N_{LT,y} = N_{da,y} * (N_{p,y}/365)$$

Where:

$N_{da,y}$ Number of days animal is alive in the farm in the year “y” (numbers)

$N_{p,y}$ Number of animals produced annually of type “LT” for the year “y” (numbers)

-Biogas Volume ($BG_{burnt,y}$): The data is collected monthly using the formulary 04.001 field data collection.

The biogas flow rate is also registered every minute in the PLC - programmable logic control system. The flow rate data is stored in the PLC and recovered by down loading the file through a pen drive connection. The file data is recovered monthly and analyzed by QA/QC officer.

The flow meter is calibrated according to the supplier requirements and followed by Brascarbon.

The flow meter used in the project is from ENDRESS+HAUSER, FLOW MONITOR, t- trend, ATT12-A99D314D1 MODEL, type: Thermal Mass Flow.

-Methane Content ($W_{CH_4,y}$ and $FV_{CH_4\ RG,y}$): The methane content is measures by the equipment BIOGAS from Landtech. To measure the methane content the BIOGAS equipment is connected to the digester and takes a biogas sample by pumping the biogas trough a connection hose and after a few seconds the instrument informs the methane content in the equipment panel. This information is registered by the field technician in the formulary for field data collection 04.001.

The monitoring frequency is monthly and it uses a portable digital analyzer (Landtech – Biogas portable model). The calibration system is in accordance to the supplier recommendations and followed by Brascarbon.

-Biogas Temperature (T_{biogas}): The monitored biogas temperature is monthly using the portable digital analyzer (Biogas portable model from Landtech).

The probe from the instrument is inserted into the digester to obtain the temperature of the biogas. After inserting the probe in the especial device in the digester the instrument BIOGAS takes a few seconds to inform the biogas temperature. This information is registered by the field technician in the formulary for field data collection 04.001.

The calibration system of the instrument is in accordance to the supplier recommendations and followed by Brascarbon.

-Methane Density (D_{CH_4}): The methane density is based in the Attachment 13 – Methodological “Tool to determine project emissions from flaring gases containing methane”, step 1, determination of the mass flow rate of the residual gas that is flared, equation 2 for density. The methane density ex-post will be adjusted in accordance to the local pressure and temperature. The frequency of methane density calculation is monthly.

-Flare Efficiency (FE): It is the efficiency of the methane destruction in the hour h in the measured temperature. The flare efficiency is 90% when the flare temperature is higher or equal to 500°C for the respective hour if the flare operation is according to the flare specification. If in any specific hour the flare operation is out of the specification then 50% efficiency is adopted for the respective hour. The flare efficiency is 0% when the flare temperature is less than 500°C for the respective hour.

The frequency of flare efficiency monitoring is hourly and the data of the flare operation can be found in the formulary 01.001 extracted from the CLP that stored all information of the flare monitoring every minute. Monthly is prepared also the formulary 08.001 containing all information of the flare efficiency calculation where it uses the data stored in the CLP.

Brascarbon developed the formulary 08.001 in the operational procedure to monitor the hourly flare efficiency according to the criteria above mentioned.

The data stored in the CLP is recovered by down loading the file through a pen drive connection.

The CLP is powered by photo-voltaic cell – no use of energy from the grid, and the file data is recovered monthly to calculate the Flare Efficiency.

The information of the flare efficiency for each hour during 24 hour per day is registered in the formulary 08.001, flare efficiency monitoring control. This formulary is available for revision and verification at Brascarbon office. The burning temperature and biogas flow rate will be monitored minute by minute by a sensor installed in the pipe and in the enclosed flare respectively and the data is stored in the CLP. The data stored in the CLP is recovered monthly and the information is sent to the QA/QC officer to manage the information to proceed with the emissions reductions calculation. The flare operation is continuously monitored and the documents to prove all data and parameters that are required to monitor the flare operation within the range of operating conditions according to manufacturer’s specifications can be found and available at Brascarbon office.

To assure that the flare operates adequately a maintenance program is established to guarantee that the flare operation is according to the manufacturer specification.

- Digester Sludge Removal (QDM): The digester sludge is the heavier fraction of waste, composed by minerals and organic components, in liquid form. This material should be removed from digester and disposed outside project boundary. When the sludge is removed, the field technician will follow the procedure to certify that the sludge will spread aerobically in the field. This information is registered in the formulary 09.001 and it is available for revision and verification at Brascarbon office.

The sludge was not removed during verification period.

- Animal weight (W_{site}): The animal weight is monitored and controlled by a formulary 16.001 where each animal category is monitored during the year, according to the information obtained in the confined feed animal operation.

Quarterly the data from the feed operations are checked and transferred to the formulary 16.001.

Records available in the feed operations will be copied and filed at Brascarbon office and attached with the formulary 16.001.

-Emission Reductions – ER_{y, ex-post}: The emission reductions achieved by the project activity will be calculated with ex-post monitored data through direct measurement of the amount of methane fuelled, flared or gainfully used.

The equations can be found in the “emission reduction spreadsheet” and it is available for validation and verification.

The emission reductions achieved in any year are the lowest value of the following:

$$ER_{y,ex-post} = \min[(BE_{y,ex-post} - PE_{y,ex-post}), (MD_y - PE_{power,y,ex-post})]$$

Where:

ER _{y,ex-post}	Emission reductions achieved by the project activity based on monitored values for year y (tCO ₂ e)
BE _{y ex post}	Baseline emissions calculated using equation B1 and using ex post monitored values of NLT _y for year y (tCO ₂ e)
PE _{y, ex post}	Project emissions calculated using equation B5 using ex post monitored values of NLT _y , MS% i,y for year y (tCO ₂ e)
MD _y	Methane captured and destroyed or used gainfully by the project activity in year y (tCO ₂ e)
PE _{power,y,ex post}	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year y (tCO ₂ e)

-Formulated feed rations (FFR): Monitoring and controlling of the formulated feed rations used per animal category per confined feed animal operation.

