CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

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Annexes

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

COTRIBÁ Swine Waste Management System Project.
Version: 4
Date: 07/02/2008

A.2. Description of the small-scale project activity:

The "Cooperativa Agrícola Mista General Osório (hereafter COTRIBÁ)", through its cooperates, has decided to implement a sustainability program in its swine confinement farms, aiming at improving animal manure management systems, reducing greenhouse gases (GHG) emissions and improving the living conditions of the population on the project sites.

Purpose: The purpose of this project is to reduce GHG emissions associated to swine waste management and to contribute to sustainable development.

Explanation of GHG emission reductions: The project proposes to replace the existing Animal Waste Management Systems (AWMS) by a lower-GHG emitting AWMS. Currently, swine waste is flushed from the barns and treated in sequential anaerobic lagoon management systems that results in high GHG emissions (additional information on the current AWMS of each farm is available in section A.4.1.4).

The project will replace this system by anaerobic digesters that capture and combusts methane in a controlled and economically sustainable manner. According to the ex-ante estimations (described in sections B.4 and B.6.1, below), this shift of animal waste management systems will result in a GHG emission reduction of 152 525 tons of CO_2e during the crediting period. Certified Emission Reductions are claimed exclusively for the emission reductions associated to methane capture and combustion.

In the project case, all animal waste will be flushed from the barns to the anaerobic digesters. The anaerobic digesters captures a considerable amount of volatile solids (as carbon dioxide and methane) produced by anaerobic bacteria. The anaerobic digestion reduces and stabilizes the organic material, retrieve the substrate for fertilizer and produces biogas (that contains methane). The biogas is captured and burned in an enclosed flare, in a controlled manner to ensure methane destruction. The equipments installed by the project activity are described in section A.4.2.

The resulting effluent will then flow into the existing storage lagoons where it is collected to irrigate either the farmer's crops or neighboring areas, if necessary. The GHG emissions should, after this process, show considerable reduction as a result of the implementation of the system. Sludge application and irrigation shall be carried out on neighboring fields, offsite, where methane emissions may be regarded as insignificant, since there are no anaerobic conditions.

Contribution to sustainable development: Swine waste is considered a serious environmental concern in the project region. The project proposes major improvements in swine waste handling. This will result not only in GHG emission reduction, but also in other environmental and social benefits, such as:

- **Contribution to local environmental sustainability:**

  - Reduction in the risk of underground water contamination due to correct management of swine manure,. The proposed AWMS is built in a manner to avoid effluent leakages or uncontrolled disposal. Effluents are managed in completely sealed pipeline and lagoons. Guidance on sludge disposal will be provided to avoid uncontrolled disposal of sludge.

  - Reduction in the odours arising from open anaerobic lagoons.

  - Reduction in the pathogenic vectors associated to animal manure. The proposed AWMS is equipped with sealed PVC cover layers to capture the resulting biogas. The cover layer also avoids oudor emissions and eliminates the presence of pathogenic vectors in the AWMS surroundings.

  - Improvement of swine manure quality as fertilizer. The proposed AWMS results in a more efficient treatment in animal manure. The organic fraction of manure will be significantly reduced due to improved anaerobic digestion, when compared to baseline AWMS. The improvement in manure treatment reduces it's pollutant potential and improves it's quality as soil fertilizer.

- **Contribution to working conditions and employment creation**

  - Increase of job opportunities during and post project activity due to the continuous need for equipment monitoring and workforce improvement. The proposed AWMS includes several equipments/technologies that do not exist in the baseline AWMS. These equipments demand regular monitoring, operation and maintenance, creating the potential for job opportunities.

  - Improvement on working conditions to farms personnel, due to odour and pathogenic vectors reduction; The presence of odours and pathogenic vectors is unpleasant and might constitute health hazards to farms personnel and to the local community. The proposed AWMS will significantly reduced or eliminate these issues.

  - Employees' professional skill development (training) to operate the installed AWMS; Training on farms personnel will be necessary to operate the proposed AWMS, since it is equipped with advanced techonlogy that does not exist in baseline AWMS.

- **Contribution to income distribution**

  - Improvement on the quality of manure to be used as fertilizer by neighbouring farmers. Neighbouring farmers consider animal manure to be an important income. The use of animal manure as fertilizer reduces or eliminates the need to acquire industrial fertilizers for these farmers. With the

proposed AWMS, the quality of such manure will be significantly improved. The amount of manure distributed to local farmers might also increase, due to better handling of animal waste.

- Financial incentive to the towns/cities involved, providing the local and regional population with either direct or indirect resources. COTRIBÁ is an important part of local economy is the region. The proposed project will assist COTRIBÁ to improve it's sustainability. This is likely to result in further investment or benefits to local economy.

- **Contribution to capacitating and technological development**

- Technological development of the region through the implementation of innovative equipment; The proposed AWMS is far more advanced than the baseline AWMS. The new AWMS is equipped with devices to capture and combust methane in a controlled manner, thus reducing local greenhouse gas emissions. Besides, the new AWMS reduces environmental hazards and pollutant potential due to manure handling. The new AWMS complies with local and national environmental law.

The proposed AWMS can also be applied to similar activities in the region, since it is produced or distributed by Brazilian companies. No international technical assistance is necessary for the operation and maintenance of the proposed AWMS.

- **Contribution for regional integration and articulation with other sectors**

  - Regional development might be attained by the replication of this project by COTRIBÁ's cooperatives in the future. The proposed AWMS also generates a new source of renewable energy, biogas. COTRIBÁ is likely to invest in the generation of thermal or electric energy for end use in the future, which is not the case in the baseline scenario. Investments on energy generation will introduce COTRIBÁ to a new market and further improve it's sustainability.

All benefits above are in line with COTRIBÁ's goals to improve the quality of its operation and to act in a positive manner in the community. According to the project participants, the project is an opportunity to adopt sustainable practices and provide guidelines for future swine confinement farms.

A.3. Project participants:

Name of Party involved* (indicate the host Country)	Private and/or public entity (ies) participating in project	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (Host)	Amazon Carbon S/S Ltda	No
	Cooperativa Agrícola Mista General Osório (COTRIBÁ)	No
(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

Further information regarding the parties involved, please refer to Annex I.

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

Brazil.

A.4.1.2. Region/State/Province etc.:

State of Rio Grande do Sul.

A.4.1.3. City/Town/Community etc:

The project activity will take place at Ibirubá and Quinze de Novembro cities.

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :

All participating farms are located in the cities of Ibirubá and Quinze de Novembro. The precise location of farms is identified by means of global positioning system as seen on Table A1. COTRIBÁ owns three of the four farms included in the project activity. The other farm is owned by Mr. Reno Bohrz and by his son, Mr. Márcio André Bohrz. A brief description of each farm follows:

- **Granja Volta Gaúcha**: Volta Gaúcha is a Piglet Producing Unit, Nursery and Finishing Unit farm owned by COTRIBÁ. It is located in Quinze de Novembro. From November 2006 to October 2007, there were approximately 24 954 animals on site. No population increase is expected during the crediting period. There are 19 containment areas that use flushing system to remove animal waste periodically. From the containment areas, animal waste is destined to a sequential system of eight anaerobic lagoons. The first and second lagoons measure 24,7 x 60,0 x 3,0 meters (width, length and depth). In the second lagoon, solids and liquids are partially separated by gravity. The solids are sent to the third and fourth lagoons, that measure 18,0 x 38,0 x 3,0. The liquid portion of the waste is sent to lagoons five to eight. Lagoons 5 and 6 measure 39,0 x 104 x 3,0, lagoon seven measures about 39 x 140 x 1,5 and the final lagoon measures 50 x 63 x 3,0.

Effluent is disposed of through irrigation on neighboring fields. Irrigation is currently done by trucks and diesel fueled pumps. No additional pumping will be necessary due to the project activity. The anaerobic digesters will be installed in the first and second lagoons. Installation of the equipments is expected to be completed by January, 2008.

- **Granja Várzea Grande**: This is a Piglet Producing Unit and Nursery Unit farm that is owned by COTRIBÁ and is located in Ibirubá. Várzea Grande has a population of 8 178 animals. Animal population was based on data from February to October 2007. This time interval was chosen because the nursery was evacuated in January 2007 to control animal disease. This was the only occasion where depopulation occurred. No evacuation will occur in the future, since this was not considered effective to control animal disease. Data from previous months demonstrate that animal population was similar to the time interval chosen. No population increase is expected during the crediting period.

Animal waste is sent from 10 containment areas to a sequential system of four anaerobic lagoons by flushing. Before entering the first lagoon, waste passes through a small solids separator. To account for volatile solids removal in the solids separator, EMBRAPA default values for this type of treatment were adopted. As a conservative action, the higher value of 25% was chosen (see *Technological Inventory of EMBRAPA for Swine Manure Management Systems*, page 17, item 9). This portion of waste is used as fertilizer and was not considered for baseline emission calculation. The first, second and third lagoons measure 26,8 x 31,3 x 3,0 meters (width, length and depth). In the first lagoon, solids and liquids are partially separated by gravity. A portion of the waste is regularly removed for irrigation purpose. As a conservative action, another fraction of 25% of volatile solids was not considered for baseline emissions, as a result of effluent removal in the first lagoon.

The remaining solids and liquids (50% of total volatile solids production) are then sent to the second, third and fourth lagoons. Analysis made on site showed that volatile solids are present in the second lagoon (and consequently in the remaining lagoons). Therefore, this fraction of waste is anaerobically digested resulting in GHG emissions.

Effluent is disposed of through irrigation on neighboring fields. Irrigation is currently done by trucks and diesel fueled pumps. No additional pumping will be necessary due to the project activity. Installation of the equipments is expected to be completed by March, 2008.

- **Granja XV de Novembro:** This is a Piglet Producing Unit, Nursery and Finishing Unit farm owned by COTRIBÁ that is located in Quinze de Novembro. From January 2007 to October 2007, there were approximately 9 967 animals on site. This time interval was chosen because COTRIBÁ was establishing animal population on previous months. No population increase is expected during the crediting period. There are 15 containment areas that use flushing system to remove animal waste periodically. From the containment areas, animal waste is destined to a sequential system of two anaerobic lagoons. The first lagoon measures 45 x 32 x 3,0 meters (width, length and depth). The second lagoon measures 37 x46 x 3,0. The effluent from the second lagoon is used for fertirrgation.

Effluent is disposed of through irrigation on neighboring fields. Irrigation is currently done by trucks and diesel fueled pumps. No additional pumping will be necessary due to the project activity. Installation of the equipments is expected to be completed by January, 2008.

- **Granja Bohrz:** Granja Bohrz is a Finishing Unit farm, owned by Mr. Reno Bohrz and by his son, Mr. Márcio André Bohrz, who are cooperate of COTRIBÁ. The farm is located in Ibirubá and finishes swines grown on other COTRIBÁ's farms, such as GranjaVolta Gaúcha. From November 2006 to October 2007, there were approximately 3 136 animals on site. No population increase is expected during the crediting period. There are 06 containment areas that use flushing system to remove animal waste periodically. From the containment areas, animal waste is destined to a sequential system of two anaerobic lagoons. There is also a small open tank that receives waste from one of the containment areas. From the open tank, this waste is directed to the first anaerobic lagoon through pumping. The first and second lagoons measure 23,0 x 45,0 x 3,0 meters (width, length and depth). In the second lagoon, solids and liquids are partially separated by gravity. Effluent is disposed of through irrigation on neighboring fields. Irrigation is currently done by diesel fueled pumps. No additional pumping will be necessary due to the project activity. Installation of the equipments is expected to be completed by April, 2008.

Farm Name	Property	Address	Town	Contact	Phone	Global Positioning System*	
						S	W
Granja Volta Gaúcha	COTRIBÁ	Linha Nove, s/nº Localidade de Volta Gaúcha	Quinze de Novembro	Mr. Paulo Cericatto	+55 (54) 3324.1245	28° 48’ 33.9’’	53° 04’ 51.4’’
Granja Várzea Grande	COTRIBÁ	Linha Três, s/n° Estrada Ibirubá – Várzea, Km 03	Ibirubá	Mr. Paulo Cericatto	+55 (54) 3324.8800	28° 38’ 06.2’’	53° 08’ 12.1’’
Granja XV de Novembro	COTRIBÁ	Estada Quinze de Novembro – Sede Aurora.	Quinze de Novembro	Mr. Paulo Cericatto	+55 (54) 3324.8800	28° 45’ 38.7’’	53° 05’ 38.0’’
Granja Bohrz	Mr. Reno Bohrz, Mr. Márcio André Bohrz	Linha seis, RS 223 – Km 55	Ibirubá	Mr. Reno Bohrz	+55 (54) 3324.8800	28° 38’ 48.8’’	53° 08’ 22.1’’
					+55 (54) 3324.8800	28º38’ 30.8’’*	53º08’ 49.1’’

Table A1: Farms location and contact information.

*****All GPS coordinates were taken in the farms main entrance. Due to the considerable distance between the entrance and the barns in Granja Bohrz, a second coordinate is shown, identifying the barns.

Fig. A1: Map showing the location of COTRIBÁ Project farms.

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

The proposed project activity fits in type III: Other project activities, category III.D/Ver. 13 Methane recovery in agricultural and agro industrial activities. This category is applicable to project activities that result in GHG emission reductions under or equal to 60 000 metric tons of CO_2 equivalent (tCO_2e). The proposed project activity will capture and combust methane gas resulting from the anaerobic decomposition of swine manure from farms located in Ibirubá and Quinze de Novembro, Rio Grande do Sul, Brazil.

The equipment used by the project activity will be provided by the Brazilian Company AVESUY. The technology shall be easily transferred to and assimilated by the project participants, since there are no problems regarding language or proximity. COTRIBÁ's personnel training and good practice guidance by the technology provider will ensure that technology transfer will be done successfully. Also, all equipment will be operating a few months before the start of the crediting period. This period will allow the project participants to ensure that the system and the monitoring plan are operational once the crediting period

starts. All technology to operate the AWMS is produced in Brazil. Technology transfer from Annex I will only be necessary for the monitoring equipment, such as the gas analyzer and the flow meters.

AVESUY was established in 1980 and has been working with anaerobic digesters since 2001. AVESUY provides technology, equipments and a wide range of products for swine farms, soil irrigation and wastewater treatment, among others. AVESUY was the technology provider for several CDM projects registered in Brazil.

The technology installed by the project includes the adaptation of existing anaerobic lagoons and the creation of new covered lagoons (in some of the farms) in order to create anaerobic digesters. The system will be built as one or more anaerobic digesters, ensuring a minimum Hydraulic Retention Time (HRT) of 30 days, to guarantee a significant reduction in organic matter and volatile solids through anaerobic digestion. The AWMS proposed includes technical components to ensure methane production, capture and combustion. A brief description of such components follows:

Manure loading system:

Animal waste is sent from the barns to the anaerobic digester through two sealed pipes made of Polymer Polyvinyl Chloride (PVC). These pipes have a diameter of 150mm each. Manure is loaded from the barns to the manure tanks.

Manure tanks:

Two manure tanks are built in each AWMS to collect manure prior to entering the anaerobic digester. The tanks have the following dimensions: 1,0 x 2,0 x 1,0 meters. Collecting pipelines are located in the bottom of the manure tanks, in order to avoid solids accumulation in the manure tanks.

Sludge removal and manure reflux system

PVC pipelines along the digester will remove manure from the bottom of the anaerobic digester and pump it to the frontal part of the anaerobic digester and will prevent gas leakages under the bottom geomembrane of the digester. Each AWMS will be equipped with one electric pump to operate this system. The electric pump is equipped with a 5 horsepower (Hp) engine, providing a flow of 50 m^3/hour. The electric pump has an estimated consumption of 1.5 KWh.

Gas draining system:.

The anaerobic digester is equipped with a gas draining system. It consists of a High Density Polyethylene (HDPE) pipeline called Kanadren. The draining system will be placed transversally along the digester.

Bottom geomembrane

The bottom geomembrane is made of PVC. This geomembrane is 0,8mm thick. PVC was chosen due to its high resistance against UV radiation, chemical compounds and physical wearing.

Internal walls:

Each anaerobic digester will be equipped with two 0,8mm thick PVC geomembranes, acting as internal walls. These walls are made to retain solids, improving the system's efficiency on organic matter degradation. Internal walls will be held by steel wires and bolted in the concrete gutter surrounding the anaerobic digester.

Agitation system

The agitation system will reflux the available biogas into the effluent through a gas compressor and a 20mm PVC pipeline. Biogas will be periodically refluxed into the effluent to avoid solid agglomeration in the bottom of the anaerobic digester, improving the system's efficiency to decompose organic matter. Each AWMS will be equipped with one gas compressor to operate this system. The gas compressor is equipped with a 5 HP engine and an estimated consumption of 1.5 KWh.

Cover layer:

The anaerobic digester will have a 1mm thick PVC layer to ensure biogas capture and storage. This layer will be sealed and fixed in the concrete gutter. It will be 1.5 to 2.5 meters high once biogas is regularly produced.

