AWMS METHANE RECOVERY PROJECT BR06-S-21, GOIAS, BRAZIL

UNFCCC Clean Development Mechanism
Simplified Project Design Document
for
Small Scale Project Activity

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CLEAN DEVELOPMENT MECHANISM
SIMPLIFIED PROJECT DESIGN DOCUMENT
FOR SMALL-SCALE PROJECT ACTIVITIES (SSC-CDM-PDD)
Version 02

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Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.

SECTION A. General description of the small-scale project activity

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

AWMS Methane Recovery Project BR06-S-21, **Goias, Brazil**

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

Purpose: The purpose of this project is to mitigate and recover animal effluent related GHG by improving AWMS practices.

Worldwide, agricultural operations are becoming progressively more intensive to realize economies of production and scale. The pressure to become more efficient drives significant operational similarities between farms of a "type," as inputs, outputs, practices, genetics, and technology have become similar around the world.

This is especially true in livestock operations (swine, dairy cows, etc.) which can create profound environmental consequences, such as greenhouse gas emissions, odour, and water/land contamination (including seepage, runoff, and over application), that result from storing (and disposing of) animal waste. Confined Animal Feeding Operations (CAFOs) use similar Animal Waste Management System (AWMS) options to store animal effluent. These systems emit both methane (CH_4) and nitrous oxide (N_2O) resulting from both aerobic and anaerobic decomposition processes.

This project proposes to apply the Methane Recovery methodology identified in Section III.D, of the Indicative Simplified Baseline and Monitoring Methodologies for Small-Scale CDM Project Activity Categories, to swine CAFOs located in Goias, Brazil. The proposed project activities will mitigate and recover AWMS GHG emissions in an economically sustainable manner, and will result in other environmental benefits, such as improved water quality and reduced odour. In simple terms, the project proposes to move from a high-GHG AWMS practice, an open air lagoon, to a lower-GHG AWMS practice, an anaerobic digester with capture and combustion of resulting biogas.

Contribution to sustainable development:

According to Brazil's *Inter-Ministerial Commission on Global Climatic Change,*[1] manure management is an important issue that needs to be solved. Failure to do so will allow existing problems (e.g., increased (insect) pest populations, problems with allergies and livestock disease, including foot-and-mouth disease (FMD) which exists in Brazil), to continue unabated. To this end, Brazil has in recent years required all CAFOs to transition from single to multi-lagoon systems, and even more recently has required them to line the bottom of their primary sedimentation lagoon to prevent effluent seepage.[2]

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[1] http://www.ambientebrasil.com.br

[2] A re-lined lagoon typically delivers a nominal 20-30 years of performance. For additional data refer to: R.J. McMillan, et al, "Studies of Seepage Beneath Earthen Manure Storages and Cattle Pens in Manitoba," Manuscript in Preparation, University of Manitoba & The Water Branch of Manitoba; Ground Water Monitoring & Assessment Program, (2001) "Effects of Liquid Manure Storage Systems on Ground Water Quality," Minnesota Pollution Control Agency; American Society of Agricultural Engineers, (2003) "Seepage Losses From Animal Waste Lagoons: A Summary of a Four Year Investigation in Kansas", Technical Library

Establishing a positive model for other livestock operations is essential. In the last ten years, Brazilian swine production grew by 28%, reaching breeding levels of approximately 36 million animals.[3] In 2004, the swine population in Goias was approximately 1.5 million.[4] Considering that a typical hog produces 5.8 kilograms of effluent daily (Table A1), annually some 3.16 million metric tons of hog waste is produced in this state alone. Introducing progressive AWMS practices throughout the region could result in an annual reduction of over 1.38 million tonnes[5] of carbon dioxide equivalent (CO_2e) annually.

Table A1. Daily production of effluent by type of porcine[6]

Stage	Manure kg/day	Manure and Urine kg/day	Volume litres/day	Volume m^3/animal/month
25-100 kg	2.3	4.9	7.0	.25
Gestating sows	3.6	11.0	16.0	.48
Nursing sows	6.4	18.0	27.0	.81
Boar pig	3.0	6.0	9.0	.28
Piglet	0.35	0.95	1.4	.05
Average	2.35	5.8	8.6	.27

Furthermore, the proper handling of this large quantity of CAFO animal waste is critical to protecting human health and the environment. Because of the practices employed by farmers, the design, location, and management of livestock operations are critical components in ensuring an adequate level of protection of human health and the environment.[7]

This project activity will have positive effects on the local environment by improving air quality (i.e., reducing the emission of Volatile Organic Compounds (VOCs) and odour) and will set the stage for future on-farm projects (i.e., changes in land application practices) that will have an additional positive impact on GHG emissions with an attendant potential for reducing groundwater contamination problems.