Records available in the feed operations will be copied and filed at Brascarbon office and attached with the formulary 14.001 that controls the formulated feed rations for each farm.

-Biogas Pressure (P_{biogas}): The biogas pressure is measured by the equipment BIOGAS from Landtech. To obtain the biogas pressure the BIOGAS equipment is connected to the digester trough a hose connection and after a few seconds after starting the instrument it informs the biogas pressure in its panel. This information is registered by the field technician in the formulary of field data collection 04.001.

The measured pressure obtained in all farms are less than 1 atm (or 1013 mbar) due all farms are located above sea level. The monitoring frequency is monthly.

The calibration system is in accordance to the supplier recommendations and followed by Brascarbon.

-Genetic Source: Monitoring and controlling of the genetic source in the project activity per farm.

Records available in the feed operations will be copied and filed at Brascarbon office and attached with the formulary 15.001 that controls the genetic source for each farm.

- **Fraction of manure handled (MS%_{i,y}):** is included to be inspected during every farm visit. No changes in the manure managing system will be permitted during the project activity. If changes occur in the manure management the information has to be described in the formulary 02.001.

- **Methane mass flow rate in the residual gas (TM_{RG,h}):**

$$TM_{RG,h} = FV_{RG,h} * fv_{yCH4,RG,h} * \rho_{CH4,n}$$

TM_{RG,h} Mass flow rate of methane in the residual gas in the hour *h* (Kg/h)

FV_{RG,h} Volumetric flow rate of the residual gas in dry basis at normal conditions in hour *h* (m³/h)

fv_{CH4,RG,h} Volumetric fraction of methane in the residual gas on dry basis in hour *h* (fraction).

ρ_{CH4,n} Density of methane at normal conditions (0.716)(Kg/m³)

- **Volumetric flow rate of the residual gas (FV_{RG,h}) (m³/h):**

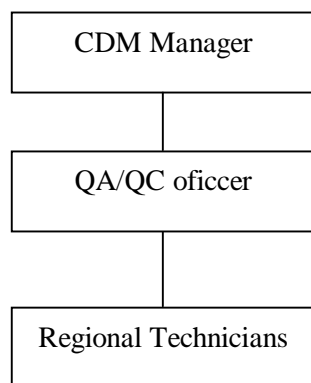
The volumetric flow rate is calculated dividing the total volume measured (BG_{burnt,y}) in the period by the total hours of measurement.

$$FV_{RG,h} = BG_{burnt,y} / \text{total hours},y$$

- **Energy consumed from the grid by the project (E) (kwh):**

The entire project will not use energy from the grid. The eventual use of energy will be monitored and registered in the formulary 22.001 by the regional technician

The organizational structure for this monitoring system is:



CDM Manager: Engineer, responsible for the CDM operations and approval of the documents.

Regional Technicians: Technician, responsible for the monitoring and maintenance of the site projects according to the procedures in the Operations Procedure Manual.

For maintenance of the equipment to attend the monitoring system, BRASCARBON will use the practices recommended by the equipment supplier for repairs, calibration, etc...

Regular maintenance of the site considering the site area, instrumentation, equipment, cleaning etc., according to the Brascarbon Operation Procedures Manual

Quality Assurance/Quality Control officer: Responsible to assure the quality control of the information and the CDM project documents and also prepares the monitoring report.

Also controls and checks all certificates of calibration and its expiration date and prepares all documents related to the CDM project for further validation and verification.

SECTION D. Data and parameters
D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	<i>VS default</i>
Data unit:	kg dry matter/animal/day
Description:	Default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population
Source of data used:	Obtained from IPCC2006, vol 4, chapter 10, Tables 10A-7 and 10A-8.
Value(s) :	0.3 for Market Swine 0,46 for Breeding Swine 0,46 for Guilts
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions
Additional comment:	No comments

Data / Parameter:	MCF _j
Data unit:	%
Description:	Annual methane conversion factor for the baseline animal waste management system “j”.
Source of data used:	Obtained from IPCC2006, vol 4, chapter 10, Tables 10.17.
Value(s) :	79%
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions
Additional comment:	No comments

Data / Parameter:	MS%Bl, _j
Data unit:	Fraction
Description:	Fraction of manure handled in baseline animal manure management system “j”.
Source of data used:	Project proponents
Value(s) :	1
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions
Additional comment:	No comments

Data / Parameter:	GWP_{CH4}
Data unit:	tCO ₂ e/tCH ₄
Description:	Global warming potential of CH ₄
Source of data used:	IPCC 2006
Value(s) :	21
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions and Project emissions
Additional comment:	No comments

Data / Parameter:	B_{0,LT}
Data unit:	m ³ CH ₄ /kg dm
Description:	Maximum methane producing potential of the volatile solid generated for animal type "LT".
Source of data used:	IPCC 2006, Tables 10-A7 and 10-A8.
Value(s) :	Sows(breeding swine more than 200 kg mass): 0.45 Finishers(market swine more than 50 Kg mass): 0.45 Nursery: 0.45 Boars and Gilts (market swine more than 100 Kg mass): 0.45
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions
Additional comment:	No comments