Upon leaving the anaerobic digester, the treated effluent will flow into the existing storage lagoons, through PVC pipelines. In the storage lagoons, the treated effluent will be collected and used to irrigate cropping areas. The captured biogas will be conducted to a flow meter and an enclosed flare system through a sealed PVC pipeline.

Enclosed combustion System (flares)

A total of six stainless steel enclosed flaring equipments will be installed by the project activity. The flaring system is automated to ensure that all produced biogas is flared (after passing through the flow

meter). Pressure control devices within the gas handling system maintain ideal biogas flow to the combustion system.

The enclosed fares are built in thermo resistant material, such as stainless steel. Two temperature meters are included to determine the combustion temperature. Ventilation devices regulate air flow to allow the complete combustion of methane. Solar energy devices provide a constant and independent energy source to the combustion system.

The system is designed to reach a minimum temperature of 500ºC in the flaring process (a second ignition system is automatically activated if the exhaust gas temperature is below the programmed temperature).

Programmable Logic Controller:

A Programmable Logic Controller will coordinate the combustion system and the monitoring equipments. Through the PLC, data on biogas flow, biogas temperature, biogas pressure, flaring temperature, etc will be recorded and stored. The PLC will record data hourly on a 16 Mb Data Flash, allowing the project participants to determine emission reductions on an hourly basis in every farm. The PLC will be interfaced to a PC terminal via Universal Serial Bus (USB) connection and appropriate software. The components parts are verified functional on a quarterly basis, in accordance with manufacturer and other technical specifications.

The PLC coordinates all systems through pressure controlling devices. Once the ideal biogas pressure is present, the ignition system is activated and monitoring information recorded (regarding biogas flow, temperature, pressure and temperature of the flaring process).

Flow meter

Biogas flow will be measured by ROOTS® G65 SSM – ICPWS flow meters. ROOTS® special service meters (SSM) are continuous duty meters for measurement of gases where entrained liquids may be present and where the gas being measured may have a corrosive effect on some of the materials employed in meters of standard construction. Typical applications would be in a production pipeline with sour, wet gases or in a sewage treatment plant to measure gases produced by a sludge digester.

SSM Construction

All carbon steel parts have been eliminated from the gas stream in a Special Service Meter. The bearings are made of stainless steel as are the timing gears, spring clips, and internal cap screws. The bearing retainers, clamps and magnet wheel housings are made of anodized aluminum to provide greater resistance to corrosion.

The impellers are made from aluminum extrusions and hard-coated to impart wear and corrosion resistance. The cylinder and head plates on the Series B meters (sizes 8C175 through the 56M175) are manufactured from aluminum and hard-coat anodized. The anodizing also makes the meter highly resistant to abrasion from particles which may be in the gas stream.

The flow meter is equipped with temperature sensors, that measure biogas temperature in order to correct biogas flow. Data on biogas temperature is automatically registered and stored by the flow meter.,More details can be found in Annex IV.

Gas analyzer

All biogas produced in the digester cells will be analyzed by a Dual wavelength Infra-red Refrigerant Gas sensor. One gas analyzer will be available in every farm. This sensor has a measurement range of 1% and an accuracy range of 2.5%. This gas sensor will be periodically connected to the gas pipeline in a specific valve and perform gas analysis. More details can be found in Annex IV.

Biogas Pressure analyzer

Biogas pressure will be determined on an hourly basis by LD301 Smart Pressure Transmitter Series in the combustion system. The LD301 series uses, as its measuring principle, the wellknown and field proven technique of capacitance sensing, enhanced by a microprocessor based electronics. Designed for process control applications, these 2-wire transmitters generate a 4-20 mA signal proportional or characterized to the applied differential pressure.

This signal can be transmitted over a pair of twisted wires through long distances (limited only by the wire resistance and load). Digital communication for remote calibration and monitoring is also provided, superimposing a digital signal on the same pair of wires that carries the 4-20 mA signal. Remarkable features of the LD301 series are its 0.075% high accuracy, 120:1 rangeability, compactness and lightweightiness, PID control capability (optional), etc. .More details can be found in Annex IV.

Exhaust gas temperature analyzer

Type K sensors will be used to determine the temperature of the flaring process, by measuring the temperature of the exhaust gas. This sensor is built in thermo resistant material and is tested to operate in temperature as high as 1 100ºC. More details can be found in Annex IV.

The AWMS installed by the project activity is far more advanced then the existing AWMS. AVESUY will perform training and guidance for COTRIBÁ personnel prior to the crediting period. Training will involve normal operation, emergency operation, maintenance, and request for warranty

service. Amazon Carbon will perform training for COTRIBÁ personnel regarding monitoring and emergency operations as well.

Physical description of the proposed AWMS:

In Granja Volta Gaúcha, the AWMS will consist of a sequential system of two digester cells, measuring 60.0 x 24.0 x 3.5 meters (length, width, and depth) each. The digester cells were built adapting two existing anaerobic lagoons (lagoon 1 and 2, as described in Section A.4.1.4) Each digester cell will have a volume of 4 221 m^3. The combined system has a total volume capacity of 8 442 m^3. Two enclosed flares will be used to combust the produced biogas in a controlled manner. The resulting effluent will flow to the remaining storage lagoons.

In Granja Várzea Grande, the AWMS will consist of a sequential system of two digester cells, measuring 39.0 x 12.0 x 4.5 meters (length, width, and depth) each. Each digester cell will have a volume of 1 400 m^3. The combined system has a total volume capacity of 2 800 m^3. One enclosed flare will be used to combust the produced biogas in a controlled manner. The digester cell was built next to the existing anaerobic lagoons. The resulting effluent will flow to the existing storage lagoons.

In Granja XV de Novembro, the AWMS will consist of a sequential system of two digester cells, measuring 42.0 x 14.0 x 4,0 meters (length, width, and depth) each. Each digester cell will have a volume of 1 752 m^3. The combined system has a total volume capacity of 3 504 m^3. Two enclosed flares will be used to combust the produced biogas in a controlled manner. In Granja XV de Novembro, the new AWMS was built where the baseline anaerobic lagoons were placed. A storage lagoon measuring 50,0 x 20,0 x 4,0 was built to store the resulting effluent prior to fertirrigation.

In Granja Bohrz, the AWMS will consist of one digester cell measuring 36.0 x 12.0 x 4.0 meters (length, width, and depth) The digester cell will have a volume of 1 224 m^3. One enclosed flare will be used to combust the produced biogas in a controlled manner. The digester cell was built next to the existing anaerobic lagoons. The resulting effluent will flow to the existing lagoons prior to fertirrigation.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

Years	Annual estimated emission reductions in tCO_2e
2008	5 725*
2009	15 252
2010	15 252
2011	15 252
2012	15 252

2013	15 252
2014	15 252
2015	15 252
2016	15 252
2017	15 252
2018	9 527**
Total estimated reductions (tCo_2e)	**152 525**
Crediting period (years)	**10**
Annual average of estimated reductions over the crediting period (CO_2e)	**15 252**

Tab. A.3: Project activity estimated GHG emission reduction values.

* For the first crediting year, the project will be operational for 184 days (from 15/08/2008 to 31/12/2008)

** For the last crediting year, the project will be operational for 181 days (from 01/01/2018 to 14/08/2018)

A.4.4. Public funding of the small-scale project activity:

No public funds will be invested in the project.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

The project activity includes only the above mentioned farms and the associated estimated emission reductions. Based on paragraph 2 of Appendix C of the Simplified Modalities and Procedures for Small Scale CDM project activities, this project is not deblundled. There are no other registered (or on application to register) large-scale CDM project activities with the same project participants, in the same project category and technology/measure whose project boundaries is within 1 km of another proposed small-scale project activity sites.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

The title of the approved baseline methodology is AMS-III.D "Methane Recovery in agricultural and agro industrial activities" version 13, and the reference is the United Nations Framework Convention on Climate Change (UNFCCC) website:

(http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html).

B.2 Justification of the choice of the project category:

The small-scale project activity category is methane recovery from manure and wastes from agricultural or agro-industrial activities that would be decaying anaerobically in the absence of the project activity by

(a) Installing methane recovery and combustion system to an existing source of methane emissions, or

(b) Changing the management practice of a biogenic waste or raw material in order to achieve the controlled anaerobic digestion equipped with methane recovery and combustion system.

The project satisfies item 1(a) of the methodology III.D and items 2(a) and (b) that follows:

(a) The sludge must be handled aerobically. In case of soil application of the final sludge the proper conditions and procedures (not resulting in methane emissions) must be ensured.

(b) Technical measures shall be used (e.g. flared, combusted) to ensure that all biogas produced by the digester is used or flared.

The project consists in implementing a methane recovery and combustion system on an existing source of methane that would continue to decay anaerobically without the project. The project activity also satisfies the applicability conditions of item 2 of the adopted methodology, since all sludge will be used to irrigate cropping areas, avoiding the occurrence of anaerobic conditions. An enclosed flare will be installed to ensure that all methane produced by the anaerobic digester is efficiently combusted. Technical measures will be adopted to ensure proper flare operation and maintenance. Based on historical data from animal population and baseline studies, the estimated emission reduction of the project activity shall not exceed 60 Kt CO_2e in any year of the crediting period, as shown in Section A.4.3.

B.3. Description of the project boundary:

The project boundary is the physical and geographic site where methane recovery occurs. Therefore, the application of treated waste to neighbouring fields occurs outside the project boundaries. The project boundary includes only the emissions (and related reductions) from the AWMS that captures and combusts methane installed by the project activity. This means that the anaerobic digester is the physical boundary of the methane recovery facility. Project boundary is shown in Figure B1 that follows:

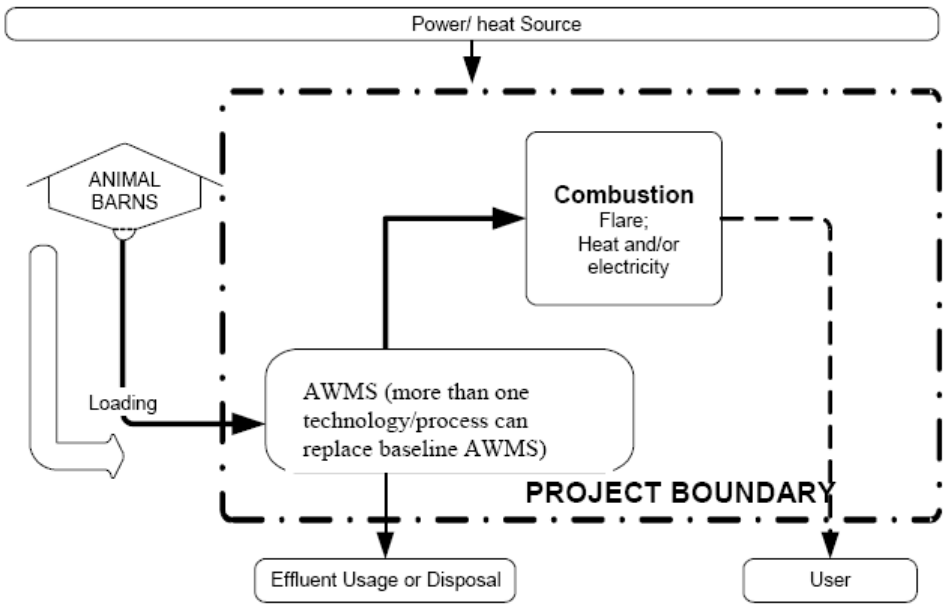

Figure B1. Project boundary

B.4. Description of baseline and its development:

The baseline emission is the amount of methane that would be released into the atmosphere during the crediting period in the absence of the project activity (ten years). The baseline emissions will be calculated as specified in paragraph 7 of AMS.III.D "The baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter are left to decay anaerobically within the project boundary and methane is emitted to the atmosphere. Baseline emissions (BEy) are calculated ex ante using the amount of the waste or raw material that would decay anaerobically in the absence of the project activity, with the most recent IPCC tier 2 approach".

Therefore, baseline emissions were determined according to the chapter 10 'Emissions from Livestock and Manure Management' under the volume 4 'Agriculture, Forestry and other Land use' of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

Step 1 – Livestock population

Animal population was determined using historical records of COTRIBÁ. A period of 12 months was chosen to determine livestock population unless otherwise stated in Section A.4.1.4. COTRIBÁ performs livestock counting on each of it's farms on a daily basis. Monitoring includes births, deaths, sales and transfers. Data recording is done using specific software, *PigChamp,* version 4.07.

COTRIBÁ also monitors piglet, nursery and finishers weight on a weekly basis, as they enter and exit each of the producing units. The following producing units are adopted at COTRIBÁ's farms:

- **PPU (Piglet Producing Unit)**: This practice consists on gilts (weighting an average of 140 Kg), gestating sows (weighting an average of 160 kg), sows (weighting an average of 220kg) that give birth 2.4 times a year on average, bearing an average 10.6 piglets per delivery and boars (weighting an average of 240kg). Piglets are then breastfed for a 21-day period and after weaning are taken to the nursery. Piglets are transferred to the nursery weighting 6 Kg on average. Considering the 21-day periods, piglets weight around 3 - 4 Kg.
- **Nursery:** This unit consists only in swine coming from the PPU. Animals are fed for a 40-days period and sold at the age of 60 days. Animals are then transferred to the Finishing Units weighting 23 Kg on average. Considering the 40 days-period, animals in the nursery weight 14 - 15 Kg.
- **FU (Finishing Unit)**: This unit contains only weanlings from the nursery. Animals proceed through fattening up and growth until slaughter. Slaughter is done when animals weight around 110 kg. Animals usually remain in the FU for a period of 120 days. Considering this period, animals in the FU unit weight 68 Kg.

  The livestock population for each farm is demonstrated in Table B1, bellow:

Animal category	Data	Granja Volta Gaúcha	Granja Várzea Grande	Granja XV de Novembro	Granja Borhz
Piglet Producing Unit					
Gilts	Population	195	69	89	-
	Average Weight (Kg)	198*	198	198	-
Sows in gestation	Population	386	404	366	-
	Average Weight (Kg)	198*	198	198	-
Sows	Population	2 481	1 206	684	-
	Average Weight (Kg)	198*	198	198	-
Boars	Population	13	0	9	-
	Average Weight (Kg)	198*	198	198	-
Piglets	Population	4 128	2 430	1 322	-
	Average Weight (Kg)	3.62	3.84	3.72	-

Nursery Unit					
Nursery	Population	8 097	4 069	3 310	-
	Average Weight (Kg)	14.01	14.81	15.30	-
Finishing Unit					
Finishers	Population	9 294	-	4 185	3 136
	Average Weight (Kg)	65.70	-	73.29	65.70
Total Livestock	**---**	**24 594**	**8 178**	**9 965**	**3 136**

Table B1. Information on farm's livestock. Historic livestock data can be found in Annex III.
*Data on breeding swine weight is only collected as they enter the PPU (as gilts and young boars). As a conservative action, IPCC default value for this parameter was chosen. See more details in Section B.6.1.

Step 2 – Methane Emission Factors

Emission factors were determined individually for every animal category shown on Table B1. The baseline AWMS is an open anaerobic lagoon, as described in Section A.4.1.4

The emission factor for each animal group is determined by the following equation:

$$EF_{CH4,i} = (Vs_{site} * Nd * Bo * DCH_4 * MCF * MS\% * GWP\_CH_4)/1000$$

Where,

$EF_{CH4,i}$: Methane emission factor for the animal category i, expressed in tCO_2e/animal/year.

Vs_{site}: Adjusted volatile solids excretion per day, expressed in kg-dm/animal/day.

Nd Number of days animals are present in containment areas

Bo: Maximum methane production capacity, in m^3 of CH_4/kg-dm

DCH_4: Density of CH_4, in kg/m^3

MCF: Methane conversion factor for the anaerobic lagoon.

MS% Fraction of waste that is treated in the baseline AWMS.

Adjusted volatile solids excretion (Vs_{site}):

$$VS_{site,i} = (W_{site,i} / W_{default}) * VS_{default}$$

Where,

$VS_{site,i}$: Adjusted daily volatile solid matter excretion for the animal category i, on a dry matter basis, for a specific animal category on project site, in kg-dm/animal/day.

W_{site}: Average weight of local animal for category i, in kg.

$W_{default}$: Default value (2006 IPCC) of average weight per animal for a specific category, in kg.

$VS_{default}$: Default value (2006 IPCC) for daily volatile solid matter excretion, on a dry matter basis, for a specific animal category, in kg-dm/animal/day.

The amount of methane emitted in the baseline scenario is calculated by the equation:

$$CH_{4a} = EF_{CH4,i} * N_a$$

Where,

CH_{4a} Methane produced by the animal population of category I, expressed in tCO2e/year.

N_a Number of animals of the type i.

Step 3 – Total Baseline emissions

$$BE = \sum CH_{4a,i}$$

Where,

BE: Total baseline emissions, in tCO_2e/year.