This project activity will also increase local employment of skilled labour for the fabrication, installation, operation and maintenance of the specialized equipment. Finally, this voluntary project activity will establish a model for world-class, scalable animal waste management practices, which can be duplicated on other CAFO livestock farms throughout Brazil, dramatically reducing livestock related GHG and providing the potential for a new source of revenue and green power.

The proposed methane recovery project uniquely satisfies the Brazilian government priorities for environmental stewardship and sustainability while positioning rural agricultural operations to develop

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[3] Anaulpec, 2001

[4] ftp://ftp.ibge.gov.br/Producao_Pecuaria/Producao_da_Pecuaria_Municipal_%5Banual%5D/2004/grandes_regioes_Ufs.zip

[5] Approximate calculation using IPCC model and emission factors

[6] Kruger I, Taylor G, Ferrier M (eds) (1995) 'Australian pig housing series: effluent at work' (NSW Agriculture: Tamworth). Another outstanding reference for manure output is: Lorimor, Powers, et.al "Manure Characteristics", Manure Management Series, MWPS-18, Section 1; pg 12.

[7] Speir, Jerry; Bowden, Marie-Ann; Ervin, David; McElfish, Jim; Espejo, Rosario Perez, "Comparative Standards for Intensive Livestock Operations in Canada, Mexico, and the U.S.," Paper prepared for the Commission for Environmental Cooperation.

and use renewable ("green") power. Indeed, it does so with no negative consequences and with a series of environmental and infrastructure co-benefits.

Because the proposed project establishes an advanced AWMS the project participants believe the farm managers will adopt – and continue to practice – AWMS practice changes that result in meaningful, and permanent, GHG emission reductions beyond the project's expected lifespan.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	• AgCert Do Brasil Solucoes Ambientais Ltda.	No

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):

The host party for this project activity is **Brazil.**

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

The project will be located in **Goias**.

A.4.1.3. City/Town/Community etc:

The project sites are shown in Figure A1 with specifics detailed in Table A2.

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

The physical location of each of the sites involved in this project activity is shown in Figure A1 and listed in Table A2.

Agropecuaria Montisui Ltda has one site in Goias:

- Fazenda Lage Cabeceira (26822) is a farrow to finish operation with a capacity of over 8,800 animals. Housing for the animals is provided in six containment areas. Containment areas 1 and 3, which house the sows, use the scraper method of manure removal. All other containment areas are cleared of manure by flushing. The AWMS consists of two primary open lagoons and surface spread is the method of effluent disposition. Waste flows from all containment areas into one distribution point that divides the waste between the two lagoons.

Dolvimar Lucas Lovatto has two sites in Goias:

- Fazenda Varginha Monte Alegre Sitio I (850031) is a finishing operation with a capacity of over 4,000 animals. Four containment areas house the animals and manure is removed by flushing. Waste from all containment areas flows to a central distribution box and then into four open lagoons in succession. Effluent will be disposed of through surface spread.

- Fazenda Varginha Monte Alegre Sitio II (850051) is a finishing operation with a capacity of over 4,000 animals. Four containment areas house the animals and manure is removed by flushing. Waste from all containment areas flows to a central distribution box and then into four open lagoons in succession. Effluent will be disposed of through surface spread.

Antonio de Bartoli has two sites in Goias:

- Fazenda Posse - Granja Chapéu do Sol (21232) is a farrowing operation with a capacity of approximately 700 animals. Over 10 years, the producer expects a 20% growth for the initial two years and 10% per year thereafter. The five containment areas that house the animals use either the scraper or flush manure removal method. Waste flows from the containment areas into one primary and one secondary open lagoon and irrigation is used to dispose of effluent. Monthly animal inventories were estimated based upon the producer's annual inventory average.

- Fazenda Posse - Granja Chapéu do Sol – Sitio 2 (21552) is a farrow to finish operation with a capacity of over 4,600 animals. The animals are housed in four containment areas. Manure is removed by flushing. This site's AWMS consists of one primary open lagoon and effluent is disposed of through irrigation.

Neuri Segatt has two sites:

- Fazenda Segatt – Granja Segatt – Finishers (850211) is a finishing operation with a capacity for over 13,000 animals. The animals are housed in nine containment areas, all of which use the scraper method of manure removal. Waste from all the containment areas is divided among the site's three open lagoons. Effluent is disposed of through irrigation.

- Fazenda Segatt – Granja Segatt - Sows (20072) is a farrowing operation with a capacity of over 1,200 animals. Over 10 years, the producer expects a 10% growth per year. Four containment areas house the animals and manure is removed using the scraper method. Waste from the containment areas is divided between the two primary open lagoons at this site. Irrigation is used to dispose of effluent.