Data / Parameter:	W default
Data unit:	Kg
Description:	Default average animal weight of a defined population at the project site.
Source of data used:	IPCC 2006, Tables 10-A7 and 10-A8.
Value(s) :	Sows(breeding swine): 198 kg Finishers(market swine): 50 kg Nursery (market swine): 50 kg Boars (market swine): 50 kg Gilts (breeding swine): 198 kg
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions
Additional comment:	No comments

Data / Parameter:	D_{CH4}
Data unit:	t/m ³ at room temperature
Description:	Methane Density
Source of data used:	IPCC - 2006
Value(s) :	0.00067
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions
Additional comment:	No comments

Data / Parameter:	UF _b
Data unit:	No unit applied
Description:	Model correction factor to account for model uncertainties
Source of data used:	Reference: FCCC/SBSTA/2003/10/Add.2, page 25.
Value(s) :	0.94
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions
Additional comment:	No comments

D.2. Data and parameters monitored

Data / Parameter:	T f																																																																																																																																					
Data unit:	°C																																																																																																																																					
Description:	Combustion temperature of the flare																																																																																																																																					
Measured /Calculated /Default:	Measured																																																																																																																																					
Source of data:	Brascarbon Monitoring Report System																																																																																																																																					
Value(s) of monitored parameter:	Above 500°C																																																																																																																																					
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions																																																																																																																																					
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	<div>Thermocouple⁽¹⁾</div> <table><tr><th>Farm Name</th><th>Site ID</th><th>Thermocouple Serial Number ⁽²⁾</th><th>Calibration Certificate Number</th><th>Calibration Date ⁽³⁾</th><th>Installation Date</th><th>Expiration Date</th></tr><tr><td>Lote 28 e 27</td><td>BCA-039MS1-05</td><td>39MS1-05-021/10-6</td><td>021/10-6</td><td>21/03/10</td><td>23/03/10</td><td>20/03/12</td></tr><tr><td>Lote 55 e 54</td><td>BCA-034MS1-05</td><td>34MS1-05-021/10-7</td><td>021/10-7</td><td>21/03/10</td><td>23/03/10</td><td>20/03/12</td></tr><tr><td>Lote 71</td><td>BCA-037MS1-05</td><td>37MS1-05-021/10-5</td><td>021/10-5</td><td>21/03/10</td><td>23/03/10</td><td>20/03/12</td></tr><tr><td>Lote 82</td><td>BCA-038MS1-05</td><td>38MS1-05-021/10-10</td><td>021/10-10</td><td>21/03/10</td><td>23/03/10</td><td>20/03/12</td></tr><tr><td>Lote 101</td><td>BCA-036MS1-05</td><td>36MS1-05-062/10-5</td><td>062/10-5</td><td>15/05/10</td><td>17/05/10</td><td>14/05/12</td></tr><tr><td>Lote 105</td><td>BCA-035MS1-05</td><td>35MS1-05-021/10-14</td><td>021/10-14</td><td>21/03/10</td><td>23/03/10</td><td>20/03/12</td></tr><tr><td>Fazenda Bela Vista</td><td>BCA-040MS1-05</td><td>40MS1-05-021/10-2</td><td>021/10-2</td><td>21/03/10</td><td>23/03/10</td><td>20/03/12</td></tr><tr><td>Fazenda Cachoeira</td><td>BCA-042MS1-05</td><td>42MS1-05-021/10-13</td><td>021/10-13</td><td>21/03/10</td><td>23/03/10</td><td>20/03/12</td></tr><tr><td>Fazenda Dragão</td><td>BCA-032MS1-05</td><td>32MS1-05-021/10-17</td><td>021/10-17</td><td>21/03/10</td><td>23/03/10</td><td>20/03/12</td></tr><tr><td>Fazenda Sorgatto</td><td>BCA-046MS1-05</td><td>46MS1-05-021/10-15</td><td>021/10-15</td><td>21/03/10</td><td>23/03/10</td><td>20/03/12</td></tr><tr><td>Fazenda Bambú - Quinhão A</td><td>BCA-051MS1-05</td><td>51MS1-05-021/10-4</td><td>021/10-4</td><td>21/03/10</td><td>23/03/10</td><td>20/03/12</td></tr><tr><td>Fazenda Folleto</td><td>BCA-052MS1-05</td><td>52MS1-05-021/10-11</td><td>021/10-11</td><td>21/03/10</td><td>23/03/10</td><td>20/03/12</td></tr><tr><td>Fazenda Agua Branca</td><td>BCA-030MS1-05</td><td>30MS1-05-021/10-3</td><td>021/10-3</td><td>21/03/10</td><td>23/03/10</td><td>20/03/12</td></tr><tr><td>Fazenda Rodeio - Gleba C</td><td>BCA-031MS1-05</td><td>31MS1-05-021/10-12</td><td>021/10-12</td><td>21/03/10</td><td>23/03/10</td><td>20/03/12</td></tr><tr><td>Granja Serra Dourada</td><td>BCA-041MS1-05</td><td>41MS1-05-021/10-8</td><td>021/10-8</td><td>21/03/10</td><td>23/03/10</td><td>20/03/12</td></tr><tr><td>Granja Capivara</td><td>BCA-043MS1-05</td><td>43MS1-05-062/10-10</td><td>062/10-10</td><td>15/05/10</td><td>17/05/10</td><td>14/05/12</td></tr><tr><td>Fazenda Santa Catarina</td><td>BCA-047MS1-05</td><td>47MS1-05-021/10-16</td><td>021/10-16</td><td>21/03/10</td><td>23/03/10</td><td>20/03/12</td></tr><tr><td>Fazenda Ponte Vermelha</td><td>BCA-068MS1-05</td><td>68MS1-05-021/10-9</td><td>021/10-9</td><td>21/03/10</td><td>23/03/10</td><td>20/03/12</td></tr></table> <div>(1) Monitoring equipment: thermocouple (2) Accuracy class: Accuracy - ± 1,5°C (3) Calibration frequency: Based on expiration date.</div>	Farm Name	Site ID	Thermocouple Serial Number ⁽²⁾	Calibration Certificate Number	Calibration Date ⁽³⁾	Installation Date	Expiration Date	Lote 28 e 27	BCA-039MS1-05	39MS1-05-021/10-6	021/10-6	21/03/10	23/03/10	20/03/12	Lote 55 e 54	BCA-034MS1-05	34MS1-05-021/10-7	021/10-7	21/03/10	23/03/10	20/03/12	Lote 71	BCA-037MS1-05	37MS1-05-021/10-5	021/10-5	21/03/10	23/03/10	20/03/12	Lote 82	BCA-038MS1-05	38MS1-05-021/10-10	021/10-10	21/03/10	23/03/10	20/03/12	Lote 101	BCA-036MS1-05	36MS1-05-062/10-5	062/10-5	15/05/10	17/05/10	14/05/12	Lote 105	BCA-035MS1-05	35MS1-05-021/10-14	021/10-14	21/03/10	23/03/10	20/03/12	Fazenda Bela Vista	BCA-040MS1-05	40MS1-05-021/10-2	021/10-2	21/03/10	23/03/10	20/03/12	Fazenda Cachoeira	BCA-042MS1-05	42MS1-05-021/10-13	021/10-13	21/03/10	23/03/10	20/03/12	Fazenda Dragão	BCA-032MS1-05	32MS1-05-021/10-17	021/10-17	21/03/10	23/03/10	20/03/12	Fazenda Sorgatto	BCA-046MS1-05	46MS1-05-021/10-15	021/10-15	21/03/10	23/03/10	20/03/12	Fazenda Bambú - Quinhão A	BCA-051MS1-05	51MS1-05-021/10-4	021/10-4	21/03/10	23/03/10	20/03/12	Fazenda Folleto	BCA-052MS1-05	52MS1-05-021/10-11	021/10-11	21/03/10	23/03/10	20/03/12	Fazenda Agua Branca	BCA-030MS1-05	30MS1-05-021/10-3	021/10-3	21/03/10	23/03/10	20/03/12	Fazenda Rodeio - Gleba C	BCA-031MS1-05	31MS1-05-021/10-12	021/10-12	21/03/10	23/03/10	20/03/12	Granja Serra Dourada	BCA-041MS1-05	41MS1-05-021/10-8	021/10-8	21/03/10	23/03/10	20/03/12	Granja Capivara	BCA-043MS1-05	43MS1-05-062/10-10	062/10-10	15/05/10	17/05/10	14/05/12	Fazenda Santa Catarina	BCA-047MS1-05	47MS1-05-021/10-16	021/10-16	21/03/10	23/03/10	20/03/12	Fazenda Ponte Vermelha	BCA-068MS1-05	68MS1-05-021/10-9	021/10-9	21/03/10	23/03/10	20/03/12
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Measuring/ Reading/ Recording frequency:	Every minute																																																																																																																																					
Calculation method (if applicable):	N/A																																																																																																																																					
QA/QC procedures applied:	Check the data for more accurate information. Although the reading measure of burning temperature is stored every minute in the CLP this information is recovery monthly in the site.																																																																																																																																					