$CH_{4a,i}$ Methane produced by the population of animal categories i.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

The additionality of the proposed project activity was defined as per guidance of the Attachment A to Appendix B of the Simplified modalities and procedures for small-scale clean development mechanism project activities.

The most probable baseline hypotheses have been selected for the proposed Project activity. In this case, the baseline scenario is determined as the scenario that represents "emissions from a technology which is economically attractive as far as the investment barriers are concerned". Therefore, this hypothesis determines the baseline scenario under a cost-benefit assessment point of view and assumes that high cost scenarios shall not be implemented. The various possible baseline scenarios, including different effluent management technologies, are described in detail in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Chapter 10, Table 10.18) and also in the GHG emissions inventory of the Ministry of Technology and Science

(http://www.mct.gov.br/index.php/content/ view /3881.html).

The baseline scenario for the COTRIBÁ and its cooperates has been defined as per the following steps:

Step 1: Identifying the project activity alternatives

In the first step of the procedure to prove the additionality of the proposed project activity, the complete set of possible baseline scenarios and project activity, which are listed in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories should be taken into account.

This includes the following swine manure treatment options:

- Disposal of untreated manure to environment
- Daily spread
- Liquid/slurry
- Solid storage
- Dry lot
- Anaerobic lagoon
- Pit storage below animal confinements
- Anaerobic digester
- Deep litter
- Composting
- Aerobic treatment
- Burned for fuel

Step 2: Identification of plausible scenarios

2.a: Consistency with mandatory laws and regulations.

According to the Technical Criteria for Environmental Licensing for New Swine Raising Farms (Critérios Técnicos para o Licenciamento de Novos Emrpreendimentos Destinados à Suinocultura) of FEPAM (Fundação Estadual de Proteção Ambiental Luiz Henrique Roessler), the only excluded scenario is the disposal of untreated manure to water streams or in Environmental Protected areas. The referenced document is available at FEPAM website, below:

http://www.fepam.rs.gov.br/central/diretrizes/diret_suinos_novos.pdf

Bearing current practice in Brazil, a number of plausible scenarios have been identified from the list of possible options. The aspects that have been considered in order to identify the plausible baseline scenarios are: historic or pre-existing practices within the organization, technology available, possible and correct application of the technology in the context and assessment of national technological development.

These plausible scenarios are based on data described in the First Brazilian anthropogenic GHG emissions inventory of the Ministry of Science and Technology and EMBRAPA, available at:

(http://www.mct.gov.br/index.php/content/view/17341.html):

- Daily spread
- Composting
- Pit storage below animal confinements
- Anaerobic lagoon
- Anaerobic digester
- Aerobic digester

A justification for the inclusion/exclusion of the manure management systems that cannot be considered a plausible baseline scenario (including the proposed project activity) was determined according to the Technological Inventory of EMBRAPA for Swine Manure Management Systems, available at:

(http://www.cnpsa.embrapa.br/invtec/15.html)

Excluded scenarios:

The criteria used to determine the scenarios excluded are practical and economical regarding the type of technology. From these analyses, the excluded scenarios follow:

- Solid storage: Usually, the type of swine manure storage offers no protection against pathogenic vectors and, because it's a non-sealed area, releases odors that jeopardize the residents' quality of life.
- Daily spread: This system has been excluded due to the size of the livestock. Manure production is too great to allow daily spread on cropping areas. Besides, manure is handled in liquid form, as it is removed from the barns through a flushing system.
- Dry lot: This system has been excluded because it does not apply to confined animals.
- Liquid/slurry: This system was excluded because manure is removed by a flushing system that adds a considerable amount of water to the manure.
- Pit storage below animal confinements: This treatment system has been excluded due to the fact that biological manure digestion releases methane, which can intoxicate the herd when it's not properly eliminated through exhaustion systems.

- Deep litter: This type of treatment is not often used in Brazil since swine raisers regard it as hard and disagreeable. The remaining users are choosing to replace it by liquid or solid waste treatment systems in order to optimize cost/benefit.
- Composting: Composting systems are not suitable for great volumes of confined swine manure. This occurs because there is too much water in the waste, which makes the drying process very hard. This treatment is more effective when dealing with the sludge resulting from bacterial decomposition processes.
- Aerobic treatment: This type of treatment is more commonly used when dealing with sludge or diluted waste. The solids in the manure are difficult to homogenize and oxygenate, which demands too much activity from the agitators. Another important consideration is the ammonium release potential from the system when it is not properly aerated. This equipment consumes high amounts of energy, which increases costs for the swine raiser.
- Burned for fuel: Animal waste is handled in a liquid form, since flushing systems are used to remove manure from the barns. Burning waste or organic matter is also not encouraged by FEPAM due to odor and smoke emissions.

Through this analysis, the plausible scenarios have been reduced to two potential manure treatment systems:

Plausible baseline scenario: Anaerobic lagoon.

Proposed project activity: Anaerobic Digester.

Included scenarios:

- Anaerobic Lagoon: This treatment system is easy to operate, which requires little workforce and maintenance investment. It is a viable alternative and has been considered a plausible baseline scenario.
- Anaerobic digester: This system is easy to operate, retrieves methane, which is responsible for global warming, is capable of producing biogas and biofertilizer, and also reduces odors. It requires high implementation costs and medium maintenance cost. This alternative is not very popular among Brazilian swine raisers and has been considered the project activity.

After the identification of the plausible scenarios, following the process of measurement and additionality demonstration, an analysis shall be made to demonstrate the barriers that the proposed project activity selected above will face without the CDM project register.

Step 3: ***Barrier Analysis***
This Project activity is not adopted nationally due to the following barriers:

Investment Barriers: this manure management system is regarded as one of the most advanced practices worldwide. A few countries use this technology due to high costs involved when compared to other systems. The technology applied by the project demands an investment of U$23 to U$61 per cubic meter of installed digester capacity. Less expensive AWMS are available, but result in higher GHG emissions, as demonstrated in the Technological Inventory of EMBRAPA for Swine Manure Management Systems.

Technological Barriers: In order to justify the implementation of an anaerobic digester, a great deal of manure is needed, as well as proximity and concentration of barns, since the smaller the herd, the more expensive the implementation of the system regarding cost/benefit.

Anaerobic digesters are systems that need detailed planning to be installed. Operating also involves controlled manure handling practices, constant performance checking and maintenance. This is not usually the case for baseline scenarios, where farmers have little to no control of the existing AWMS. The lack of knowledge to operate anaerobic digesters was a serious barrier to the adoption of such system in Brazil, as described by Mr. Airton Kunz, in his Article '*EMBRAPA's experience with anaerobic digestion of swine waste – I* (Experiência da EMBRAPA com biodigestão anaeróbica de dejetos de suínos - I), available at the following website:

(http://www.cnpsa.embrapa.br/sgc/sgc_publicacoes/publicacao_r6e60d8p.pdf)

Legal Restrictions: The Brazilian legislation related to swine confinement farms is focused on the protection of water sources and protected areas. A few water quality guidelines are determined. It is also forbidden to dispose untreated effluent into the environment, as demonstrated by FEPAM's Technical Criteria for Environmental Licensing for New Swine Raising Farms, amongst others. No specific effluent treatment or GHG emission control in swine farm operations are required.

Step 4: Common practice analysis:

According to the First Brazilian anthropogenic GHG emissions inventory of the Ministry of Science and Technology and EMBRAPA, the Brazilian swine manure systems can be divided into two distinct groups. The first group (occurring mainly in the states of São Paulo, Goiás and Mato Grosso) with large farms, over one thousand swine and usually treatment systems that consist of a series of stabilization lagoons and, in some cases, partly digested waste spray. And the second group (occurring mainly in the west of the state of Santa Catarina, state of Paraná and northwest of the state of Rio Grande do Sul), with

small farms, distributed as follows: small (up to 100 swine), medium (100 to 300 swine) and large (over 300 swine). The treatment system commonly used is the open tank (single anaerobic lagoon), which a retention time that varies from 20 to 90 days. After that period it's applied to the soil on site or in neighboring areas.

As described above, we are able to conclude that the usual technology applied to Brazilian swine confinement farms is based on anaerobic lagoons. Therefore the project activity, which consists on anaerobic digesters, is not similar to what can be commonly found in Brazil.

Step 5: Impact caused by the registration of the project as CDM:

As shown in the steps above, the only way to implement the proposed project activity is by overcoming the barriers mentioned and reducing the risks commonly associated to this type of project.

The potential of the CDM project, mainly the environmental and financial one, was extremely important in the decision-making process of the swine raisers of COTRIBÁ. The implementation of such an innovative technology into the production system, which can bring great environmental improvements due to GHG emission reduction, would be impossible in the absence of the financial aid raised by the project activity.

Within the process of gathering the producers to implement the project activity it was possible to notice how resilient some of them were regarding the technology applied, which was caused mainly by the lack of information regarding economic and environmental cost/benefit. This type of situation was only clarified by the possibility of implementation of this system on the farms mentioned in the project activity.

We must also consider the development and encouragement of new technologies or the application of well-known, widespread technologies to other productive activities, as they are adjusted for highly atmospheric polluting activities (such as swine confinement farms).

As demonstrated in this fifth step of the additionality analysis, it becomes evident that the impact caused by the registration of the CDM project was decisive to overcome the barriers to the implementation of the proposed project activity.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Baseline emissions are calculated as described in Section B.4. Project emissions were determined according to the approved small-scale methodology AMS.III.D. The project emissions for the proposed project activity are defined as the amount of methane that would be emitted to the atmosphere during the crediting period due to the project activity, besides emissions associated to fossil fuel and energy

consumption within project boundary. An anaerobic digester is considered the project activity and projects emissions consist of:

Ex ante estimation of Emissions from project activity ($PE_{ex-ante}$):

Four factors are considered emissions from the project activity: methane emissions from digester, methane emissions from inefficient flaring, CO_2 emissions from fossil fuel combustion and CO_2 emissions from electricity consumption. The following formulae are used to calculate these factors:

$$PE = PE_{digester} + PE_{flare} + PE_{FC} + PE_{EC}$$

Where,

PE	Project emissions, in tCO_2e.
$PE_{digester}$	Methane emissions from anaerobic digester, in tCO_2e.
PE_{flare}	Methane emissions from inefficiency in methane flaring in tCO_2e.
PE_{FC}	CO_2 emissions from fossil fuel combusted to operate the AWMS
PE_{EC}	CO_2 emissions from electricity consumption to operate the AWMS

Methane emissions from anaerobic digester ($PE_{digester}$)

Anaerobic digester emissions were also estimated according to the Tier 2 approach of the 2006 IPCC Guidelines for Greenhouse Gas Inventories, chapter 10 'Emissions from Livestock and Manure Management' under the volume 4 'Agriculture, Forestry and other Land use'. Emissions from this source were determined through the following steps:

Step 1 – Livestock population

Livestock population was defined as described in section B.4. Livestock population will remain constant during the project activity.

Step 2 – Methane Emission Factors

Emission factors were determined individually for every animal category shown on Table B1.

The emission factor for each animal group is determined by the following equation:

$$EF_{CH4,i} = (Vs_{site} * Nd * Bo * DCH_4 * MCF * MS\% * GWP\_CH_4)/1000$$

Where,

$EF_{CH4,i}$:	Methane emission factor for the animal category i, expressed in tCO_2e/animal/year.
Vs_{site}:	Adjusted volatile solids excretion per day, expressed in kg-dm/animal/day.
Nd	Number of days animals are present in containment areas
Bo:	Maximum methane production capacity, in m^3 of CH_4/kg-dm
DCH_4:	Density of CH_4, in kg/m^3

MCF: Methane conversion factor for the anaerobic digester.

MS% Fraction of waste that is treated in the project AWMS.

Adjusted volatile solids excretion (Vs_{site}):

$$VS_{site,i} = (W_{site,i} / W_{default}) * VS_{default}$$

Where,

$VS_{site,i}$: Adjusted daily volatile solid matter excretion for the animal category i, on a dry matter basis, for a specific animal category on project site, in kg-dm/animal/day.

W_{site}: Average weight of local animal for category i, in kg.

$W_{default}$: Default value of average weight per animal for a specific category, in kg.

$VS_{default}$: Default value (2006 IPCC) for daily volatile solid matter excretion, on a dry matter basis, for a specific animal category, in kg-dm/animal/day.

The amount of methane emitted by an animal population is calculated by the equation:

$$CH_{4a} = EF_{CH4,i} * N_a$$

Where,

CH_{4a} Methane emissions by the animal population of category i, expressed in tCO2e/year.

N_a Average number of animals of the type i.

Step 3 – Total methane emissions from anaerobic digester

$$PECH_4 = \sum CH_{4a,i}$$

Where,

$PECH_4$: Methane emissions from anaerobic digester.

$CH_{4a,i}$ Methane emissions by the population of animal categories , expressed in tCO2e/year.

Ex ante estimation of Emissions from inefficiency in methane flaring (PE_{flare}):

Emissions from this source were estimated per guidance of the *"Tool to determine project emissions from flaring gases containing methane, version 1"*, available in the UNFCCC website below:

(http://cdm.unfccc.int/Reference/Guidclarif/index.html)

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

Where,

PE_{flare}: Emissions from inefficient flaring, in tCO_2e.

$TM_{RG,h}$: Mass flow rate of methane in the residual gas in the hour *h*.

η_{flare}: Flare efficiency for methane destruction. 90% is the value used for flaring efficiency.

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

Mass flow rate of methane will be monitored during the project activity as described in Section B.7.2 For ex-ante calculation of mass flow rate of gas sent to the flare, a default EMBRAPA value was adopted to determine biogas production from swine manure. The reference is the Technical Report (Comunicado Técnico) 417/2005. This report demonstrates results from biogas production in an anaerobic digester similar to the equipment installed by the project activity (same technology provider) and in a region with similar climate as the project sites. In this report, the following information was obtained:

Data	Value	Unit
Biogas/Volatile Solids rate	0,45	m^3 biogas/Kg Vs

Yearly mass flow rate was estimated as:

$$\sum TM_{RGh} = Na_i * Vs_{site} * Nd * MS\% * BVs * C_{CH4} * DCH4$$

Where,

BVs Biogas/Volatile Solids ratio.

CCH4 Methane concentration in biogas.

CO_2 emissions from fossil fuel combusted to operate the AWMS

Project emissions from this source are considered negligible, because the AWMS installed as the project activity will not result in increase in fossil fuel consumption.

CO_2 emissions from electricity consumption to operate the AWMS

Project emissions from this source are considered negligible, because the AWMS installed as the project activity will not result in significant increase in energy consumption. The combined electricity consumption of the electric pumps and the gas compressors for all farms is approximately 3 MWh per year.

Leakage emissions (LE):

Leakage emissions are not considered, as defined in paragraph 9 of approved small-scale methodology AMS.III.D, version 13.

Emission Reductions (ER)

In order to obtain the project activity emission reductions, project activity emissions and leakage emissions must be subtracted from the baseline emissions, as described below:

Estimated project activity emission reductions ($ER_{PA\_estimated}$):

$$ER_{PA\_estimated} = BE - PE - LE$$

Where,

$ER_{PA\_estimated}$ is expressed in tCO_2e.

BE: Total baseline emissions in tCO_2e.

PE: Total emissions from project activity.

LE Total leakage emissions.

Calculated project activity emission reductions ($ER_{PA\_calculated}$):

The actual emission reduction achieved by the project during the crediting period will be calculated using the amount of methane recovered and destroyed by the project activity, calculated as:

$$ER_{PA\_calculated} = MD_y - PE_y - Leakage$$

Where:

PEy actual project emissions in the year y

MDy methane captured and destroyed by the project activity in the year "y" (tCO2 e), that will be measured using the conditions of the flaring process:

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

Where:

$BG_{burnt,y}$ biogas flared or used as fuel in the year "y" (m^3).

$w_{CH4,y}$ methane content in biogas in the year "y" (mass fraction).

$D_{CH4,y}$ density of methane at the temperature and pressure of the biogas in the year "y" (tonnes/m3).

FE flare efficiency in the year "y" (fraction)

GWPCH4 Methane global warming potential (21)

Explanation of methodological choices

Default values are used to represent volatile solid excretion (Vs), methane production from treated manure (Bo) and Methane Conversion Factors (MCF). Default values have been chosen to quantify the emissions, since the existing AWMS did not include direct monitoring of such values. Determining these parameters on site is not an economically viable option. Default values for Vs are used to determine Adjusted Vs values, as descrbied above. Default values are taken from 2006 IPCC Guidelines for Greenhouse Gas Inventories, chapter 10 'Emissions from Livestock and Manure Management' under the volume 4 'Agriculture, Forestry and other Land use', unless otherwise stated. Default value for North American genetics were chosen, since this is the genetics used in COTRIBÁ's farms.