Janice Orlando Faguerazzi e Cleonice Orlando Giese has one site:

- Granja Orlando II (21912) is a farrowing operation with a capacity of over 5,000 animals. The animals are housed in four containment areas which measure 95m x 13m each. The scraper method is used to remove manure. Three primary open lagoons receive the waste from the containment areas. The method of effluent disposition in use is irrigation.

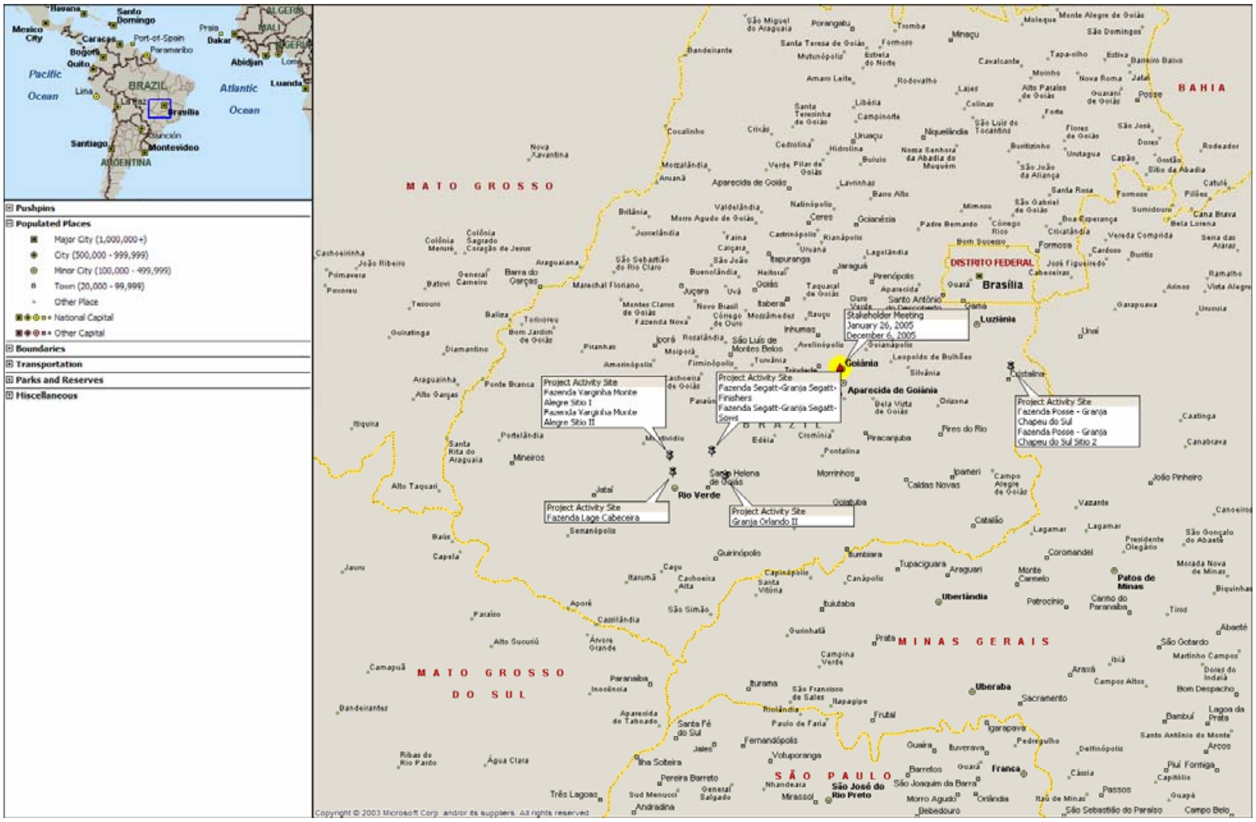

Figure A1. State of Goias, Brazil project activity sites

Table A2. Detailed physical location and identification of project sites

Farm/Site Name	AgCert ID	Address	Town / State	Contact	Phone	GPS Coord
Antonio de Bartoli	Home Office	Rua Rio Araguai, 269 - Centro	Cristalina, Goias	Antonio de Bortoli	55 61 612-4951	n/a
Fazenda Posse - Granja Chapéu do Sol	21232	Rodovia GO 309 - Cristalina Unai, Km. 6 a direita				16.70043S 47.576652W
Fazenda Posse - Granja Chapéu do Sol - Sítio 2	21552					16.69514S 47.577865W
Dolvimar Lucas Lovatto	Home Office	Rua Belmiro Candido de Abreu Quadra 14 Lote B Vitória Regia	Rio Verde, Goias	Dolvimar Lucas Lovatto	55 64 3622-1131	n/a
Fazenda Varginha Monte Alegre Sítio I	850031	Rodovia GO 174, Km. 06			55 64 8117-6230	17.565838S 50.975882W
Fazenda Varginha Monte Alegre Sítio II	850051					17.566882S 50.970120W
Fazenda Lage Cabeceira	26822	Rodovia GO 174 Km 06 - Zona Rural	Rio Verde, Goias	Caio Nogueira Battistetti	55 64 3612-4936	17.72S 50.95W
Neuri Segatt	Home office	Rodovia BR 060, Km 377	Santo Antônio da Barra,Goias	Neuri Segatt	55 64 622-6284	n/a
Fazenda Segatt - Granja Segatt - Finishers	850211					17.52S 50.56W
Fazenda Segatt - Granja Segatt - Sows	20072					17.518S 50.562W
Granja Orlando II	21912	Estrada Santa Helena - Goias KM 01 - Turvelandia	Turvelandia, Goias	Janice Orlando Faguerazzi e Cleonice Orlando Giese	55 11 888-8888	17.75676S 50.43098W