Data / Parameter:	SITE INSPECTION
Data unit:	Documents
Description:	Inspection on the site considering relevant regulation and the infrastructure of the site
Measured /Calculated /Default:	Brascarbon Monitoring Report System
Source of data:	Documents
Value(s) of monitored parameter:	N/A
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	N/A
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Check of the monitoring documents prepared during the site visit

Data / Parameter:	$N_{LT,y}$
Data unit:	Number
Description:	Annual average number of animals of type “LT” in year “y”
Measured /Calculated /Default:	Measured
Source of data:	Brascarbon Monitoring Report System
Value(s) of monitored parameter:	Number of heads
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	$N_{LT,y} = N_{da,y} * (N_{p,y}/365)$ <p>Where: $N_{da,y}$ =Number of days animal is alive in the farm in the year “y” (numbers) $N_{p,y}$ =Number of animals produced annually of type “LT” for the year “y” (numbers)</p>
QA/QC procedures applied:	Check of the site records and documents.

Data / Parameter:	$N_{\text{day,y}}$
Data unit:	Number
Description:	Number of days animal is alive in the farm, in year “y”
Measured /Calculated /Default:	Measured
Source of data:	Brascarbon Monitoring Report System
Value(s) of monitored parameter:	Number of days
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Check of the site records and documents.

Data / Parameter:	$N_{\text{p,y}}$
Data unit:	Number
Description:	Number of animals produced annually of type “LT” in year “y”
Measured /Calculated /Default:	Measured
Source of data:	Brascarbon Monitoring Report System
Value(s) of monitored parameter:	Number of heads
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Check of the site records and documents.