Carbon dioxide emissions from methane combustion (burned in the flare) are biogenic. This assumption is based on the fact that the organic matter consumed by the animals has a renewable origin (and therefore is not considered fossil). CO_2 emissions from anaerobic digestion do not represent any difference in the emission volumes between each scenario since there is no possible additional transformation once that compound is burned. Methane emissions from biogas flaring were determined as described above

The characteristics of the livestock regarding number and weight of individuals were sampled on site. Therefore, the degree of uncertainty of these variables is minimal. Data on animal population and weight is monitored and stored by specific software. Animal population is recorded on a daily basis, through individual swine counting. Livestock is weighted on a weekly basis as piglet, nursery and finisher swine enter and exit the different producing units. To determine the applied value of these parameters, historic record was used for each farm.

Data on final animal weight was not available for Granja Bohrz. This parameter was considered to be equal to the weight of finishers of Granja Volta Gaúcha. Granja Bohrz finishes mostly swine transferred from Granja Volta Gaúcha Nursery. Granja Bohrz also adopts the same management techniques used in Granja Volta Gaúcha Finishing Unit. Finally, finisher weights of Granja Volta Gaúcha are the lowest among all farms. Hence, adopting the values of Granja Volta Gaúcha to Granja Bohrz is a conservative action.

Breeders are only weighted when swine are transferred from the Finishing Unit to the Piglet Producing Unit as gilts and young boars. No data on the final weight of these animals is available. For this reason, default IPCC values were adopted to determine breeder's weight. A value of 198 Kg/animal was extracted from Table 10A-8 of the Chapter 10 of volume 4 of the 2006 IPCC Guidelines for National GHG Inventories. This value was chosen considering the genetics, management and practices used in COTRIBÁ'S farms.

The following sources have been used to calculate the baseline and project emissions:

- Approved small-scale methodology AMS.III.D.
- 2006 IPCC Guidelines for National GHG Inventories;
- First Brazilian Inventory on GHG Anthropogenic Emissions – Support Report – Agriculture and Animal Husbandry.
- Technological Inventory of EMBRAPA for Swine Manure Management Systems
- EMBRAPA Technical Report 417/2005

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**Na**
Data unit:	N/A
Description:	Average number of animals of type i
Source of data used:	COTRIBA monitoring spreadsheets
Value applied:	Values applied are described in TableB.1.
Justification of the choice of data or description of measurement methods and procedures actually applied:	COTRIBA performs regular monitoring of livestock. Data is stored digitally using PigChamp software. Historical records were used to determine Na.
Any comment:	

Data / Parameter:	**Nflare**
Data unit:	Fraction or percentage
Description:	Flare efficiency for methane destruction
Source of data used:	Methodological Tool to determine project emissions from flaring gases containing methane
Value applied:	90%
Justification of the choice of data or description of measurement methods and procedures actually applied:	A default value of 90% is adopted as a conservative action, since data to determine the actual efficiency will not available.
Any comment:	

Data / Parameter:	**CCH_4**
Data unit:	Fraction or percentage
Description:	Methane concentration in biogas
Source of data used:	AVESUY
Value applied:	70%
Justification of the choice of data or description of	Methane concentration in biogas is expected to range from 60 to 70%. For project emissions calculation, the higher the CCH4, the higher the emissions

measurement methods and procedures actually applied:	from this source. Therefore, 70% is a conservative value.
Any comment:	

Data / Parameter:	**$VS_{default}$**
Data unit:	Kg-dm/animal/day
Description:	Daily volatile solids excretion rate
Source of data used:	2006 IPCC, Annex 10A.2, Table 10A-7 (market swine) and 10A-8 (breeding swine)
Value applied:	0.27 (market swine) 0.50 (breeding swine)
Justification of the choice of data or description of measurement methods and procedures actually applied:	Default values are applied because local data is not available. Local data collection is not a viable option for excretion rate.
Any comment:	

Data / Parameter:	**VS_{site}**
Data unit:	Kg-dm/animal/day
Description:	Daily volatile solids excretion rate, corrected for local animal weight
Source of data used:	2006 IPCC, Annex 10A.2, Table 10A-7 (market swine) and 10A-8 (breeding swine)
Value applied:	0.5 for gilts 0.5 for sows in gestation 0.5 for sows 0.5 for boars 0.021, 0.022 and 0.021for piglets 0.082, 0.087 and 0.089 for nursery 0.385, 0.399 and 0.430 for finishers
Justification of the choice of data or description of measurement methods and procedures actually applied:	A correction of VS default value was made considering local animal weight. Default values are used for Gilts, Sows and Boars due to insufficient local data.
Any comment:	

Data / Parameter:	**$W_{default}$**
Data unit:	Kg/animal
Description:	Default animal weight per animal category
Source of data used:	2006 IPCC, Annex 10A.2, Table 10A-7and 10A-8
Value applied:	198 for breeding swine and 46 for market swine
Justification of the choice of data or description of measurement methods and procedures actually	

applied:	
Any comment:	These values are only used to determine VSsite, as shown in Sections B.4 and B.6.1

Data / Parameter:	Wsite
Data unit:	Kg/animal
Description:	Average animal weight per animal category
Source of data used:	COTRIBÁ
Value applied:	198 for gilts 198 for sows in gestation 198 for sows 198 for boars 3.62, 3.84 and 3.72 for piglets 14.01, 14.81 and 15.3 for nursery 65.7 and 73.29 for finishers
Justification of the choice of data or description of measurement methods and procedures actually applied:	COTRIBÁ performs weight monitoring as animals move from one productive stage to another. Historical data of animal weight was considered to determine average weight for each animal category. Monitoring data was made available through *PigChamp* recording. Default values are used for Gilts, Sows and Boars due to insufficient local data.

Data / Parameter:	**nd_y**
Data unit:	Days/year
Description:	Number of days per year that treatment plant was operational in year y
Source of data used:	COTRIBÁ
Value applied:	184 for 2008, 181 for 2018 and 365 the remaining years
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	**Bo**
Data unit:	m^3/Kg of VS
Description:	Maximum methane producing capacity for manure produced by animal type
Source of data used:	2006 IPCC, Annex 10A.2, Table 10A-7 (market swine) and 10A-8 (breeding swine)
Value applied:	0.48
Justification of the choice of data or description of measurement methods and procedures actually applied:	Default values are applied because local data is not available. Local data collection is not a viable option for methane producing capacity.
Any comment:	

Data / Parameter:	**D_{CH4}**

Data unit:	tonnes/m^3
Description:	Density of methane
Source of data used:	Approved methodology ACM0010, version 3
Value applied:	0.00067
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	**MCF**
Data unit:	Fraction or percentage
Description:	Methane Conversion Factor for baseline and project AWMS
Source of data used:	2006 IPCC Table 10.17
Value applied:	77 for baseline AWMS and 10 for project AWMS
Justification of the choice of data or description of measurement methods and procedures actually applied:	Default values are applied because local data is not available. Local data collection is not a viable option for methane convertion factor. The project AWMS (anaerobic digester) is a sealed system that does not result in methane emissions. A 10% conservative factor was adopted to account for uncertainties.
Any comment:	

Data / Parameter:	**MS% baseline**
Data unit:	Fraction or percentage
Description:	Faction of waste destined to the baseline AWMS
Source of data used:	COTRIBÁ
Value applied:	100% for Granja Volta Gaúcha, Granja Bohrz and Granja XV de Novembro 50% for Granja Várzea Grande
Justification of the choice of data or description of measurement methods and procedures actually applied:	All manure is destined to the baseline AWMS (anaerobic lagoons) in the farms. As a fraction of solids are removed in the solid separator and from the first anaerobic lagoon in Granja Várzea Grande, a conservative value of 50% of solid removal was adopted.
Any comment:	

Data / Parameter:	**MS% project activity**
Data unit:	Fraction or percentage
Description:	Faction of waste destined to the project AWMS
Source of data used:	Avesuy
Value applied:	100%
Justification of the choice of data or description of measurement methods and procedures actually applied:	All manure will be destined to the project AWMS (anaerobic digesters) in the farms. The solid separator system in Granja Várzea Grande will be removed, as it is ineffective.
Any comment:	

Data / Parameter:	**GWP CH_4**
Data unit:	tCO_2/tCH_4
Description:	Methane Global Warming Potential, valid for the relevant commitment period
Source of data used:	2006 IPCC
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Any comment:	

Data / Parameter:	**BVs**
Data unit:	Fraction or percentage
Description:	Biogas/Volatile solids ratio
Source of data used:	EMBRAPA Technical Report 417/2005
Value applied:	0,45
Justification of the choice of data or description of measurement methods and procedures actually applied:	This parameter was used for *ex-ante* estimation of biogas production in the anaerobic digester. It was determined in a digester similar to the o digesters installed as the project activity, in a region with similar climate.
Any comment:	

Data / Parameter:	TM_{RGh}
Data unit:	Kg/hour
Description:	Amount of methane produced and sent to the flare
Source of data used:	EMBRAPA Technical Report 417/2005
Value applied:	452 578 for Granja Volta Gaúcha 96 136 for Granja Várzea Grande 208 022 for Granja XV de Novembro 93 159 for Granja Bohrz
Justification of the choice of data or description of measurement methods and procedures actually applied:	The amount of methane sent to the flare was estimated using Biogas/Volatile solids ratio described above.
Any comment:	This data is used to determine ex ante project emissions from flaring. The value showed above is an estimate for yearly methane production, since this is the value used to estimate project emissions.

B.6.3 Ex-ante calculation of emission reductions:

Baseline emissions were determined as described in section B.4. Project emissions and emissions reductions were determine through equations shown in section B.6.1. A summary of emission reductions for each farm are shown in Tables B.2 to B.5:

Granja Volta Gaúcha											
Baseline emissions											
Animal category	Na	Wdefault	Wsite	Vssite	Bo	DCH4	MS%	MCF	GWPCH4	EFi	Annual CH4 emissions (in tCO2e)
Gilts	195	198	198	0.5000	0.48	0.00067	100	0.77	21	0.949	185
Sows in gestation	386	198	198	0.5000	0.48	0.00067	100	0.77	21	0.949	366
Sows	2 481	198	198	0.5000	0.48	0.00067	100	0.77	21	0.949	2 355
Boars	13	198	198	0.5000	0.48	0.00067	100	0.77	21	0.949	12
Piglets	4 128	46	3.62	0.0212	0.48	0.00067	100	0.77	21	0.040	166
Nursery	8 097	46	14.01	0.0822	0.48	0.00067	100	0.77	21	0.156	1 264
Finishers	9 294	46	65.70	0.3856	0.48	0.00067	100	0.77	21	0.732	6 803
									Baseline emissions		**11 152**
Project emissions											
Animal category	Na	Wdefault	Wsite	Vssite	Bo	DCH4	MS%	MCF	GWPCH4	EFi	Annual CH4 emissions (in tCO2e)
Gilts	195	198	198	0.5000	0.48	0.00067	100	0.10	21	0.123	24
Sows in gestation	386	198	198	0.5000	0.48	0.00067	100	0.10	21	0.123	48
Sows	2 481	198	198	0.5000	0.48	0.00067	100	0.10	21	0.123	306
Boars	13	198	198	0.5000	0.48	0.00067	100	0.10	21	0.123	2
Piglets	4 128	46	3.62	0.0212	0.48	0.00067	100	0.10	21	0.005	22
Nursery	8 097	46	14.01	0.0822	0.48	0.00067	100	0.10	21	0.020	164
Finishers	9 294	46	65.70	0.3856	0.48	0.00067	100	0.10	21	0.095	883
									PEdigester		**1 448**
									PEflare		**950**
									Project emissions		**2 399**

Table B.2 Baseline and project emissions for Granja Volta Gaúcha.

Granja Várzea Grande											
Baseline emissions											
Animal category	Na	Wdefault	Wsite	Vssite	Bo	DCH4	MS%	MCF	GWPCH4	EFi	Annual CH4 emissions (in tCO2e)
Gilts	69	198	198	0.5000	0.48	0.00067	50	0.77	21	0.475	33
Sows in gestation	404	198	198	0.5000	0.48	0.00067	50	0.77	21	0.475	192
Sows	1206	198	198	0.5000	0.48	0.00067	50	0.77	21	0.475	572
Boars	0										0
Piglets	2430	46	3.84	0.0225	0.48	0.00067	50	0.77	21	0.021	52
Nursery	4 069	46	14.81	0.0869	0.48	0.00067	50	0.77	21	0.082	336
Finishers	0	46	0								0
									Baseline emissions		**1 184**
Project emissions											
Animal category	Na	Wdefault	Wsite	Vssite	Bo	DCH4	MS%	MCF	GWPCH4	EFi	Annual CH4 emissions (in tCO2e)
Gilts	69	198	198	0.5000	0.48	0.00067	100	0.10	21	0.123	9
Sows in gestation	404	198	198	0.5000	0.48	0.00067	100	0.10	21	0.123	50
Sows	1206	198	198	0.5000	0.48	0.00067	100	0.10	21	0.123	149
Boars	0										0
Piglets	2430	46	3.84	0.0225	0.48	0.00067	100	0.10	21	0.006	14
Nursery	4 069	46	14.81	0.0869	0.48	0.00067	100	0.10	21	0.021	87
Finishers	0										0
									PEdigester		**308**
									PEflare		**202**
									Project emissions		**510**

Table B.3 Baseline and project emissions for Granja Várzea Grande.

Granja XV de Novembro											
Baseline emissions											
Animal category	Na	Wdefault	Wsite	Vssite	Bo	DCH4	MS%	MCF	GWPCH4	EFi	Annual CH4 emissions (in tCO2e)
Gilts	89	198	198	0.5000	0.48	0.00067	100	0.77	21	0.949	84
Sows in gestation	366	198	198	0.5000	0.48	0.00067	100	0.77	21	0.949	347
Sows	684	198	198	0.5000	0.48	0.00067	100	0.77	21	0.949	649
Boars	9	198	198	0.5000	0.48	0.00067	100	0.77	21	0.949	9
Piglets	1 322	46	3.72	0.0218	0.48	0.00067	100	0.77	21	0.041	55
Nursery	3 310	46	15.30	0.0898	0.48	0.00067	100	0.77	21	0.170	564
Finishers	4 185	46	73.29	0.4302	0.48	0.00067	100	0.77	21	0.817	3 417
									Baseline emissions		**5 126**
Project emissions											
Animal category	Na	Wdefault	Wsite	Vssite	Bo	DCH4	MS%	MCF	GWPCH4	EFi	Annual CH4 emissions (in tCO2e)
Gilts	89	198	198	0.5000	0.48	0.00067	100	0.10	21	0.123	11
Sows in gestation	366	198	198	0.5000	0.48	0.00067	100	0.10	21	0.123	45
Sows	684	198	198	0.5000	0.48	0.00067	100	0.10	21	0.123	84
Boars	9	198	198	0.5000	0.48	0.00067	100	0.10	21	0.123	1
Piglets	1 322	46	3.72	0.0218	0.48	0.00067	100	0.10	21	0.005	7
Nursery	3 310	46	15.30	0.0898	0.48	0.00067	100	0.10	21	0.022	73
Finishers	4 185	46	73.29	0.4302	0.48	0.00067	100	0.10	21	0.106	444
									PEdigester		**666**
									PEflare		**437**
									Project emissions		**1 103**

Table B.4 Baseline and project emissions for Granja XV de Novembro.

Granja Bohrz											
Baseline emissions											
Animal category	Na	Wdefault	Wsite	Vssite	Bo	DCH4	MS%	MCF	GWPCH4	EFi	Annual CH4 emissions (in tCO2e)
Gilts	0										0
Sows in gestation	0										0
Sows	0										0
Boars	0										0
Piglets	0										0
Nursery	0										0
Finishers	3 136	46	65.70	0.3856	0.48	0.00067	100	0.77	21	0.732	2 295
									Baseline emissions		**2 295**
Project emissions											
Animal category	Na	Wdefault	Wsite	Vssite	Bo	DCH4	MS%	MCF	GWPCH4	EFi	Annual CH4 emissions (in tCO2e)
Gilts	0										0
Sows in gestation	0										0
Sows	0										0
Boars	0										0
Piglets	0										0
Nursery	0										0
Finishers	3 136	46	65.70	0.3856	0.48	0.00067	100	0.10	21	0.095	298
									PEdigester		**298**
									PEflare		**196**
									Project emissions		**494**

Table B.5 Baseline and project emissions for Granja Bohrz.

B.6.4 Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity emissions (tonnes of CO_2 e)	Estimation of baseline emissions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of overall emission reductions (tonnes of CO_2 e)
2008	1 690	7 416	Neglected	**5 725**
2009	4 504	19 757	Neglected	**15 252**
2010	4 504	19 757	Neglected	**15 252**
2011	4 504	19 757	Neglected	**15 252**
2012	4 504	19 757	Neglected	**15 252**
2013	4 504	19 757	Neglected	**15 252**
2014	4 504	19 757	Neglected	**15 252**
2015	4 504	19 757	Neglected	**15 252**
2016	4 504	19 757	Neglected	**15 252**
2017	4 504	19 757	Neglected	**15 252**
2018	2 814	12 341	Neglected	**9 527**
Total (tCO_2e)	**45 044**	**197 570**	**Neglected**	**152 525**

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**Sludge removal**
Data unit:	Numeric frequency
Description:	Sludge removal count
Source of data to be used:	Amazon Carbon Data collection and Monitoring spreadsheets
Value of data applied for the purpose of calculating expected emission reductions in section B.5	N/A
Description of measurement methods and procedures to be applied:	Measured each time sludge removal is performed. Proper disposition of sludge shall be accomplished to avoid anaerobic conditions that can lead to methane emissions.
QA/QC procedures to be applied:	Amazon Carbon will provide good practice guidance and training for COTRIBÁ personnel. This parameter will be electronically recorded in spreadsheets. Back up copies shall be made weekly.
Any comment:	Data will be available for the duration of the crediting period plus 2 years.