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

The project activity described in this document is classified as a Type III, Other Project Activities, Category III.D./Ver 11, Methane recovery in agricultural and agro industrial activities.

The project activity will capture and combust methane gas produced from the decomposing manure of swine CAFOs located in Goias, Brazil.

The technology to be employed by the project activity includes the installation of new covered lagoons creating an anaerobic digester. The system will be comprised of a lined and covered lagoon creating a digester with sufficient capacity and Hydraulic Retention Time (HRT) to greatly reduce the volatile solids loading in the effluent. The cover consists of a synthetic high density polyethylene (HDPE) geomembrane, which is secured to the liner by means of an anchor trench around the perimeter. HDPE is the most commonly used geomembrane in the world and is well suited for use in this project. HDPE is an excellent product for large applications that require UV, ozone, and chemical resistance. The digester has been designed to permit solids residue removal without breaking the gas retention seal. Processed effluent from the digester(s) will be routed to a secondary and tertiary lagoon system, as needed, and captured biogas will be routed to an efficient combustion system to destroy methane gas produced. Special maintenance procedures have been developed to ensure proper handling and disposition of the digester sludge.

The enclosed flaring combustion system is automated to ensure that all biogas that exits the digester and passes through the flare (and flow meter) is combusted. Pressure control devices within the gas handling system maintain proper biogas flow to the combustion system. A continuous ignition system ensures methane combustion whenever biogas is present at the flare. Two (2) sparking electrodes provide operational redundancy. If biogas is present in the flare, it is immediately ignited by the sparking system. If biogas is not present, the igniter sparks harmlessly approximately every 3 seconds. This continuous ignition system is powered by a robust solar module (solar-charged battery system) that operates independently from the power grid. With a fully charged battery, the module will provide power to the igniter for up to two weeks without sunlight. The component parts are verified functional on a periodic basis in accordance with manufacturer and other technical specifications.

Technology and know-how transfer:

The project developer is implementing a multi-faceted approach to ensure the project, including technology transfer, proceeds smoothly. This approach includes careful specification and design of a complete technology solution, identification and qualification of appropriate technology/services providers, supervision of the complete project installation, farm staff training, ongoing monitoring (by the project developer) and developing/implementing a complete Monitoring Plan using project developer staff. As part of this process, the project developer has specified a technology solution that will be self-sustaining (i.e., highly reliable, low maintenance, and operate with little or no user intervention). The materials and labour used in the base project activity are sourced from the host country whenever economically possible.

By working so closely with the project on a “day to day” basis, the project developer will ensure that all installed equipment is properly operated and maintained, and will carefully monitor the data collection and recording process. Moreover, by working with the farm staff over many years, the project developer will ensure that the staff acquires appropriate expertise and resources to operate the system on an ongoing/continuous basis.

A.4.3. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed small-scale project activity, including why the emission reductions would not occur in the absence of the proposed small-scale project activity, taking into account national and/or sectoral policies and circumstances:

Anthropogenic GHGs, specifically methane is released into the atmosphere via decomposition of animal manure. Currently, the farm produced GHG is not collected or destroyed.

The proposed project activity intends to change current AWMS practices. These changes will result in the recovery of anthropogenic GHG emissions by controlling the lagoon's decomposition processes and collecting and combusting the methane biogas.

A.4.3.1 Estimated amount of emission reductions over the chosen crediting period:

THE TOTAL ESTIMATE OF EMISSIONS REDUCTION OVER THE 10 YEAR CREDITING PERIOD

A.4.3.1 - Estimated Emission Reductions over chosen Crediting Period	
Years	**Annual estimation of emission reductions in tonnes of CO_2e**
Year 1	16,826
Year 2	17,036
Year 3	17,276
Year 4	17,483
Year 5	17,711
Year 6	17,961
Year 7	18,236
Year 8	18,539
Year 9	18,872
Year 10	19,238
Total estimated reductions (tonnes CO_2e)	179,177
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	17,918

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

There is no official development assistance being provided for this project.