Data / Parameter:	BG burnt,y																																																																																																																																																																								
Data unit:	m ³																																																																																																																																																																								
Description:	Biogas flared or used as a fuel in the year y.																																																																																																																																																																								
Measured /Calculated /Default:	Measured																																																																																																																																																																								
Source of data:	Brascarbon Monitoring Report System																																																																																																																																																																								
Value(s) of monitored parameter:	to be measured during the monitoring period																																																																																																																																																																								
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QA/QC procedures applied:	<p>Check the registers sent from the field. Control and assure the calibration program of the flow meter according manufacture recommendation.</p> <p>The biogas flared is measured continuously and the data is stored in the CLP every minute. The data is recovered monthly from the CLP by the use of the pen drive.</p>																																																																																																																																																																								

Data / Parameter:	$W_{CH_4, y}$																																																																																																												
Data unit:	Fraction																																																																																																												
Description:	Methane content in biogas in the year “y”																																																																																																												
Measured /Calculated /Default:	Measured																																																																																																												
Source of data:	Brascarbon Monitoring Report System																																																																																																												
Value(s) of monitored parameter:	To be measured during the monitoring period.																																																																																																												
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions																																																																																																												
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Data / Parameter:	T _{biogas}																																																																																																												
Data unit:	°C																																																																																																												
Description:	Temperature of the biogas at ambient conditions																																																																																																												
Measured /Calculated /Default:	Measured																																																																																																												
Source of data:	Brascarbon Monitoring Report System																																																																																																												
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Calculation method (if applicable):	N/A																																																																																																												
QA/QC procedures applied:	Check the registers in the generated documents. Control and assure the calibration program of the instrument.																																																																																																												

Data / Parameter:	$D_{CH_4,y}$
Data unit:	tones / m ³
Description:	Density of the methane combusted at room temperature and pressure
Measured /Calculated /Default:	Calculated
Source of data:	Brascarbon Monitoring Report System
Value(s) of monitored parameter:	Determined according the temperature and pressure of biogas
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	$D_{CH_4,y} = \frac{P_n}{\frac{R_u}{MM_{RG,h}} \times T_n}$ <p> $D_{CH_4,y}$: Density of methane in the biogas kg/m³ P_n: Pressure of biogas (Pascal) R_u: Universal Gas Constant (8314 Pa.m³/Kmol K) $MM_{RG,h}$:Molecular mass of methane (16.04 kg / mol) </p>
QA/QC procedures applied:	Check and verify the density value calculation.

Data / Parameter:	FE or η_{flare}
Data unit:	%
Description:	Flare Efficiency
Measured /Calculated /Default:	Calculated
Source of data:	Brascarbon Monitoring Report System
Value(s) of monitored parameter:	If flare temperature $\geq 500^{\circ}\text{C}$ then 90% efficiency If flare operation conditions is out of spec then 50% efficiency If flare temperature $< 500^{\circ}\text{C}$ then 0% efficiency
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Enclosed flare is used in the entire project. All data and parameters that are required to monitor the flare operation within the range of operating conditions according to manufacturer's specifications will be continuously monitored. The temperature and biogas flow rate data will be monitored minute by minute by a sensor installed in the pipe and in the enclosed flare respectively and both are stored by a CLP. The data stored in the CLP is recovered monthly by the use of a pen drive and the file containing the information will be sent to the QA/QC officer to manage the information. Brascarbon developed the formulary 08.001 in the operational procedure to monitor the hourly flare efficiency according to the criteria above mentioned.
Measuring/ Reading/ Recording frequency:	Hourly
Calculation method (if applicable):	<p>1) Continuous monitoring of compliance with manufacturer's specification of flare:</p> $\text{FE} = \frac{\sum H(\text{temp} \geq 500^{\circ}\text{C})}{H_t} * 0,9 * 100\%$ <p>2) If any specific hour any of the flare parameters is out of the range of specifications, 50% of default value should be used for this specific hour.</p> $\text{FE} = \frac{\sum H(\text{temp} \geq 500^{\circ}\text{C})}{H_t} * 0,9 * 50\%$ <p>3) If at any given time the temperature of the flare is below 500°C, 0% default value should be used for this period</p> $\text{FE} = \frac{\sum H(\text{temp} < 500^{\circ}\text{C})}{H_t} * 0,9 * 0\%$ <p>FE: Flare efficiency in 90% for the total of operational hours in the operational period, in % H (temp$\geq 500^{\circ}\text{C}$): Sum of hours total in the measured period in which the temperature is higher or equal to 500°C. H (temp$< 500^{\circ}\text{C}$): Sum of hours total in the measured period in which the temperature is lower than 500°C. H_t: Total of hours in the measured period</p>

QA/QC procedures applied:	<p>The enclosed flare will regularly undergo a maintenance process subject to the appropriate industrial standards and/or manufacturer's specifications in order to ensure measurement accuracy.</p> <p>The Monitoring Operational Procedure POP-08 was developed to calculate the monthly efficiency and it can be found at the Brascarbon Operational Procedure Manual.</p> <p>According to the manufacture specifications of the enclosed flares the body dimension, the burners, the air mixer, the refractory and the continuous sparking system of the enclosed flares were sized according to the maximum theoretical flow of biogas for each swine farm.</p> <p>50% efficiency of the flare is considered when the temperature $\geq 500^{\circ}\text{C}$ and the flare is operating out of the specification parameters (flow and temperatures).</p>
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Data / Parameter:	Q_{DM}
Data unit:	N/A
Description:	Sludge soil application
Measured /Calculated /Default:	N/A
Source of data:	Site inspection check list.
Value(s) of monitored parameter:	N/A
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	N/A
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	Every Batch Disposed.
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Check the registers in the generated documents.