Data / Parameter:	TM_{RGh}
Data unit:	Kg/hour

Description:	Mass flow rate of methane in the residual gas in the hour h
Source of data to be used:	Amazon Carbon Data collection and Monitoring spreadsheets
Value of data applied for the purpose of calculating expected emission reductions in section B.5	452 578 for Granja Volta Gaúcha 96 136 for Granja Várzea Grande 208 022 for Granja XV de Novembro 93 159 for Granja Bohrz
Description of measurement methods and procedures to be applied:	Biogas flow will be continuously measured by Roots Special Service Meters, with an accuracy of +/- 0.55% and electronically recorded hourly by a PLC system,. Mass flow rate of methane will be calculated considering the methane concentration in residual biogas. Methane content in residual gas is determined as described bellow.
QA/QC procedures to be applied:	Biogas flow meter will be subject to constant checking and maintenance. Data will be recorded automatically by the PLC and will be made available online for Amazon Carbon and COTRIBÁ through PC terminals.
Any comment:	Data will be available for the duration of the crediting period plus 2 years. The value showed above is an estimate for yearly methane production, since this is the value used to estimate project emissions.

Data / Parameter:	**CCH_4**
Data unit:	Fraction or percentage
Description:	Methane concentration in residual gas (biogas)
Source of data to be used:	Amazon Carbon Data collection and Monitoring spreadsheets
Value of data applied for the purpose of calculating expected emission reductions in section B.5	70%
Description of measurement methods and procedures to be applied:	Measured and recorded on a daily basis by dual wavelength Infra-red refrigerant gas sensors. This sensor has a accuracy of +-2.5%. Analysis will be stored in PC terminals, organized in spread sheets. A 95% confidence level will be ensured through maintenance and calibration of gas sensors.
QA/QC procedures to be applied:	Biogas analyser will be subject to constant checking and maintenance. Data will be recorded automatically and will be available online for Amazon Carbon and COTRIBÁ.
Any comment:	Data will be available for the duration of the crediting period plus 2 years.

Data / Parameter:	**Methane flared**
Data unit:	Kg
Description:	Amount of methane flared due to the project activity
Source of data to be used:	Amazon Carbon Data collection and Monitoring spreadsheets
Value of data applied for the purpose of calculating expected emission reductions in	Not applicable

section B.5	
Description of measurement methods and procedures to be applied:	The amount of methane flared will be determined as the mass flow rate of methane multiplied by the system efficiency on methane destruction.
QA/QC procedures to be applied:	All sensors and meters will be subject to maintenance and calibration. Data to determine the methane flared will be digitally recorded and stored by the PLC.
Any comment:	Data will be available for the duration of the crediting period plus 2 years.

Data / Parameter:	**RGT**
Data unit:	ºC
Description:	Residual Gas temperature
Source of data to be used:	Amazon Carbon Data collection and Monitoring spreadsheets
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable. Residual Gas temperature will be monitored to determine the density of methane combusted during the project activity. This data will be automatically recorded by biogas flow meter.
Description of measurement methods and procedures to be applied:	Measured by Roots Special Service Meters, with an accuracy of +/- 0.55% and recorded automatically by the PLC.
QA/QC procedures to be applied:	Roots Special Service Meters are built and calibrated according to national and international standards. Recalibration, testing and maintenance will be performed during the crediting period. More details are available in Annex IV
Any comment:	Data will be available for the duration of the crediting period plus 2 years.

Data / Parameter:	**RGP**
Data unit:	Bar
Description:	Residual Gas Pressure
Source of data to be used:	Amazon Carbon Data collection and Monitoring spreadsheets
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable. Residual Gas pressure will be monitored to determine the density of methane combusted during the project activity.
Description of measurement methods and procedures to be applied:	Measured by LD301 Smart Pressure Transmitter Series with an accuracy of +/- 0.075%and recorded automatically by the PLC and the pressure controlling devices.
QA/QC procedures to be applied:	LD301Smart Pressure Transmitter Series will be subject to constant checking and maintenance. Data will be recorded automatically will be available online for Amazon Carbon and COTRIBÁ.
Any comment:	Data will be available for the duration of the crediting period plus 2 years.

Data / Parameter:	**Methane density**

Data unit:	Kg/m^3
Description:	Density of flared methane
Source of data to be used:	Amazon Carbon Data collection and Monitoring spreadsheets
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable
Description of measurement methods and procedures to be applied:	Methane density will be determined through measurement of temperature and pressure of flare residual gas.
QA/QC procedures to be applied:	Temperature and pressure sensors will be subject to constant maintenance and calibration
Any comment:	Data will be available for the duration of the crediting period plus 2 years.

Data / Parameter:	**ExGT**
Data unit:	ºC
Description:	Temperature of the exhaust gas
Source of data to be used:	Amazon Carbon Data collection and Monitoring spreadsheets
Value of data applied for the purpose of calculating expected emission reductions in section B.5	>500ºC
Description of measurement methods and procedures to be applied:	Measured and recorded automatically by type K temperature sensors within the combustion systems. This parameter is measured to determine the fraction of time the flare is operational.
QA/QC procedures to be applied:	Temperature sensors are made to operate in a temperature range of 0 to 1280ºC. This type of sensor provides +- 2.2ºC accuracy .. Data will be recorded automatically by the PLC with 100% precision and will be available online for Amazon Carbon and COTRIBÁ.
Any comment:	Data will be available for the duration of the crediting period plus 2 years. Flare temperature is measured to determine methane combustion efficiency.

Data / Parameter:	**GWP CH4**
Data unit:	tCO_2/tCH_4
Description:	Methane Global Warming Potential, valid for the relevant commitment period
Source of data to be used:	2006 IPCC
Value of data applied for the purpose of calculating expected emission reductions in	21

section B.5	
Description of measurement methods and procedures to be applied:	GWPCH4 will be obtained from the most recent IPCC Guidelines for National Greenhouse Gas Inventories
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	**FE**
Data unit:	Fraction or percentage
Description:	Flare efficiency for methane destruction
Source of data to be used:	Methodological Tool to determine project emissions from flaring gases containing methane, version 1
Value of data applied for the purpose of calculating expected emission reductions in section B.5	90%
Description of measurement methods and procedures to be applied:	The temperature of the exhaust gas will be measured to determine Flare efficiency. A default value of 90% will be adopted for the fraction of time the temperature is above 500ºC.
QA/QC procedures to be applied:	This value shall be obtained from the most recent version off the referenced tool;
Any comment:	A default value of 90% is adopted as a conservative action, since data to determine the actual efficiency will not available.

B.7.2 Description of the monitoring plan:

Amazon Carbon and COTRIBÁ will perform monitoring of methane capture and combustion during the crediting period. COTRIBÁ personnel will operate the installed AWMS in all farms. Amazon Carbon will provide training on data collection and storage, as well as emergency reporting procedures.

Amazon Carbon will also execute on-site inspections on each individual farm for each verification period, to confirm that the monitoring plan is being executed properly.

The variables monitored are described in Section B.7.1 above. Emission reductions and project emissions will be determined according to the monitored amount of methane captured and destroyed. Data used for the ex ante estimation of baseline and project emissions (described in Section B.6.2) do not need to be monitored.

The actual project emissions will be calculated according to the monitored amount of methane destined to the flares. The amount of methane sent to the flare will be determined as the mass flow rate of methane in the residual gas in the hour *h*, described above. Hence,

$$PE_{digester,} = \sum TM_{RG,h} * MCF * GWPCH4$$

Where,

MCF Methane conversion factor of the anaerobic digester

Methane emissions from inefficiency in methane flaring are incorporated in the calculation of Methane captured and destroyed by the project activity in the year "y" (MD_y), as described in Section B.6.1. Through this equation, inefficiencies in the flaring process are accounted since the total amount of biogas flared is multiplied by a flaring efficiency factor of 90%.

Sludge removal will be performed by COTRIBA personnel. Guidance for sludge removal and application was developed by AVESUY and will be made available in the projects sites during the crediting period (see Annex IV). Data on sludge removal will be recorded every time sludge removal is performed in electronic spreadsheets. The final destination of sludge will also be monitored to ensure that anaerobic conditions are avoided.

In every farm, all monitoring equipment (flow meter, gas analyser, biogas pressure and temperature analyser, exhaust gas temperature analyser) will be controlled by a PCL and connected to a PC terminal, allowing the electronic collection and recording of monitoring data.

The Programmable Logic Controller (PLC) is a digital computer used for automation of industrial processes. Unlike general-purpose computers, the PLC is designed for multiple inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. The PLC will register monitoring information on an hourly basis. 100% precision is ensured due to the automation of the process.

Through the PC terminals COTRIBA and Amazon Carbon will have real time access to monitoring variables via internet connection. Data will also be stored in data discs by COTRIBA and by Amazon Carbon, providing redundancy in data storage. All data will be stored and made available for the crediting period plus two years.

The PC terminals in every farm will store all data necessary to determine the amount of methane fuelled and flared in a given crediting year. These terminals will also store any additional data that is necessary to calculate emission reductions.

The amount of biogas produced and sent to the flare will be continuously measured by ROOTS Special Service Flow meters. Details on the flow meter are provided in Annex IV. The amount of methane

actually destroyed will be obtained by monitoring the methane content in the biogas, the pressure and temperature of the biogas previous to the flaring process.

The methane content in the biogas will be analysed by a Dual wavelength Infra-red Refrigerant Gas sensor. This sensor has a measurement range of 1% and an accuracy range of 2.5%. This gas sensor will be periodically connected to the gas pipeline in a specific valve and perform gas analysis. Additional information on the gas analyzer is available in Annex IV. Biogas pressure and temperature will be measured by monitoring components within the combustion system.

The efficiency of the flaring process will not be directly measured. Default values will be adopted, and the temperature of the exhaust gas will be monitored. Flare efficiency will be considered 90% in the fraction of time the exhaust gas temperature is higher than 500ºC. In the cases where the temperature of the exhaust gas is lower than 500ºC the flaring efficiency will be considered 0%.

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

Date of completion of the application of the methodology to this project activity: 06/02/2008.

Name of the person/entity responsible for the application of the baseline and monitoring methodology to this project activity:

Amazon Carbon S/S Ltda (project participant)**.**

Thiago Othero (Projects Director)

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SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

The starting date of the project activity is 14/11/2007.

C.1.2. Expected operational lifetime of the project activity:

25 years, 0 months.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

Not applicable.

C.2.1.2. Length of the first crediting period:

Not applicable.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

The start of the crediting period is 15/08/2008 or on the date of the registration of the project activity, whichever is later.

C.2.2.2. Length:

The duration of the project activity is 10 years, 0 months.

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

The Brazilian environmental legislation forces swine breeders to go through a process of environmental licensing where environmental impacts are assessed. COTRIBÁ and the cooperate licences have already been issued to the operations of the barns. Local environmental authorities shall be informed of the installation of anaerobic digesters, but no Environmental Impact Study is necessary.

The AWMS proposed by the project will result in various environmental benefits, as described in section A.4.3 of this report. The project, besides promoting GHG emission reduction, will also contribute to sustainable development. The anaerobic digester reduces the organic matter in the effluent when compared to anaerobic lagoons. Besides, the odour arising from the volatile molecules, which result from the anaerobic digestion, is considerably diminished since the gases produced are contained by a sealed cover and then flared. No transboundaries impacts are expected to result from the project activity.

COTRIBÁ's pro-active stand to implement an anaerobic digester on swine farms is a great challenge that must be regarded as an initiative that will encourage other swine breeders in the State of Rio Grande do Sul, as well as in other states, to improve the existing effluent treatment systems, aiming to reduce the overall environmental impacts caused by the activity.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

No action required. Environmental impacts of the project activity are considered positive since they contribute to local, regional and global sustainable development.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

The invitation to the project stakeholders was made as per the "September 11th, 2003 Resolution No. 1 (Approved by Administrative Law Nr 863, of November 27th, 2003 and published in the "Diário Oficial da República Federativa do Brasil" on December 2nd, 2003.)". Invitations were sent by postal service, on 22/10/2007.The following stakeholders were invited:

Entity	Present at the lecture
Prefeitura Municipal de Ibirubá (IBIRUBÁ CITY HALL)	✓
Prefeitura Municpal de Quinze de Novembro (Quinze de Novembro City Hall)	✓
Câmara Municipal de Ibirubá (Ibirubá City Council)	✓
Câmara Municipal de Quinze de Novembro (Quinze de Novembro City Council)	✓
Promotoria De Justiça (Ibirubá Justice Department)	
Secretaria Estadual de Meio Ambiente (Rio Grande do Sul Environmental Authority)	
Amoviunida (Community association)	
Amoviflor (Community association)	
Amoviher (Community association)	
Amoviplan (Community association)	
Amovihelena (Community association)	
Amovidim (Community association)	
Fórum Brasileiro de Ongs e Movimentos Sociais para o Meio Ambiente e Desenvolvimento (Brazilian Forum for NGOs and Social Movements for the Environment and Devolopment)	

Secretaria de Desenvolvimento De Ibirubá (Secretary of Development of Ibirubá – Ibirubá Environmental Authority)	✓
Departamento Municipal de Turismo, Cultura e Meio Ambiente de Quinze de Novembro (Department of Tourism, Culture and Environment of Quinze de Novembro)	✓

A lecture was held in 31/10/2007, at Ibirubá to expose the project to stake holders. The lecture was presented by the Projects Director of Amazon Carbon and by the Production Manager of COTRIBÁ. The PDD was made publicly available on Amazon Carbon website seven days in advance.

E.2. Summary of the comments received:

Comments by stakeholders and local community were received orally during and after the presentation. Written commentaries were received through a questionnaire that was made available for attendees.

Attendees seemed to approve the proposed project. Comments were made on the environmental benefits that will result from the project. No negative comments were made orally or via the questionnaire. No modification of the project was suggested either.

According to the local community, COTRIBÁ is taking an important step to mitigate GHG emissions and environmental impacts. Comments were also made on lack of knowledge regarding Clean Development Mechanism projects in the region.

E.3. Report on how due account was taken of any comments received:

No action required.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Amazon Carbon S/S Ltda
Street/P.O.Box:	General Couto de Magalhães, 847
City:	Porto Alegre
Postfix/ZIP:	90540-131
Country:	Brazil
Represented by:	Augusto Leipnitz
Direct FAX:	+ 55 (51) 3019.7157
Direct tel:	+ 55 (51) 8140.1271
Personal E-Mail:	augusto@amazoncarbon.com.br

Organization:	Cooperativa Agrícola Mista General Osório (COTRIBÁ)
Street/P.O.Box:	2359 Mauá Street
City:	Ibirubá
Postfix/ZIP:	98200-000
Country:	Brazil
Represented by:	Paulo Cericatto
Direct FAX:	+ 55 (54) 3324.8800
Direct tel:	+ 55 (54) 9972.0019
Personal E-Mail:	paulo@cotriba.com.br

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funds will be invested in the project.