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

Based on paragraph 2 of Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities,[8] this project is not debundled. There are no other registered small-scale CDM project activities with the same project participants, in the same project category and technology/measure whose project boundary is within 1 km of another proposed small-scale activity.

SECTION B. Application of a baseline methodology:

[8] http://cdm.unfccc.int/EB/Meetings/007/eb7ra07.pdf

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

The project activity is a Type III, Other Project Activities, Category III.D./Ver 11, Methane recovery in agricultural and agro industrial activities. The project is a small scale project because it comprises methane recovery from agro-industries, and project emissions are less than 60 kt CO2eq.

B.2 Project category applicable to the small-scale project activity:

The simplified methodologies are appropriate because the project activity site is considered an agro-industry and GHG emissions calculations can be estimated using internationally accepted IPCC guidance.

The project activity will capture and combust methane gas produced from the decomposing manure at swine CAFOs located in Goias, Brazil. This simplified baseline methodology is applicable to this project activity because without the proposed project activity, methane from the existing AWMS would continue to be emitted into the atmosphere.

B.3. 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:

Anthropogenic GHGs, specifically methane, are released into the atmosphere via decomposition of animal manure. Currently, this farm-produced biogas is not collected or destroyed.

The proposed project activity intends to improve current AWMS practices. These changes will result in the mitigation of anthropogenic GHG emissions, specifically the recovery of methane, by controlling the lagoon's decomposition processes and collecting and combusting the biogas.

There are no existing, pending, or planned national, state, or local regulatory requirements that govern GHG emissions from agro-industry operations (specifically, pork production activities) as outlined in this PDD. The project participants have solicited information regarding this issue during numerous conversations with local and state government officials and through legal representation and have determined there is no regulatory impetus for producers to upgrade current AWMS beyond existing open air lagoon. The following paragraphs discuss the Brazilian pork industry and how conditions hinder changes in AWMS practices.

Assessment of barriers:

Absent CDM project activities, the proposed project activity has not been adopted on a national or worldwide scale due to the following barriers:

a. *Investment Barriers***:** This treatment approach is considered one of the most advanced AWMS systems in the world. Only a few countries have implemented such technology because of the high investment costs compared to other available systems and due to regionalized subsidies for electric generation. The Brazilian energy market does not currently offer incentives to sell biogas into the grid. The investment required to produce energy by utilizing biogas is still too high compared to electricity prices in Brazil. Additionally, much of the power distributed in Brazil is derived from hydroelectric sources.

EMBRAPA noted that in general, producers view the AWMS as a stage that is outside of the production process and have difficulty financing changes that should be undertaken. Even banks have been unwilling to finance such activities absent government guarantees or other incentives. Professor Dr. Carlos Claúdio Perdomo, a swine and poultry researcher from EMBRAPA, states: "*Many producers don't possess the capacity of investment for a new AWMS. Even the big large producing farms that require more sophisticated systems also lack this capacity of investment*."[9]

b. *Technology barriers*: Anaerobic digester systems have to be sized to handle projected animal/effluent volumes with a Hydraulic Retention Time (HRT) consistent with extracting most/all CH_4 from the manure. These systems become progressively more expensive on a 'per animal' basis as farm animal population (i.e., farm size) is decreased. Moreover, operations and maintenance requirements involved with this technology, including a detailed monitoring program to maintain system performance levels, must also be considered. Worldwide, few anaerobic digesters have achieved long-term operations, due primarily to inappropriate operations and maintenance.

   The proposed AWMS represents the most advanced AWMS technology in the state. The proposed project activity AWMS mitigates GHG emissions with associated environmental co-benefits.

c. *Legal barriers*: The implementation of this project activity by these farms highly exceeds current Brazilian regulations for swine waste treatment. Apart from existing legislation in Brazil that establishes water quality parameters that require lagoons to be lined, hence protecting water supplies from contamination, there is no legislation in place that requires specific swine manure treatment, especially as it relates to the emission of GHG.

Per local and state officials as well as the project developer's legal consul, there were no existing laws or regulations, nor were any anticipated, that would require these farms to change their open lagoon AWMS practice in order to mitigate GHG emissions.An analysis was performed to assess whether the basis in choosing the baseline scenario is expected to change during the crediting period and the results follow:

a) *Legal constraints*: There is no expectation that Brazilian legislation will require future use of digesters due to the significant investments required. Further, there is no expectation that Brazil will pass any legislation which deals with the GHG emissions (see Step 4c above).

b) *Common practice*: While past practices cannot predict future events, it is worth noting most farms (see Table A2) have been in existence for many years, during which time most have only used open lagoons as their AWMS practice. Local agricultural officials/inspectors confirmed (at the stakeholders' meeting) that open lagoons have always been used at these farms.