Data / Parameter:	Wsite
Data unit:	Kg
Description:	Average animal weight of a defined livestock population at the project site in year
Measured /Calculated /Default:	Measured
Source of data:	Brascarbon Monitoring Report System
Value(s) of monitored parameter:	Checking data and records in the confined feed animal operation
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Check of the site records and documents

Data / Parameter:	ER _{y,ex-post}
Data unit:	Ton CO ₂ e
Description:	Ex-post emission reductions achieved by the project activity based on monitored values for the year “y”.
Measured /Calculated /Default:	Calculated
Source of data:	Brascarbon Monitoring Report System
Value(s) of monitored parameter:	To be determinated according to the measured data.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	$ER_{y,ex-post} = \min[(BE_{y,ex-post} - PE_{y,ex-post}), (MD_y - PE_{power,y,ex-post})]$ <p>Where: ER_{y,ex-post} = Emission reductions achieved by the project activity based on monitored values for year y (tCO₂e) BE_{y ex post} = Baseline emissions calculated using equation B1 and using ex post monitored values of NLT,y for year y (tCO₂e) PE_{y, ex post} = Project emissions calculated using equation B5 using ex post monitored values of NLT,y ,MS% i,y for year y (tCO₂e) MD_y= Methane captured and destroyed or used gainfully by the project activity in year y (tCO₂e) PE_{power,y,ex post}= Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year y (tCO₂e)</p>
QA/QC procedures applied:	Check the registers in the generated documents.

Data / Parameter:	FFR
Data unit:	No data unit applied
Description:	Formulated feed rations
Measured /Calculated /Default:	N/A
Source of data:	Brascarbon Monitoring Report System
Value(s) of monitored parameter:	Check data and documents in the confined feed animal operation
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	N/A
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Check the registers and/or food purchases records on the farm.

Data / Parameter:	P biogas																																																																																																												
Data unit:	mbar																																																																																																												
Description:	Pressure of the biogas																																																																																																												
Measured /Calculated /Default:	Measured																																																																																																												
Source of data:	Brascarbon Monitoring Report System																																																																																																												
Value(s) of monitored parameter:	Values obtained from measurement with portable local pressure instrument BIOGAS.																																																																																																												
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QA/QC procedures applied:	Check the registers in the generated documents. Control and assure the calibration program of the instrument.																																																																																																												

Data / Parameter:	GENETIC SOURCE
Data unit:	No data unit applied
Description:	Genetic source from annex I party
Measured /Calculated /Default:	N/A
Source of data:	Check data and documents in the confined feed animal operation
Value(s) of monitored parameter:	Western Europe
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Check data on records of farm operation.

Data / Parameter:	MS% i,y
Data unit:	Fraction
Description:	Fraction of manure handled in project emissions in system “i”, year “y”.
Measured /Calculated /Default:	Measured
Source of data:	Brascarbon Monitoring Report System
Value(s) of monitored parameter:	1
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Check of generated documents.

Data / Parameter:	$TM_{RG,h}$
Data unit:	Kg/h
Description:	Mass flow rate of methane in the residual gas in the hour h
Measured /Calculated /Default:	Calculated
Source of data:	Brascarbon Monitoring Report System
Value(s) of monitored parameter:	To be calculated during the monitoring period
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	To be calculated according to the operational procedure. POP 17 includes the instruction to the calculation
Measuring/ Reading/ Recording frequency:	Monthly
Calculation method (if applicable):	$TM_{RG,h} = FV_{RG,h} * fV_{CH_4, RG,h} * 0,716$ <p>Where:</p> <p>$FV_{RG,h}$: Biogas volume burned in the total monitored hours</p> <p>$fV_{CH_4, RG,h}$: Volumetric fraction of methane (monitored value).</p> <p>0,716: Density of methane in normal condtions 9 default value indicated in EB 28, ANNEX 13, "Tool to determine project emissions from flaring gases containing methane", Page 9.</p>
QA/QC procedures applied:	Check the data and the calculation of the parameter.

Data / Parameter:	$FV_{RG,h}$																																																																																																																																																																								
Data unit:	m^3/h																																																																																																																																																																								
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Measuring/ Reading/ Recording frequency:	Monthly																																																																																																																																																																								
Calculation method (if applicable):	$FV_{RG,h} = BG_{burnt,y} / \text{Total hours}$ <p>Where:</p> <p>$BG_{burnt,y}$: Biogas flared or used as a fuel in the year y.</p>																																																																																																																																																																								
QA/QC procedures applied:	Check the data and the calculation of the parameter.																																																																																																																																																																								

Data / Parameter:	fv _{CH₄,RG}																																												
Data unit:	Fraction																																												
Description:	Volumetric fraction of methane content in the residual gas on dry basis measured as 95% confidence level.																																												
Measured /Calculated /Default:	Measured																																												
Source of data:	Brascarbon Monitoring Report System																																												
Value(s) of monitored parameter:	To be measured during the monitoring period																																												
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions																																												
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Calculation method (if applicable):	N/A																																												
QA/QC procedures applied:	Check of generated documents.																																												

Data / Parameter:	E
Data unit:	Kwh
Description:	Electricity consumed from the grid by the project
Measured /Calculated /Default:	Measured
Source of data:	Brascarbon Monitoring Report System
Value(s) of monitored parameter:	0 Kwh
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project Emissions
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	N/A
QA/QC procedures applied:	Check of generated documents.

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

The baseline emission can be calculated as follows:

Equation 1

$$BE_y = GWP_{CH_4} * D_{CH_4} * UFB * \sum MCF_j * B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{Bl,j}$$

Where:

BE_y Baseline emissions in year “y” (tCO₂e)

GWP_{CH_4} Global Warming Potential (GWP) of CH₄ (21)

D_{CH_4} CH₄ density (0.00067 t/m³ at room temperature (20 °C) and 1 atm pressure).