Annex 3

BASELINE INFORMATION

GRANJA BOHRZ LIVESTOCK

FINISHING UNIT FARM

Farm	Reno Bohrz		
Date	Transfer	Return	Stock
nov/06	832	0	832
Dec/06	0	0	832
Jan/07	3290	0	4122
Feb/07	0	902	3220
Mar/07	1565	3220	1565
apr/07	0	0	1565
May/07	0	0	1565
jun/07	1666	1565	1666
jul/07	0	0	1666
Aug/07	0	0	1666
sep/07	0	0	1666
aug/07	1568	1666	1568

Farm	Márcio André Bohrz		
Date	Transfer	Return	Stock
nov/06	0	834	832
dez/06	0	0	832
jan/07	832	832	832
fev/07	0	0	832
mar/07	1537	832	1537
abr/07	0	0	1537
mai/07	0	0	1537
jun/07	832	1537	832
jul/07	832	0	1664
ago/07	0	0	1664
set/07	0	0	1664
out/07	1944	1664	1944

Granja Bohrz			
Date	Reno's Stock	Márcio's Stock	Total stock
nov/06	832	832	1664
dez/06	832	832	1664
jan/07	4122	832	4954
fev/07	3220	832	4052
mar/07	1565	1537	3102
abr/07	1565	1537	3102
mai/07	1565	1537	3102
jun/07	1666	832	2498
jul/07	1666	1664	3330
ago/07	1666	1664	3330
set/07	1666	1664	3330
out/07	1568	1944	3512
Average	**1827.75**	**1308.92**	**3136.67**

VOLTA GAÚCHA LIVESTOCK

Piglet Producing Unit, Nursery and Finishing Unit farm

Piglet Producing Unit	nov/06	dez/06	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	Average
Gilts	105	139	131	128	171	204	243	249	224	272	235	237	194.8
Sows in gestation	485	391	365	349	328	346	381	412	416	401	396	366	386.3
Sows	2404	2509	2503	2540	2520	2492	2442	2446	2476	2474	2480	2482	2480.7
Boars	13	13	13	13	13	13	13	13	13	13	13	13	13.0
Piglets	4120	4336	3350	3458	4378	4154	4118	4259	4410	4614	4888	3451	4128.0
PPU total livestock	7127	7388	6362	6488	7410	7209	7197	7379	7539	7774	8012	6549	7202.8

Nursery	nov/06	dez/06	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	Average
Nursery	8639	9090	9622	8147	7822	7203	7483	7742	6626	7810	8467	8512	8096.9

Finishing Unit	nov/06	dez/06	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	Average
Finishers	9323	9902	9267	9732	10057	9060	9260	9124	9698	8646	8389	9074	9294.3

Volta Gaúcha Total Livestock	**25089**	**26380**	**25251**	**24367**	**25289**	**23472**	**23940**	**24245**	**23863**	**24230**	**24868**	**24135**	**24594.1**

VARZEA GRANDE LIVESTOCK

Piglet Producing Unit and Nursery farm

Piglet Producing Unit	nov/06	dec/06	jan/07	feb/07	mar/07	apr/07	may/07	jun/07	jul/07	aug/07	sep/07	oct/07	Average
Gilts	0	1	158	114	123	67	64	25	33	69	56	69	68.9
Sows in gestation	45	189	394	661	804	690	505	299	224	169	155	133	404.4
Sows	1177	1071	894	892	870	968	1134	1330	1400	1413	1413	1430	1205.6
Boars	20	0	0	0	0	0	0	0	0	0	0	0	0.0
Piglets	2168	2352	0	2637	2697	2754	2112	2024	2531	2433	2579	2105	2430.2
PPU total livestock	3410	3613	1446	4304	4494	4479	3815	3678	4188	4084	4203	3737	4109.1

Nursery	nov/06	dez/06	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	2007 average*
Nursery	4486	3128	0	509	4043	4702	4826	4228	4251	4528	4436	5100	4069.2

Várzea Total Livestock	**7896**	**6741**	**1446**	**4813**	**8537**	**9181**	**8641**	**7906**	**8439**	**8612**	**8639**	**8837**	**8178.3**

XV de Novembro Livestock

Piglet Producing Unit, Nursery and Finishing Unit farm

Piglet Producing Unit	nov/06	dec/06	jan/07	feb/07	mar/07	apr/07	may/07	jun/07	jul/07	aug/07	sep/07	oct/07	Average
Gilts	243	70	157	28	7	101	145	121	26	40	166	100	89.1
Sows in gestation	551	790	902	819	541	356	218	162	201	169	132	162	366.2
Sows	0	0	84	301	555	669	810	877	892	887	900	865	684.0
Boars	0	0	9	9	9	9	9	9	9	9	9	9	9.0
Piglets	0	0	775	1588	1393	1124	1015	1121	1767	1983	1358	1093	1321.7
PPU total livestock	794	860	1927	2745	2505	2259	2197	2290	2895	3088	2565	2229	2470.0

Nursery	nov/06	dez/06	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	2007 average*
Nursery	0	0	770	2717	4196	4079	3262	3233	3301	3976	3525	4045	3310.4

Finishing Unit	nov/06	dez/06	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	Média 2007
Finishers	2116	2552	3459	3386	4575	5018	4849	4751	3626	4250	4399	3540	4185.3

XV Total livestock	**2910**	**3412**	**6156**	**8848**	**11276**	**11356**	**10308**	**10274**	**9822**	**11314**	**10489**	**9814**	**9965.7**

VOLTA GAÚCHA LOCAL WEIGHT

Volta Gaúcha													
Piglet Producing Unit													
	nov/06	dez/06	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	Average
Born weight	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Average Piglet weight	5.6	5.5	5.7	5.7	5.7	6	6.1	5.7	5.5	5.6	5.8	5.9	5.73
PPU weight	**3.55**	**3.5**	**3.6**	**3.6**	**3.6**	**3.75**	**3.8**	**3.6**	**3.5**	**3.55**	**3.65**	**3.7**	**3.62**
Nursery													
	nov/06	dez/06	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	Average
Entry weight	5.6	5.5	5.7	5.7	5.7	6.0	6.1	5.7	5.6	5.6	6.0	5.8	5.75
Transfered animals	3368	2968	2407	2921	1653	1394	3205	2715	2743	1790	2128	3721	2584.42
Average weight	19	20	20	20	19	19	22	24	22	19	21	22	20.58
Transfered animals weight	12.3	12.8	12.9	12.9	12.4	12.5	14.1	14.9	13.8	12.3	13.5	13.9	13.17
Swines on nursery	4038	2417	3622	3826	3607	4024	2583	2031	3192	3364	3323	3106	3261.08
Average weight	23	23	22	23	23	23	24	26	24	23	23	25	23.50
Swines on nursery weight	14.30	14.25	13.85	14.35	14.35	14.50	15.05	15.85	14.80	14.30	14.50	15.40	14.63
Nursery weight	**13.39**	**13.42**	**13.45**	**13.70**	**13.72**	**13.99**	**14.50**	**15.28**	**14.34**	**13.61**	**14.11**	**14.58**	**14.01**
Finishing Unit													
	nov/06	dez/06	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	Average
Entry weight	19	20	20	20	19	19	22	24	22	19	21	22	20.58
Animals sold	2091	1963	2679	2118	925	2044	2564	2522	1750	2356	2071	2617	2141.67
Average weight	114	109	104	102	109	117	123	117	106	105	110	112	110.67
Animals sold weight	66.50	64.50	62.00	61.00	64.00	68.00	72.50	70.50	64.00	62.00	65.50	67.00	65.63
Animals sold as breeders	175	79	30	0	31	50	214	70	161	148	50	140	95.67
Average weight	121	109	130		101	107	114	120	113	110	115	121	114.64
Animals sold as breeders weight	70.00	64.50	75.00	20.00	60.00	63.00	68.00	72.00	67.50	64.50	68.00	71.50	67.64
Animals transferred to PPU as breeders	55	93	70	101	142	141	153	147	92	140	85	111	110.83
Average weight	116	111	110	104	110	116	120	117	113	105	110	114	112.17
Animals transferred to PPU weight	67.5	65.5	65	62	64.5	67.5	71	70.5	67.5	62	65.5	68	66.38
Finishing weight	**66.79**	**64.54**	**62.22**	**61.05**	**63.95**	**67.86**	**72.09**	**70.54**	**64.44**	**62.14**	**65.56**	**67.26**	**65.70**

VÁRZEA GRANDE LOCAL WEIGHT

Várzea Grande													
Piglet Producing Unit													
	nov/06	dez/06	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	Average
Born weight	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Average Piglet weight	6.2	5.9	5.6	5.5	5.8	5.8	6.1	6.6	6.1	6	6.6	6.1	6.19
PPU weight	**3.85**	**3.7**	**3.55**	**3.5**	**3.65**	**3.65**	**3.8**	**4.05**	**3.8**	**3.75**	**4.05**	**3.8**	**3.84**
Nursery													
	nov/06	dez/06	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	Average
Entry weight	6.2	5.9	5.6	5.5	5.8	5.8	6.0	6.6	6.1	6.2	6.1	6.6	6.03
Average weight	23	21	11			22	23	25	25	25	21	23	23.43
Nursey weight	**14.6**	**13.5**	**8.3**	**5.5**	**5.8**	**13.9**	**14.5**	**15.8**	**15.6**	**15.6**	**13.6**	**14.8**	**14.81**

XV DE NOVEMBRO LOCAL WEIGHT

XV de Novembro													
Piglet Producing Unit													
	nov/06	dez/06	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	Average
Born weight			1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Average Piglet weight			6	6.2	5.9	5.7	5.9	5.6	5.9	6	6.2	6	5.94
PPU weight	**#DIV/0!**	**#DIV/0!**	**3.75**	**3.85**	**3.7**	**3.6**	**3.7**	**3.55**	**3.7**	**3.75**	**3.85**	**3.75**	**3.72**
Nursery													
	nov/06	dez/06	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	Average
Entry weight			6.0	6.2	5.9	5.7	5.9	5.5	5.9	6.0	6.2	6.0	5.93
Transfered animals				413	1813	1815	849	1249	1252	1525	1117	1308	1260.11
Average weight				25	24	23	28	28	29	23	20	23	24.78
Transfered animals weight	#DIV/0!	#DIV/0!	6.0	15.6	15.0	14.4	17.0	16.8	17.5	14.5	13.1	14.5	15.35
Swines on nursery						1160	2340	832	850	1385	1962	1072	1371.57
Average weight						25	28	30	25	23	20	21	24.57
Swines on nursery weight	#DIV/0!	#DIV/0!	6.00	6.20	5.90	15.35	16.95	17.75	15.45	14.50	13.10	13.50	15.23
Nursery weight	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**15.60**	**14.95**	**14.74**	**16.95**	**17.15**	**16.64**	**14.50**	**13.10**	**14.05**	**15.30**
Finishing Unit													
	nov/06	dez/06	jan/07	fev/07	mar/07	abr/07	mai/07	jun/07	jul/07	ago/07	set/07	out/07	Average
Entry weight	21.5	22.1	16.7	17.3	18.7		28	28	29	23	20	23	22.63
Animals sold	790	850	25	440	735	690	936	1302	2343	842	867	2094	1027.40
Average weight animals sold	118	102	148	116	102	117	115	109	115	107	114	102	114.50
Finishing weight	**69.75**	**62.05**	**82.35**	**66.65**	**60.35**	**117.00**	**71.50**	**68.50**	**72.00**	**65.00**	**67.00**	**62.50**	**73.29**

Annex 4

MONITORING INFORMATION

This section provides further details on monitoring equipment, training, monitoring procedures, data recording and maintenance.

System Overview:

The Animal Waste Management System installed by the project is illustrated in figure 1. The system consists in four major components:

- Manure loading system
- Anaerobic digester cells
- Biogas transfer and flow meters
- Flaring system

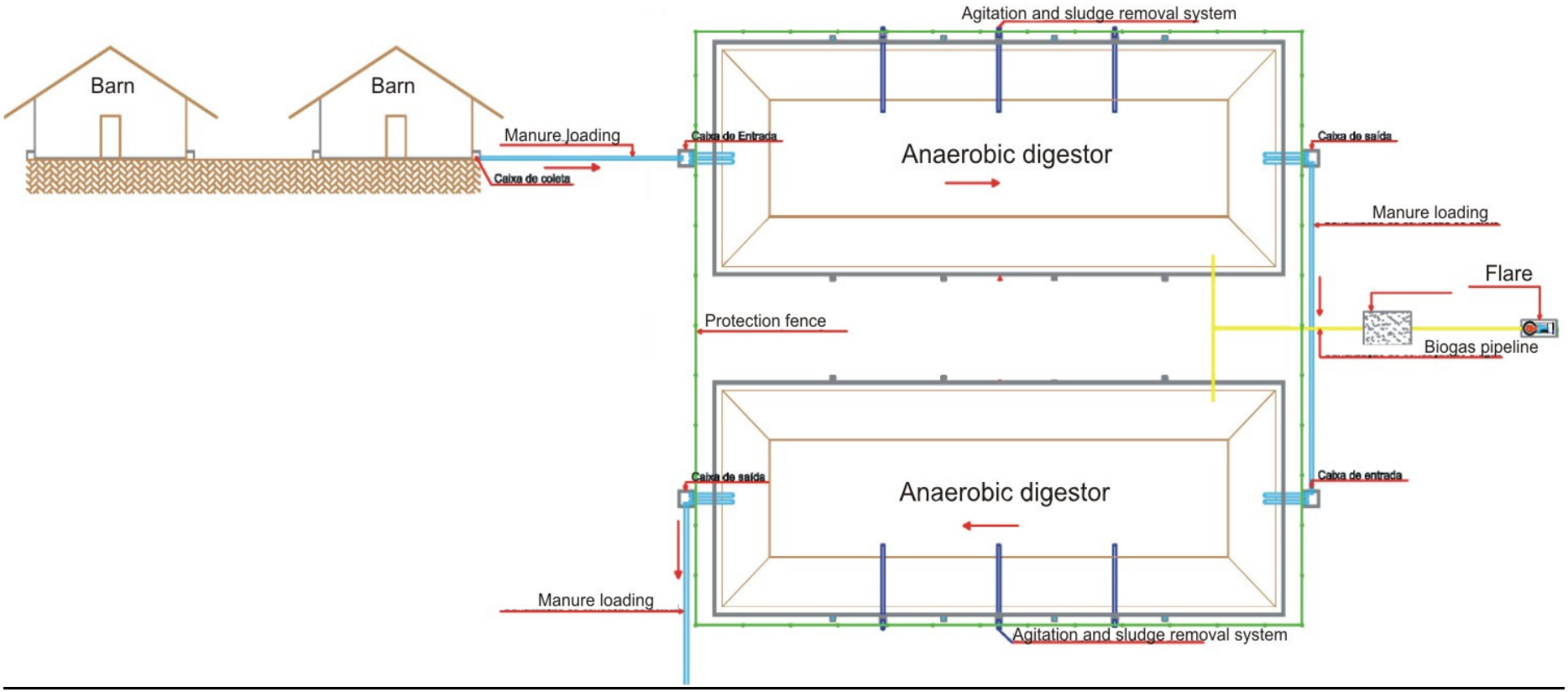

Figure 1. AWMS installed as the project acitivity.

System components Operation and maintenance:

1. Manure loading system

Training: Training on manure loading system will be provided by the technology manufacturer. Training shall include: system components, normal operation, emergency operations, maintenance and request for warranty service. Reporting procedures shall be made directly to Amazon Carbon.

Normal Operation: The manure loading system installed by the project activity is not much different than the existing system. COTRIBÁ personnel are familiar with the system operation and maintenance. Under normal operations, manure is removed from the barns using water hoses and squeegees. This effluent is collected and flushed from the barns periodically. The effluent is sent to the manure tanks and then to the digester cells. In Granja Bohrz, part of the manure is pumped from one open tank to the digester cells, as described in Section A.4.1.4. To optimize manure treatment and biogas production, the excessive use of water shall be avoided.

Safety issues: All personnel working on the barns make use of appropriated gear and clothing. Sanitary and health issues are a serious concern. Care should be taken on handling animal manure and around the manure tanks, to avoid falling into them.

Regular inspections: Regular inspections shall be executed at least on a weekly basis, and will include the following procedures:

- ✓ Check for pipeline obstruction and leakages;
- ✓ Check for corrosion at exposed joints
- ✓ Check for clogging in the manure tanks
- ✓ Check the operational status of the pumping station, where applicable.

Alternative Operating procedures: In the event of malfunction of the manure loading system, COTRIBÁ personnel shall immediately notify Amazon Carbon. The AWMS manufacturer will be notified to provide warranty or maintenance services, if required. Upon restoration of the system, Amazon Carbon shall be notified.

The proximity between the project sites and the manufacturer Head Office will allow fast emergency maintenance. Upon report by COTRIBA, AVESUY maintenance team shall arrive on site in less than 24

hours. In the mean time, COTRIBA and Amazon Carbon shall work together to identify an alternative method to route the effluent in order not to affect the farm nor result in additional GHG emissions.

2. Anaerobic digester:

The anaerobic digesters will be surrounded by a protection fence. Only authorized and trained personnel shall be in contact with the digesters.

Training: Training on the anaerobic digesters shall be provided to COTRIBÁ personnel by the system manufacturer. Training shall include: construction and installation, system components, start-up procedures, normal operation, biogas and sludge handling, emergency operation, safety issues, maintenance and request for service. Reporting procedures shall be directly to Amazon Carbon.

Normal Operation:

Training on normal operation will include the basic operations of the system, biogas production, sludge production and disposal, start-up procedures, safety procedures, daily inspections, technical components and effluent quality.

Safety issues: Safety advice shall include the following instructions:

- ✓ No open flame permitted within 10 meters of the digester
- ✓ Do not allow the access of untrained personnel in the digester surroundings
- ✓ Do not use sharp objects, tools around the digester cover

Regular inspections: Regular inspections shall be executed at least on a weekly basis, and will include the following procedures:

- ✓ Cover material – check for cracks, tears, points of distress and other irregularities around the perimeter of the digester cell.
- ✓ Check for excessive ballooning of cover or presence of odor
- ✓ Check seams for signs of gas leakages
- ✓ Check for manure leakages

Alternative operation procedures: In the event of malfunction of the anaerobic digesters, COTRIBÁ personnel shall immediately notify Amazon Carbon. The AWMS manufacturer will be notified to provide

warranty or maintenance services, if required. Upon restoration of the system, Amazon Carbon shall be notified. The proximity between the project sites and the manufacturer Head Office will allow fast emergency maintenance. Upon report by COTRIBA, AVESUY maintenance team shall arrive on site in less than 24 hours. In the mean time, COTRIBA and Amazon Carbon shall work together to identify an alternative method to route the effluent in order not to affect the farm nor result in additional GHG emissions.