These anaerobic lagoon systems are economically feasible, reliable, effective, and satisfy regulatory and social requirements, and there is no reason to expect that these conditions will change in the foreseeable future.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the small-scale project activity:

The project boundary is illustrated in Figure B1. It describes the basic layout of the project farm in a schematic format. The proposed project boundary considers the GHG emissions that come from AWMS

[9] http://www.jornalexpress.com.br/noticials/detalhes.php?id_jornal=2&id_noticia=5802

practices, including the GHG resulting from the capture and combustion of biogas. The project activity site uses a system of one or more lagoons. Proposed AWMS practice changes include the construction of a digester comprised of cells that capture the resulting bio-gas which is then combusted. Based on the methodology, the anaerobic digester is the physical boundary of the methane recovery facility.

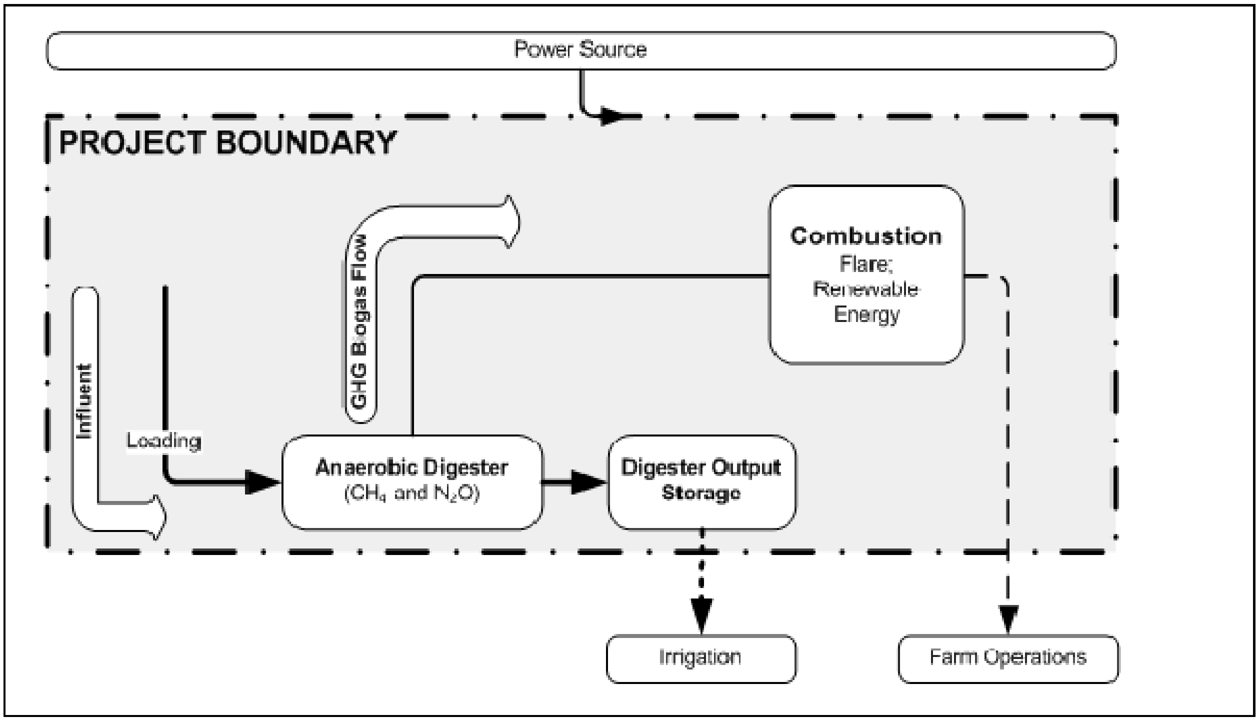

Figure B1. Project Boundary

B.5. Details of the baseline and its development:

The amount of methane that would be emitted to the atmosphere in the absence of the project activity can be estimated by referring to Table 10.17 of the 2006 IPCC Guidelines for National GHG Inventories.

The final draft of this baseline section was completed on 07/12/2006. The name of entity determining the baseline is AgCert. AgCert is a project participant, as well as the project developer.
The baseline for this project activity is defined as the amount of methane that would be emitted to the atmosphere during the crediting period in the absence of the project activity. The methane emissions are calculated ex-ante using the most recent IPCC tier 2 approach, which permits the use of default data.[10]
Direct use of the IPCC formula is not possible since no country-specific data for Brazil is available. VS values are calculated by using IPCC 2006 North American swine default VS excretion values (0.27 kg dm VS/head/day for market swine and 0.50 kg dm VS/head/day for breeding swine) and IPCC 2006 default values for body weight (46 kg for market swine and 198 kg for breeding swine). The rationale for using North America values is that the predominant genetic strains of swine used in commercial operations in Brazil are of North American origin; therefore, swine in Brazilian commercial operations reflect the values of North American swine. Furthermore, the default values from IPCC 2006 for Latin American