LT Index for all types of livestock

j Index for animal waste management system

MCF_j Annual methane conversion factor (MCF) for the baseline animal waste management system “j”

$B_{0,LT}$ Maximum methane producing potential of the volatile solid generated for animal type “LT” (m³ CH₄/kg dm)

$N_{LT,y}$ Annual average number of animals of type “LT” in year “y” (numbers)

$VS_{LT,y}$ Volatile solids for livestock “LT” entering the animal manure management system in year “y” (on a dry matter weight basis, kg dm/animal/year)

$MS\%_{Bl,j}$ Fraction of manure handled in baseline animal manure management system “j”

UF_b Model correction factor to account for model uncertainties (0.94)

Where:

(A) VS_{LT,y} can be determinate by scaling default IPCC values to adjust for a site-specific average animal weight.

Equation 2

$$VS_{LT,y} = \left(\frac{W_{site}}{W_{default}} \right) * VS_{default} * nd_y$$

Where:

W_{site} Average animal weight of a defined livestock population at the project site (kg)

W_{default} Default average animal weight of a defined population, this data is sourced from IPCC 2006 (kg)

VS_{default} Default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population (kg dm/animal/day)

nd_y Number of days in year “y” where the treatment plant was operational.

And,

(B) N_{LT,y}, the annual average number of animals can be determinate as follows:

Equation 3

$$N_{LT,y} = N_{da,y} * (N_{p,y}/365)$$

Where:

N_{da,y} Number of days animal is alive in the farm in the year “y” (numbers)

N_{p,y} Number of animals produced annually of type “LT” for the year “y” (numbers)

The following table summarized the Baseline emissions. The spreadsheet of the baseline emissions calculation is available for verification.

Table E1. Baseline Emissions

Baseline Emissions BE _y (ton CO ₂ e)		
Site Name	Site ID	Period from 01 February 2011 to 31 October 2011
Lote 27 / 28	BCA-039MS1-05	2.644
Lote 55 / 54	BCA-034MS1-05	2.721
Lote 71	BCA-037MS1-05	1.916
Lote 82	BCA-038MS1-05	1.400
Lote 101	BCA-035MS1-05	2.115
Lote 105	BCA-036MS1-05	1.891
Fazenda Bela Vista	BCA-040MS1-05	4.270
Fazenda Cachoeira	BCA-042MS1-05	4.885
Fazenda Dragão	BCA-032MS1-05	1.707
Fazenda Sorgatto	BCA-046MS1-05	3.272
Faz. Bambú - Quinhão A	BCA-051MS1-05	3.144
Faz. Folleto	BCA-052MS1-05	1.787
Faz. Rodeio - Gleba C	BCA-031MS1-05	3.123
Faz. Água Branca	BCA-030MS1-05	2.218
Granja Serra Dourada	BCA-041MS1-05	4.586
Granja Capivara	BCA-043MS1-05	3.621
Faz. Santa Catarina	BCA-047MS1-05	4.300
Faz. Ponte Vermelha	BCA-068MS1-05	923
Total BE_y - in ton CO₂e		50.523

E.2. Project emissions calculation

According to the simplified baseline and monitoring methodology for a small-scale CDM project Type-III (AMS-III.D – version 14), project emissions consist of:

- (a) Physical leakage of biogas in the manure management systems, which includes production, collection and transport of biogas to the point of flaring/combustion or gainful use ($PE_{PL,y}$);
- (b) Emissions from flaring or combustion of the gas stream ($PE_{flare,y}$);
- (c) CO₂ emissions using fossil fuels or electricity for the operation of all the installed facilities ($PE_{power,y}$).

Equation 4

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y}$$

Where:

PE_y Project emissions in year “y” (tCO₂e)

$PE_{PL,y}$ Emissions due to physical leakage of biogas in year “y” (tCO₂e)

$PE_{flare,y}$ Emissions from flaring or combustion of the biogas stream in the year “y” (tCO₂e)

$PE_{power,y}$ Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year “y” (tCO₂e)

(A) Emissions due to physical leakage of biogas can be determinate as follows:

Equation 5

$$PE_{PL,y} = 0,10 * GWP_{CH4} * D_{CH4} * \sum B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{i,y}$$

Where:

- $PE_{PL,y}$ Emissions due to physical leakage of biogas in year “y” (tCO₂e)
 GWP_{CH4} Global Warming Potential (GWP) of CH₄ (21)
 D_{CH4} CH₄ density (0.00067 t/m³ at room temperature (20 °C) and 1 atm pressure).
 LT Index for all types of livestock
 J Index for animal waste management system
 $B_{0,LT}$ Maximum methane producing potential of the volatile solid generated for animal type “LT” (m³ CH₄/kg dm)
 $N_{LT,y}$ Annual average number of animals of type “LT” in year “y” (numbers)
 $VS_{LT,y}$ Volatile solids for livestock “LT” entering the animal manure management system in year “y” (on a dry matter weight basis, kg dm/animal/year)
 $MS\%_{i,y}$ Fraction of manure handled in system “i” in year “y”

(B) Emissions from flaring determinate as follows:

Equation 6

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} * (1 - \eta_{flare,h}) * GWP_{CH4} / 1000$$

Where:

- $PE_{flare,y}$ Project emissions from flaring of the residual gas stream in year y, tCO₂e
 $TM_{RG,h}$ Mass flow rate of methane in the residual gas in the hour h, kg/h

- GWP_{CH4} Global Warming Potential of methane valid for the commitment period, tCO₂e/tCH₄
 $\eta_{flare,h}$ Flare efficiency in the hour h

Equation 7

$$TM_{RG,h} = FV_{RG,h} * fV_{CH4,RG,h} * 0,716$$

Where:

- $FV_{RG,h}$: Biogas volume burned in the total monitored hours
 $fV_{CH4,RG,h}$: Volumetric fraction of methane (monitored value).
 0,716: Density of methane in normal conditions 9 default value indicated in EB 28, ANNEX 13, "Tool to determine project emissions from flaring gases containing methane", Page 9.