3. Biogas transfer and flow meter devices:

Training on the biogas transfer and flow meter devices shall be provided to COTRIBÁ personnel by the system manufacturer (AVESUY). Training shall include: system components, normal operation, emergency operation, safety issues, maintenance and request for service. Reporting procedures shall be directly to Amazon Carbon.

Normal operation: The biogas produced by the anaerobic digesters will be contained by a sealed geomembrane and sent to the combustion system through PVC pipeline. The combustion system, through the PLC will be regulated by pressure controlling devices to ensure ideal biogas pressure. ROOTS B3 G65 – SSM ICPWS Flow meters will be connected to the PVC pipeline and continuously measure biogas flow to the combustion system. Biogas flow meters also monitor biogas temperature. The flow meters are incorporated to the PLC, which will record biogas flow on an hourly basis. The PLC will be connected to a PC terminal that will store monitoring data and transmit it via internet to Amazon Carbon personnel.

Safety issues: Measures will be taken to avoid biogas leakage and pipeline damages. Care shall be taken when performing maintenance on the flow meters and when digging near the pipelines.

Preventive maintenance: Maintenance procedures shall be conducted according the manufacturer's recommendations. Preventive maintenance shall be executed on a quarterly basis.

Regular inspections: Regular inspections shall be executed at least on a weekly basis, and will include the following procedures:

- ✓ Check for leaks in exposed pipelines
- ✓ Check for operational status of flow meters
- ✓ Check for PLC operational status.
- ✓ Check for PC terminal operational status (on a daily basis)

- ✓ Make security copies of monitoring information on data discs (DVD).

Alternative operating procedures: In the event of malfunction of the biogas transfer system and flow meter devices, COTRIBÁ personnel shall immediately notify Amazon Carbon. The AWMS manufacturer will be notified to provide warranty or maintenance services, if required. Upon restoration of the system, Amazon Carbon shall be notified. The proximity between the project sites and the manufacturer Head Office will allow fast emergency maintenance. Upon report by COTRIBA, AVESUY maintenance team shall arrive on site in less than 24 hours. In the mean time, COTRIBA and Amazon Carbon shall work together to identify an alternative method to route the effluent in order not to affect the farm nor result in additional GHG emissions.

4. Combustion System (flares):

Training: Training on the combustion system shall be provided to COTRIBÁ personnel by the system manufacturer. Training shall include: system components, normal operation, emergency operation, safety issues, maintenance and request for service. Reporting procedures shall be directly to Amazon Carbon.

Normal operation: The flare installed by the project activity has an automatic system designed to combust methane whenever biogas is present at the combustion chamber. The system is also equipped with pressure control devices to maintain ideal flow to the flares. More details on the flaring system are provided in Section A.4.2.

Safety issues: This system will be surrounded by a protection fence. Only authorized and trained personnel shall near the combustion system. Prior to maintenance, the gas flow must be turned off. Double checking of operational status shall be performed prior to maintenance procedures.

Regular inspections: Regular inspections shall be executed at least on a weekly basis, and will include the following procedures:

- ✓ Check for flaring operational status by checking the presence of a flame, the temperature of the combustion system and data from PC terminal. Night inspections will allow the visual confirmation of the combustion process.
- ✓ Check for PLC operational status.
- ✓ Check for PC terminal operational status (on a daily basis)
- ✓ Store monitoring information on data discs (DVD).

Preventive maintenance: Preventive maintenance shall be conducted on a quarterly basis.

System components Operation and maintenance:

Amazon Carbon and COTRIBÁ will have real time access to monitoring information via internet connection. All monitoring equipment will be regulated by a PLC, which collects and stores information. PLCs will be connected to PC terminals for storage and distribution of data. Emergency and malfunction on any of the equipment installed by the project shall be reported immediately to Amazon Carbon. COTRIBÁ will have trained personnel working on the farms on a daily basis. The equipment provider will assist in preventive and emergency maintenance during the crediting period.

Maintenance and Trouble reporting:

In the event of failure in the components of the AWMS installed by the project, including the digesters and the combustion system, COTRIBÁ shall immediately report to Amazon Carbon and to AVESUY. Contact information for emergency situations follows:

Person/ Entity	Phone	e-mail
Amazon Carbon Projects Department	+ 55 51 3019.7157	amazoncarbon@amazoncarbon.com.br
Amazon Carbon Projects Director	+ 55 51 8140.1274	thiago@amazoncarbon.com.br
Amazon Carbon Technology Analyst	+ 55 51 8140.1272	alexandre@amazoncarbon.com.br
Avesuy Head Office	+ 55 49 3433. 4594	avesuy@avesuy.com.br
COTRIBÁ Office	+ 55 54 3324.8800	cotriba@cotriba.com.br

Data storage:

All monitoring data will be stored by COTRIBÁ and Amazon Carbon. The above contact information applies to the responsible for data storage.

Monitoring Procedures:

Monitoring of emission reduction shall include the following items/procedures:

ID	Item	Performed by	Recording procedures
1	Sludge removal	COTRIBÁ personnel	Recorded by trained personnel every time sludge removal occurs. Digitally stored in PC terminal and data discs on a weekly basis.
2	Biogas produced	COTRIBÁ and Amazon Carbon	Electronically recorded by ROOTS B3 G65 – SSM ICPWS Flow meters continuously. Digitally stored by PLCs and PC terminals.
3	Methane combusted	COTRIBÁ and Amazon Carbon	Total methane combusted will be obtained by determining the amount of methane in the combusted biogas multiplied by the flare efficiency. Methane content in biogas will be determined by a gas analyzer on a daily basis. Results will be electronically recorded through a PLC and a PC terminal.
4	Flare efficiency	COTRIBÁ and Amazon Carbon	Flare efficiency will be determined on an hourly basis and will be determined by the temperature in the exhaust gas stream. If the temperature is below 500ºC, the flare efficiency will be considered 0%. Flare efficiency will be considered 90% when the measured temperature is above 500ºC. Data to determine methane combustion efficiency will be electronically detected by Type K temperature sensors and and digitally stored by a PLC system and a PC terminal.
5	Residual gas pressure	COTRIBÁ and Amazon Carbon	The combustion system is equipped with LD301Smart Pressure Transmitter Series, used to assure proper residual gas (biogas) flow to the combustion system. Residual gas pressure is used to determine methane density. Data will be electronically recorded by electronic sensors in the combustion system and digitally stored by a PLC system and a PC terminal.
6	Residual gas temperature	COTRIBÁ and Amazon Carbon	Measured by ROOTS B3 G65 – SSM ICPWS Flow meters. Residual gas temperature is used to determined methane density. Data will be electronically recorded by electronic sensors in the combustion system and digitally stored by a PLC system and a PC terminal.

Monitoring Instructions

This Section provides an overview for monitoring the items described above.

1. Sludge Removal: sludge removal shall be executed as follows:

Step	Activity	Recording/storage	Documentation	Comment
1	Determine the need to remove sludge			Sludge will be disposed through soil application on nearby cropping areas
2	Perform sludge removal in accordance to guidance provided		AVESUY guidance on sludge removal (paper)	
3	Document disposal method on monitoring form	Manual recording by COTRIBÁ personnel	Spread sheet (paper/electronic)	
4	Store data in data discs (DVD)		Electronic	

2. Biogas produced: Biogas produced shall be monitored as follows:

Step	Activity	Recording/storage	Documentation	Comment
1	Record biogas flow meter reading	Automatically recorded by a PLC system connected to the flow meter	Electronic	Biogas flow is measured continuously and recorded electronically by a PLC system. COTRIBÁ and Amazon Carbon will have real time access to this monitoring paramter
2	Check for last 24 hours recording		Electronic	
3	Check PLC and flow meter operational status			If PLC or PC terminal are not operating properly, contact Amazon Carbon for maintenance procedures
4	Store data in data discs (DVD)		Electronic	

3. Methane Combusted: shall be monitored as follows

Step	Activity	Recording/storage	Documentation	Comment
1	Prepare the gas analyzer as indicated in operator manual		Gas analyzer operations manual	
2	Connect the gas analyzer to the biogas pipeline system			
3	Open valve on test port			
4	Take gas reading in accordance with Operations manual			
5	Record reading on PC terminal	Recording on gas analysis will be downloaded to PC terminals.	Electronic	If the analysis demonstrate significant differences from previous readings (more than 10% points) contact Amazon Carbon for maintenance procedures
6	Close valve on test port			

7	Disconnect gas analyzer from biogas pipeline			
8	Check PLC and PC terminal operational status			If PLC or PC terminal are not operating properly, contact Amazon Carbon for maintenance procedures
9	Store data in data discs (DVD)		Electronic	

4. Flare efficiency

Step	Activity	Recording/storage	Documentation	Comment
1	Record temperature of exhaust gas stream	Automatically recorded by electronic sensors in the combustion system and a PLC and PC terminal.	Electronic	
2	Check PLC and PC terminal operational status			If PLC or PC terminal are not operating properly, contact Amazon Carbon for maintenance procedures
3	Store data in data discs (DVD)		Electronic	
4	Check for last 24 hour records to confirm that readings are within expected limits			If the combustion system is not operating properly, immediately contact Amazon Carbon for maintenance procedures.

5. Residual gas pressure

Step	Activity	Recording/storage	Documentation	Comment
1	Record residual gas (biogas) pressure	Automatically recorded by LD301 Smart Pressure Transmitter Series and a PLC and PC terminal.	Electronic	
2	Check PLC and PC terminal operational status			If PLC or PC terminal are not operating properly, contact Amazon Carbon for maintenance procedures
3	Store data in data discs (DVD)		Electronic	
4	Check for last 24 hour records to confirm that readings are within expected limits			If the combustion system is not operating properly, immediately contact Amazon Carbon for maintenance procedures.

6. Residual gas temperature

Step	Activity	Recording/storage	Documentation	Comment
1	Record residual gas (biogas) temperature	Automatically recorded by the flow meters and the PLC and PC terminal.	Electronic	Data on biogas temperature is collected to provide corrected biogas flow. The flow meter automatically records data on biogas temperature.
2	Check PLC and PC terminal operational status			If PLC or PC terminal are not operating properly, contact Amazon Carbon for maintenance procedures
3	Store data in data discs (DVD)		Electronic	
4	Check for last 24 hour records to confirm that readings are within expected limits			If the combustion system is not operating properly, immediately contact Amazon Carbon for maintenance procedures.

Sludge removal Guidance:

Sludge removal from the digesters cells will be made using a pumping system. The followings procedures should be adopted when performing sludge removal:

- ✓ Connect the pump flexible pipeline to the appropriate sludge removal pipe, located laterally in the digester cells. Do not connect more than one pipeline at the same time.
- ✓ Place the other pipeline (pump outlet) in the distribution tanks.
- ✓ Activate the pumping system.
- ✓ Dispose sludge on cropping areas.
- ✓ Record data on sludge removal in monitoring spreadsheet.

Sludge disposal is critical to avoid methane emissions. Care should be taken in order:

- ✓ Not to cause sludge spills.
- ✓ Not to use the pumping system longer than necessary. Deactivate the pumping system immediately after removing the necessary amount of sludge.
- ✓ To perform sludge disposal immediately after loading the distribution tanks.
- ✓ Not to dispose sludge in places other than cropping areas.
- ✓ To correctly record data on the monitoring spreadsheet.

Dual wavelength Infra-red refrigerant gas sensor

Specifications

Specifications

Sensing Technology	Infra Red			
Measurement Range	CO_2 (1000ppm, 5000ppm)	CO (3,10,30,100%)	CH_4 (1%)	N2O (1000ppm)
Accuracy	± 80ppm, 2.5% of range	± 2.5% of range	± 2.5% of range	± 160ppm
Stability (per year)	± 180ppm, 2.0% of range	± 2.0% of range	± 2.0% of range	± 360ppm
Repeatability at zero	± 0.9%, 0.3%	± 0.3%	± 0.3%	± 20ppm
Repeatability at span	± 4.5%, 1.5%	± 1.5%	± 1.5%	± 90ppm
Response Time	T_{90} < 30s	T_{90} < 30s	T_{90} < 30s	T_{90} < 30s
Operating Temperature	0 - 40°C	0 - 40°C	0 - 40°C	0 - 40°C
Temperature Drift	± 0.1% of range per °C	± 0.1% of range per °C	± 0.1% of range per °C	± 0.2% of range per °C
Warm Up Time - operational	3 mins	3 mins	3 mins	3 mins
Warm Up Time - full specification	40 mins	40 mins	40 mins	40 mins
Humidity	unaffected by 5-90% RH (non condensing)	unaffected by 5-90% RH (non condensing)	unaffected by 5-90% RH (non condensing)	unaffected by 5-90% RH (non condensing)
Linear Output Resolution	0.006mA	0.006mA	0.006mA	0.006mA
Power Consumption	13W typical	13W typical	13W typical	13W typical
Input Voltage Requirements	88-138VAC or 172-276VAC (switch selectable)	88-138VAC or 172-276VAC (switch selectable)	88-138VAC or 172-276VAC (switch selectable)	88-138VAC or 172-276VAC (switch selectable)
Dimensions	267 x 258 x 148mm	267 x 258 x 148mm	267 x 258 x 148mm	267 x 258 x 148mm

EDINBURGH SENSORS: The gas sensor division of EDINBURGH INSTRUMENTS Ltd.

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Gas analysers will measure methane content in produced biogas in parts per million (ppm). Gas analysers will be calibrated according to manufacturer specifications. Calibration certificates will be provided when the equipment is installed in project sites. Calibration certificates shall be made available during the crediting period.

Calibration frequency will be determined by frequent recalibration of gas analysers in the first months of operation. Calibration frequency, however, shall not exceed two years. Calibration is done using Industrial Pure gas cylinders, such as Synthetic Air or Nitrogen. Recalibration shall be done according to equipment manual by trained personnel.

ROOTS B3 G65 – SSM ICPWS Flow meter

Specifications

SERIES B3: G65 ROOTS® Meter

	UNITS	Metric
Temperature Range	deg. C	-40 to +60
Base Rating (Q Max.)	m³/h	100
Max. Operating Pressure (MAOP)	bar	12
Leak Test (125% MAOP)	bar	15
Static Test (2 x MAOP)	bar	24
Rangeability +/- 1%	ratio	89:1
Rangeability +/- 2%	ratio	163:1
Start Rate	m³/h	0,0595
Stop Rate	m³/h	0,0510
Flow Rate @ 1,25 mbar, Gas	m³/h	73,1
Avg. Differential, 100% Flow	mbar	3,2
Max. Pressurization Rate	kPa/sec	35
Max. Operating Speed	rpm	2350
Gear Ratio	ratio	141,1764:1
Displaced Volume/Revolution	m³	0,000708
Drive Rate, CD	m³/rev	0,1
Min. Odometer Reading	m³	0,002
Odometer Turnover	yrs.	1,14
Nominal Pipe Size	mm	50
Flange-to-Flange	mm	172
Flange Connection	ANSI	150#FF
Bolts per Flange	qty.	4
Bolt Size[1]	in.	5/8 - 11
Flange Bolt Hole Depth	mm	23,8
Bolt Torque: Lubricated/Non-Lub.	N-m	74/81
Restricting Orifice (120%)	mm	9,525
Oil Capacity – Side Inlet	ml	37
Oil Capacity – Top Inlet	ml	226
Counter Version (CTR)[2]		
Net Weight	kg	13
Shipping Weight	kg	14
Carton Size	cm	69 x 28 x 23
Counter with Instrument Drive (CD)[2]		
Net Weight	kg	15
Shipping Weight	kg	17
Carton Size	cm	79 x 38 x 33

NOTES:
[1] Bolt Length varies by application.
[2] Weights and dimensions available for CPS upon request.

ROOTS B3 G65 – SSM ICPWS Flow meters are built and calibrated according to INMETRO (National Institute of Metrology, Standardization and Industrial Quality) Standard 114/1997 and OIML (International Organization of Legal Metrology) Recommendation 32. Standards and recommendations are annexed to this document.