[10] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_10_Ch10_Livestock.pdf , p. 10.42

swine are not realistic for commercial swine operations in Brazil as they would not be economically sustainable. Compared with North American IPCC 2006 default values for body weight and VS excretion, use of the Latin American default values in weight adjusted calculations are not the most conservative values as they tend to overestimate VS excretion. VS values for each subgroup of swine are then calculated using country specific average bodyweight for that subgroup as a ratio of IPCC 2006 default bodyweight for that subgroup. This ratio is then multiplied by the IPCC 2006 default VS excretion rate for that subgroup of swine. In order to remain conservative, this approach uses IPCC default values and weight adjustments in the absence of country-specific data.[11]

In this case an open anaerobic lagoon is considered the baseline and estimated emissions are determined as follows:

Step 1 – Animal Population

Animal populations for the project activity sites are described in the Section E.1.2.1, Table E1. To determine the population for Equation B.2, the most recent twelve months of animal inventory provided by the producer is used to calculate a monthly average per animal type, unless otherwise noted in Table E.1. The AWMS used on the farms is an open anaerobic lagoon, unless otherwise noted in Section A.4.1.4.

Step 2 – Emission Factors

The emission factor for the animal group is:

$$EF_i = VS_i * n_m * B_{0i} * 0.67kg/m3 * MCF_{jk} * MS\%_{ijk}$$

Equation B1[12]

Where:

EF_i = emission factor (kg) for animal type i (e.g., swine, weight adjusted),

VS_i = Volatile solids excreted in kg/day for animal type i, max Vs is 0.5 kg/head/day (adjusted as $VS=(W_{site/}W_{default}$[13]$)*VS_{IPCC}$)

n_m = Number of days animals present,

[11] http://books.nap.edu/openbook.php?record_id=6016&page=111

[12] 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Page 10.41 Equation 10.23 and page 10.81, Table 10A-7.

[13] Obtained from 2006 IPCC, Table 10A-7, page 10.81

B_o	=	Maximum methane producing capacity (m^3/kg of *VS*) for manure produced by animal type i,
MCF_{jk}	=	Methane conversion factor for each manure management system j by climate region k; and
$MS\%_{ijk}$.	=	fraction of animal type i's manure handled using manure system j in climate region k.

The amount of methane emitted can be calculated using:

$$CH_{4a} = EF_i * Population_{year}$$

Equation B2[14]

Where:

CH_{4a}	=	methane produced in kg/yr for animal type i,
EF_i	=	emission factor (kg) for animal type i (e.g., swine),
$Population_{year}$	=	yearly average population of animal type i.

Step 3 – Total Baseline Emissions

To estimate total yearly methane emissions the selected emission factors are multiplied by the associated animal population and summed.

$$BE = [CH_{4a} * GWP_{CH4}]/1000$$

Equation B3[15]

Where:

BE	=	Baseline carbon dioxide equivalent emission in metric tons per year,
CH_{4a}	=	annual methane produced in kg/yr for animal type i,
GWP_{CH4}	=	global warming potential of methane (21).

SECTION C. Duration of the project activity / Crediting period:

C.1. Duration of the small-scale project activity:

[14] Adapted from 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Page 10.41, Equation 10.23.

[15] Adapted from Equation 9, page 12, AM0016/version 02, 22 October 2004 / UNFCCC / CDM Meth Panel

C.1.1. Starting date of the small-scale project activity:

The starting date for this activity is 01/08/2004.

C.1.2. Expected operational lifetime of the small-scale project activity:

The expected life of this project is 13y 10m.

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

The project activity will use a **fixed** crediting period.

C.2.1. Renewable crediting period:

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

C.2.1.2. Length of the first crediting period:

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

The starting date of the crediting period is 01/08/2007.

C.2.2.2. Length:

The length of the crediting period is **10y 0m**.

SECTION D. Application of a monitoring methodology and plan:

D.1. Name and reference of approved monitoring methodology applied to the small-scale project activity:

The methodology applied to this project activity is AMS-III.D./Ver 11, Methane recovery in agricultural and agro industrial activities.

D.2. Justification of the choice of the methodology and why it is applicable to the small-scale project activity:

The simplified monitoring methodologies are applicable to this project activity because they provide a method to accurately measure and record the GHG emissions that will be captured and combusted by the project activity.

D.3 Data to be monitored:

See Table D1 for specific parameters to be monitored.