(C) Emissions from use of fossil fuels or electricity for the operation:

No fossil fuel or electricity will be used in the project, therefore, $PE_{power,y}$ = zero.

E.3. Leakage calculation

According to the simplified baseline and monitoring methodology AMS-III.D - version 14, no leakage calculation is required.

The following table summarized the Project emissions. The spreadsheet of the Project emissions calculation is available for verification.

Table E2. Project Emissions

Project Emissions ($PE_{y,ex-post}$) (ton CO ₂ e)		
Site Name	Site ID	Period from 01 February 2011 to 31 October 2011
Lote 27 / 28	BCA-039MS1-05	642
Lote 55 / 54	BCA-034MS1-05	579
Lote 71	BCA-037MS1-05	482
Lote 82	BCA-038MS1-05	347
Lote 101	BCA-035MS1-05	493
Lote 105	BCA-036MS1-05	482
Fazenda Bela Vista	BCA-040MS1-05	1.043
Fazenda Cachoeira	BCA-042MS1-05	1.222
Fazenda Dragão	BCA-032MS1-05	429
Fazenda Sorgatto	BCA-046MS1-05	820
Faz. Bambú - Quinhão A	BCA-051MS1-05	749
Faz. Folleto	BCA-052MS1-05	449
Faz.Rodeio - Gleba C	BCA-031MS1-05	714
Faz Agua Branca	BCA-030MS1-05	570
Granja Serra Dourada	BCA-041MS1-05	1.098
Granja Capivara	BCA-043MS1-05	844
Faz. Santa Catarina	BCA-047MS1-05	1.331
Faz. Ponte Vermelha	BCA-068MS1-05	306
Total $PE_{y,ex-post}$ - in ton CO₂e		12.600

E.4. Emission reductions calculation / table

The emission reductions achieved by the project activity will be determined ex post through direct measurement of the amount of methane fuelled, flared or gainfully used. The emission reductions achieved in any year are the lowest value of the following:

Equation 8

$$ER_{y,ex-post} = \min[(BE_{y,ex-post} - PE_{y,ex-post}), (MD_y - PE_{power,y,ex-post})]$$

Where:

$ER_{y,ex-post}$	Emission reductions achieved by the project activity based on monitored values for year y (tCO ₂ e)
$BE_{y,ex-post}$	Baseline emissions calculated using equation B1 and using ex post monitored values of NLT _y for year y (tCO ₂ e)
$PE_{y,ex-post}$	Project emissions calculated using equation B5 using ex post monitored values of NLT _y , MS% i,y for year y (tCO ₂ e)

MD_y	Methane captured and destroyed or used gainfully by the project activity in year y (tCO ₂ e)
$PE_{power,y,ex\ post}$	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year y (tCO ₂ e)

The flaring/combustion MD_y will be measured using the conditions of the flaring Process and MD_y according the following equation:

Equation 9

$$MD_y = BG_{burnt,y} * W_{CH4,y} * D_{CH4} * FE * GWP_{CH4}$$

Where:

$BG_{burnt,y}$ = Biogas flared or combusted in year y (m³)

$W_{CH4,y}$ = Methane content in biogas in the year y (volume fraction)

FE = Flare efficiency in the year y (fraction)

GWP_{CH4} = Global Warming Potential (GWP) of CH₄ (21)

D_{CH4} = CH₄ density (0.00067 t/m³ at room temperature (20 °C) and 1 atm pressure).

The following table shows the MD_y calculated for the project activity. The spreadsheet of the emissions reductions calculation is available for verification.

Table E.3. Methane captured and destroyed (MD_y .)

Site Name	Site ID	MD_y (ton CO ₂ e)
Lote 27 / 28	BCA-039MS1-05	2.032
Lote 55 / 54	BCA-034MS1-05	1.589
Lote 71	BCA-037MS1-05	1.673
Lote 82	BCA-038MS1-05	1.079
Lote 101	BCA-035MS1-05	1.548
Lote 105	BCA-036MS1-05	1.318
Fazenda Bela Vista	BCA-040MS1-05	3.472
Fazenda Cachoeira	BCA-042MS1-05	4.204
Fazenda Dragão	BCA-032MS1-05	1.489
Fazenda Sorgatto	BCA-046MS1-05	2.814
Faz. Bambú - Quinhão A	BCA-051MS1-05	2.428
Faz. Folleto	BCA-052MS1-05	1.527
Faz. Rodeio - Gleba C	BCA-031MS1-05	2.183
Faz. Água Branca	BCA-030MS1-05	1.997
Granja Serra Dourada	BCA-041MS1-05	3.561
Granja Capivara	BCA-043MS1-05	2.649
Faz. Santa Catarina	BCA-047MS1-05	4.961
Faz. Ponte Vermelha	BCA-068MS1-05	1.355
Total Emissions Reductions Calculated – (ton CO₂e)		41.879

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD
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Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO ₂ e)	37.786	36.851

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

History of the document

Version	Date	Nature of revision
01	EB 54, Annex 34 28 May 2010	Initial adoption.
Decision Class: Regulatory Document Type: Guideline, Form Business Function: Issuance		