Calibration frequency will be determined by sample checking of flow meters in the first months of operation. Calibration frequency, however, shall not exceed five years, as stated in INMETRO Standard 114/1997. Calibration is done using ROOTS® Proving System. This equipment is certified according to NMI (Netherland Measurment Institute) standards. System specification follows:

ROOTS® Proving System Model 5 2M/10M

Specifications
(excludes computer)

Accuracy:		+/- 0.55%
Repeatability:		+/- 0.15%
Ambient Operating Temperature:	Master Meter:	+32° to +140°F 0° to +60°C
	Controller, etc.:	-4° to +140°F -20° to +60°C
Ambient Storage Temperature:	Master Meter:	-40° to +140°F -40° to +60°C
	Controller, etc.:	-40° to +185°F -40° to +85°C
Humidity:		Up to 95% non-condensing
AC Power:	Blower: Electronics:	120 or 240 volts ± 15%, 48 to 62 hertz 120 or 240 volts ± 15%, 48 to 62 hertz
Blower Capacity:	Single:	0 to 7,200 ACFH at 10 inch differential 0 to 200 m^3/h at 25 millibar differential
Blower Capacity:	Dual:	0 to 14,400 ACFH at 10 inch differential 0 to 400 m^3/h at 25 millibar differential
Compliance:		Meets FCC Part-15 requirements NMi and NIST Traceable
Test Medium:		Air
Test Flow Rate:	10M Master Meter:	100 to 10,000 ACFH 2.83 to 283 m^3/h
	2M Master Meter:	35 to 2,300 ACFH 1 to 65.1 m^3/h
Safety Rating:		Complies with Underwriters Laboratory Requirements
Inverter Capacity Required:		2000 watts continuous
Net Weight:		10M only 143 lbs. 2M/10M 173 lbs. Hose Carton* 50 lbs
Shipping Weight:		10M only 198 lbs. 2M/10M 228 lbs. Hose Carton 60 lbs.
Overall Prover Dimensions (l x w x h):		51" x 19.5" x 29.5"
Prover Shipping Dimensions (l x w x h):		54" x 24" x 32"
Hose Carton Shipping Dimensions (l x w x h):		41" x 22" x 35"

*Hose Carton contains prover Hose and Tool Kit

Minimum Computer System Requirements:

- Microsoft Windows® 95 or Windows® 98 Me, Windows NT® 4.0
- Pentium 200Mhz processor with 32 Megabytes of RAM
- 256 color video with 800 x 600 capability
- 100 MB of free Hard Disk space

DRESSER Roots Meters & Instruments

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TS:MODEL 5
9.02

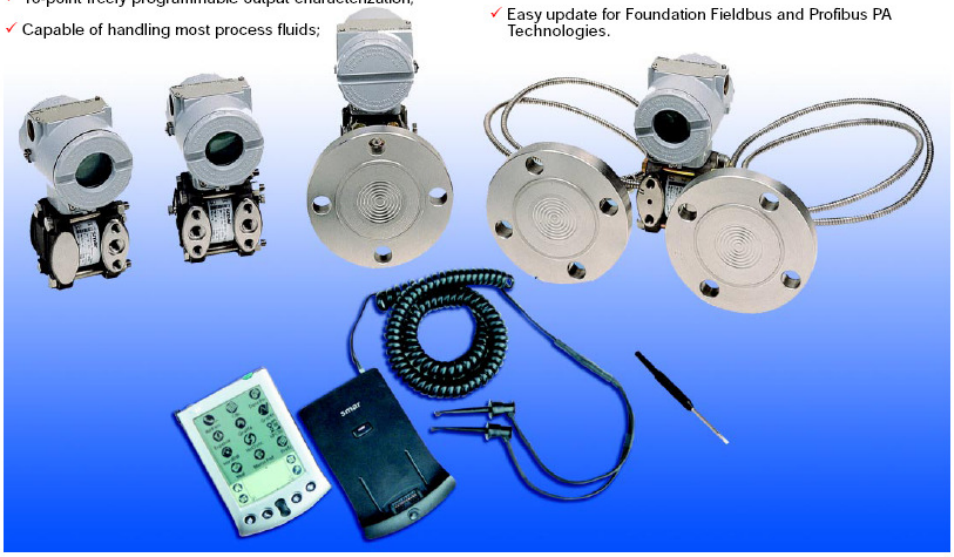
LD301 Smart Pressure Transmitter Series

Specifications

LD301

FEATURES

- ✓ 0.075% accuracy;
- ✓ 120:1 rangeability; NEW
- ✓ 0-125 Pa to 0-40 MPa (0-0.5 inH_2O to 0-5800 psi);
- ✓ Direct digital capacitance sensing (No A/D conversion);
- ✓ 4-20 mA output plus direct digital communication (HART® Protocol), according to NAMUR-NE-43 standard;
- ✓ Updating time of output current in 100 ms;
- ✓ Output current resolution of 0.75 µA/bit;
- ✓ With high performance mathematical co-processor;
- ✓ One single eletronic board for all models;
- ✓ True noninteractive zero and span;
- ✓ Local zero and span adjustment;
- ✓ Remote calibration;
- ✓ Password protection;
- ✓ On-line and off-line programming;
- ✓ Multi-drop operation mode;
- ✓ Output functions: linear, $\sqrt{x}$, $\sqrt{x^3}$, $\sqrt{x^5}$, special function and constant current;
- ✓ Optional 4½-digit numerical and 5-character alphanumerical LCD indicator;
- ✓ ISO 9001 certified;
- ✓ Indication in engineering units, configuration file, diagnosis, etc., available in the Hand-Held Terminal;
- ✓ 16-point freely programmable output characterization;
- ✓ Capable of handling most process fluids;
- ✓ 16 MPa and 32 MPa static pressure (2320 psi and 4600 psi);
- ✓ Small and lightweight;
- ✓ Explosion proof and weather proof housing;
- ✓ Intrinsically safe;
- ✓ Constant signal generation for loop tests;
- ✓ Fully interchangeable parts for easy maintenance;
- ✓ Optional PID control function with antireset wind-up, output limitation, rate-of-change limitation, bumpless auto/manual transfer, etc;
- ✓ 16 points table for PID output and input, configurable by the user;
- ✓ EU indication, file configuration, diagnóstics, calibration file, identification, etc, via Hand Held or PC through CONF301, CONF401;
- ✓ Fail-safe level;
- ✓ Flow totalization with persistence;
- ✓ User unit;
- ✓ EMI effects: Conforms to IEC 61000-6-2, IEC 61000-6-4, IEC 61326;
- ✓ FMEDA (Failure Modes Effects and Diagnostic) Analysis;
- ✓ MTBF (Mean Time Between Failures) of 244 years;
- ✓ MTTR (Mean Time to Repair) of 18 minutes;
- ✓ MTTF (Mean Time to Failure) of 244 years;
- ✓ Applicable in safety areas according to SIL (Safety Integrity Level) requirements;
- ✓ Write protection by hardware;
- ✓ Easy update for Foundation Fieldbus and Profibus PA Technologies.



smar

B2

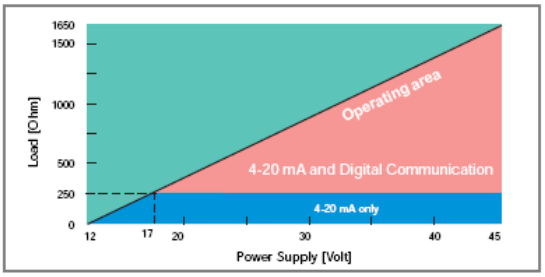
Functional Specifications

Process Fluid
Liquid, gas or vapor.

NEW **Output Signal**
Two-wire, 4-20 mA controlled according to NAMUR NE43 Specification, with superimposed digital communication (HART® Protocol).

Power Supply
12 to 45 Vdc.

Load Limitation

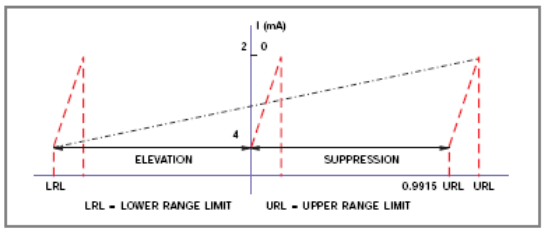


Indicator
Optional 4½-digit numerical and 5-character alphanumerical LCD indicator.

Hazardous Area Certifications
Explosion proof, weather proof and intrinsically safe (NEMKO, DMT, CEPEL, CSA and FM standards).

Zero and Span Adjustments
Noninteractive, via digital communication.

Zero Adjustment Limits



Calibrated span shall not be less than 0.0085 URL and shall not exceed 2 URL.
Low range value shall not be below LRL.
Upper range value shall not be greater than URL.

(LRL = -URL for all models, except absolute, where LRL = vacuum).

Temperature Limits

Ambient:	-40 to 85 °C (-40 to 185 °F).
Process:	-40 to 100 °C (-40 to 212 °F) (Silicone Oil).
	0 to 85 °C (-32 to 185 °F) (Fluorolube Oil).
	-40 to 150 °C (-40 to 302 °F) for LD301L.
	-25 to 85 °C (-13 to 185 °F) (Viton O-Rings).
Storage:	-40 to 100 °C (-40 to 212 °F).
Digital Display:	-10 to 60 °C (14 to 140 °F).
	-40 to 85 °C (-40 to 185 °F) without damage.

NEW **Failure Alarm**
In case of sensor or circuit failure, the self diagnostics drives the output to 3.6 or 21.0 mA, according to the user's choice.

Turn-on Time
Performs within specifications in less than 5.0 seconds after power is applied to the transmitter.

Volumetric Displacement
Less than 0.15 cm^3 (0.01 in^3).

Overpressure and Static Pressure Limits
From 3.45 kPa abs. (0.5 psia)* to:
8 MPa (1150 psi) for range 1.
16 MPa (2300 psi) for ranges 2, 3 & 4.
32 MPa (4600 psi) for models H & A5.
40 MPa (5800 psi) for model M5.
52 MPa (7500 psi) for model M6.

* except the LD301A model.
Flange Test Pressure: 60 MPa (8570 psi).

For ANSI/DIN Level flanges (LD301L models):
150lb: 6 psia to 275 psi at 38 °C (-0.6 to 19 bar).
300lb: 6 psia to 720 psi at 38 °C (-0.6 to 50 bar).
PN10/16: -60 kPa to 1.4 MPa at 120 °C.
PN25/40: -60 kPa to 4 MPa at 120 °C.

These pressures will not damage the transmitter, but a new calibration may be necessary.

Humidity Limits
0 to 100% RH.

Damping Adjustment
User configurable from any value higher than zero seconds in addition to intrinsic sensor response time (0.2s) (via digital communication).

Configuration
By digital communication (HART® protocol) using the Configuration Interface CONF301 or the Hart Pocket Configurator HPC301. Can be done partially, through local adjustment.

Performance Specifications

Reference conditions: range starting at zero, temperature 25 °C (77 °F), atmospheric pressure, power supply of 24 Vdc, silicone oil fill fluid, isolating diaphragms in 316L SS and digital trim equal to lower and upper range values.

Accuracy
0.1 URL ≤ span ≤ URL:
±0.075% of span;
0.025 URL ≤ span ≤ 0.1 URL:
±0.0375 [1+0.1 URL/span]% of span;
0.0085 URL ≤ span ≤ 0.025 URL:
±[0.0015+0.00465 URL/span]% of span (*).

(*) - Recommended minimum span for Range 1 is 0.025 URL.

For ranges 5 and 6, Absolute models, diaphragms in Tantalum, Monel or fill fluid in Fluorolube:
0.1 URL ≤ span ≤ URL:
± 0.1% of span;
0.025 URL ≤ span ≤ 0.1 URL:
±0.05 [1+0.1 URL/span]% of span;
0.0085 URL ≤ span ≤ 0.025 URL:
±[0.01+0.006 URL/span]% of span.

For Absolute - range 1:
± 0.2% of span
Linearity, hysteresis and repeatability effects are included.

Stability
± 0.1% of URL for 24 months for ranges 2, 3, 4, 5 & 6.
± 0.2% of URL for 12 months for range 1 & L models.
± 0.25% of URL for 5 years, at 20 °C temperature change and up to 7 MPa (1000 psi) of static pressure.

Temperature Effect
± (0.02% URL+0.1% span) per 20 °C (36 °F) for ranges 2, 3, 4, 5 & 6.
± (0.05% URL+0.15% span) per 20 °C (36 °F) for range 1.

For LD301L:
6 mmH_2O per 20 °C for 4" and DN100.
17 mmH_2O per 20 °C for 3" and DN80.
Consult for other flange dimensions and fill fluid.

Static Pressure Effect
Zero error:
± 0.1% URL per 7 MPa (1000 psi) for ranges 2, 3, 4 & 5, or 3.5 MPa (500 psi) for L models or 1.7 MPa (250 psi) for range 1. This is a systematic error that can be eliminated by calibrating at the operating static pressure.
Span error:
Correctable to ± 0.2% of reading per 7 MPa (1000 psi) for ranges 2, 3, 4 & 5 or 3.5 MPa (500 psi) for range 1 and L models.

Power Supply Effect
± 0.005% of calibrated span per volt.

Mounting Position Effect
Zero shift of up to 250 Pa (1 inH_2O) which can be calibrated out. No span effect.

Electro-Magnetic Interference Effect
Designed to comply with IEC 61000-6-2:1999, IEC 61000-6-4: 1997, IEC 61326: 2000.

Vibration Effects
Designed according to SAMA PMC 31.1 standard

Physical Specifications

Electrical Connection
½ - 14 NPT, Pg 13,5 or M20 x 1,5 metric.

Process Connection
¼ - 18 NPT or ½ -14 NPT (with adapter). For L models see ordering code.

Wetted Parts
- **Isolating Diaphragms**
  316L SST, Hastelloy C276, Monel 400 or Tantalum.
- **Drain/Vent Valves and Plug**
  316 SST, Hastelloy C276 or Monel 400.
- **Flanges**
  Plated carbon steel, 316 SST, Hastelloy C276 or Monel 400.
- **Wetted O-Rings (For Flanges and Adapters)**
  Buna N, Viton™ or PTFE. Ethylene-Propylene on request.

The LD301 is available in NACE MR-01-75 compliant materials.

Nonwetted Parts
- **Electronic Housing**
  Injected aluminum with polyester painting or 316 SST (NEMA 4X, IP67).
- **Blank Flange**
  Plated carbon steel, when the wetted flange is made of this same material, and 316 SST in the other cases.
- **Level Flange (LD301L)**
  316 SST.
- **Fill Fluid**
  Silicone or Fluorolube Oil.
- **Cover O-Rings**
  Buna N.
- **Mounting Bracket**
  Plated carbon steel with polyester painting or 316 SST. Accessories (bold, nuts, washers and U-clamps) in carbon steel or 316 SST.
- **Flange Bolts and Nuts**
  Plated carbon steel:
  Grade 7, 316 SST or Carbon Steel B7M (for nace applications).
- **Identification Plate**
  316 SST.

Mounting
a) Flange mounted for models LD301L.
b) Optional universal mounting bracket for surface or vertical/horizontal (DN 50) 2"-pipe (optional).
c) Via bracket on manifold valve (optional).
d) Directly on piping for closely coupled transmitter/orifice flange combinations.

Approximate Weights
3.15 kg (7 lb): all models, except L models.
5.85 to 9.0 kg (13 lb to 20 lb): L models depending on the flanges, extension and materials.

Control Characteristics (optional)

PID
Proportional Gain: 0 to 100.
Integral Time: 0.01 to 999 min/rep.
Derivative Time: 0 to 999 s.
Direct / Reverse Action.
Lower and Upper output limits.
Output rate-of-change limit: 0 to 100%/s.
Power-on safety output.
Antireset windup.
Bumpless Auto/Manual transfer.
16 point table for PID input and output, freely user configurable.

Hastelloy is a trademark of the Cabot Corp.
Monel is a trademark of International Nickel Co.
Viton and Teflon are trademarks of E. I. DuPont de Nemours & Co.
Fluorolube is a trademark of Hooker Chemical Corp.
Hart is a trademark of HART Communication Foundation.

Smar Pressure Transmitters are protected by USA patent number 6,433,791

Calibration

LD301 Smart Pressure Transmitter Series are built and calibrated in accordance with INMETRO . Conformity tests were made by the Center of Electrical Energy Research, organization that is accredited by INMETRO for such testings. Certificates of Conformity are annexed to this document. Testing and certification will be executed during the crediting period to ensure proper operation of LD301 Transmitters.

EXHAUST GAS TEMPERATURE SENSOR

Exhaust gas temperature will be measured by Type K sensors are built and calibrated according to ASTM standard ASTM-E 230/77. These sensors have a temperature range of 0 to 1 100ºC. Sensors will be regulated to operate with maximal temperature of 600 to 700ºC.

The sensor provides +- 2.2 ºC accuracy in temperature reading. The sensors are connected to the PLC, which records readings on an hourly basis, on Celsius degrees. These sensors do not need to be recalibrated. Sensors will be replaced as needed.

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The following references were used to determine the information described in this PDD:

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- Approved methodology ACM0010, version 3, equation (2);
- Approved small-scale methodology AMS.III.D., version 13;
- Methodological Tool to determine project emissions from flaring gases containing methane, version 1;
- EMBRAPA, 2003. Technological Inventory of EMBRAPA for Swine Manure Management Systems, pages 17 and 29 to 37
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