Table D1. Data to be monitored

ID number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived?	For how long is archived data to be kept?	Comment
1. SlR	Frequency	Sludge Removal count	#	m	As required	100%	electronic	Duration of project activity +2y	Sludge removal will be accomplished to ensure proper disposition so there is no resulting methane emissions.
2. BGP	Volume	Biogas produced	m^3	m	Monthly	100%	electronic	Duration of project activity +2y	This parameter measures cumulative biogas produced. A biogas meter will continuously measure amount of biogas produced.
3. MC	Percent	Methane content	%	m	Quarterly	100%	electronic	Duration of project activity +2y	This parameter determines the methane content of the biogas
4. CEE	Fraction of time	Combustion equipment efficiency	%	m	Quarterly	100%	electronic	Duration of project activity +2y	This parameter is used to determine the fraction of time in which gas is combusted. The fraction of time will be determined as 100% less any time the flare is out of service and gas is flowing. Flare maintenance records will be used to make this determination.
5.EFP	Percent	Efficiency of Flaring Process	%	m	Initial and yearly	100%	Electronic or paper	Duration of project activity +2y	AgCert will test the efficiency of the flaring process during initial installation, then perform yearly maintenance to ensure optimal operation.

D.4. Qualitative explanation of how quality control (QC) and quality assurance (QA) procedures are undertaken:

AgCert has designed and implemented a unique set of data management tools to efficiently capture and report data throughout the project lifecycle. On-site assessment (collecting Geo-referenced, time/date stamped data), supplier production data exchange, task tracking, and post-implementation auditing tools have been developed to ensure accurate, consistent, and complete data gathering and project implementation. Sophisticated tools have also been created to estimate/monitor the creation of high quality, permanent, ERs using IPCC formulae.

By coupling these capabilities with an ISO-based quality and environmental management system, AgCert enables transparent data collection and verification.

D.5. Please describe briefly the operational and management structure that the project participant(s) will implement in order to monitor emission reductions and any leakage effects generated by the project activity:

A complete set of procedures and a Monitoring Plan (Annex 3) has been developed to ensure accurate measurement of biogas produced and proper operation of the digester equipment. This plan exceeds the requirements outlined in the approved methodology outlined in Appendix B of the simplified modalities and procedures for small-scale CDM project activities as it applies to proposed project activity.

Metering devices used are designed to continuously and accurately measure biogas flow and are specially designed for corrosive environments. Meters are received from the factory fully-calibrated and retain calibration for the service life of the unit. Volumetric accuracy of the meter is permanent and non-adjustable. Accuracy is not affected by low or varying line pressures. Accuracy of the flowmeters utilized exceeds 99 percent across the entire measured rate curve with an uncertainty range of less than ± 1 percent. Periodic maintenance will be performed based on manufacturer specifications. Other equipment calibrations are accomplished using procedures developed by the project developer (Annex 4).

Methane concentration is determined using a gas analyzer (Landtec GEM-500 or equivalent). The process is described in the Monitoring Plan. The measuring equipment is calibrated in accordance with the manufacturer specifications. The equipment is accurate to within 0.5%.

An industry standard gas analyser (Landtec GEM-500 or equivalent) will be used when measuring methane content of the biogas to determine the efficiency of the flaring process. The unit will be calibrated to an accuracy of ±1 percent.

Further, AgCert has a trained staff located in the host nation to perform O&M activities including but not limited to monitoring and collection of parameters, quality audits, personnel training, and equipment inspections. The associated Monitoring Plan has been developed to provide guidance (work instructions) to individuals that collect and/or process data. AgCert staff will perform audits of farm operations personnel on a regular basis to ensure proper data collection and handling.

D.6. Name of person/entity determining the monitoring methodology:

The entity determining this monitoring methodology is AgCert, who is the project developer listed in Annex 1 of this document.

SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

E.1.1 Selected formulae as provided in appendix B:

Specific formula to calculate the GHG emission reductions by sources for the AWMS improvement are not provided in appendix B of the simplified M&P for small-scale CDM project activities.

E.1.2 Description of formulae when not provided in appendix B:

E.1.2.1 Describe the formulae used to estimate anthropogenic emissions by sources of GHGs due to the project activity within the project boundary:

The amount of methane that would be emitted to the atmosphere due to the project activity and within the project boundaries can be estimated by referring to Table 10.17 of the 2006 IPCC Guidelines for National GHG Inventories.

The project emissions for this 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. The methane emissions are calculated ex-ante using the most recent IPCC tier 2 approach, which permits the use of default data.[16] Direct use of the IPCC formula is not possible since no country-specific data for Brazil is available. VS values are calculated by using IPCC 2006 North American swine default VS excretion values (0.27 kg dm VS/head/day for market swine and 0.50 kg dm VS/head/day for breeding swine) and IPCC 2006 default values for body weight (46 kg for market swine and 198 kg for breeding swine). The rationale for using North America values is that the predominant genetic strains of swine used in commercial operations in Brazil are of North American origin; therefore, swine in Brazilian commercial operations reflect the values of North American swine. Furthermore, the default values from IPCC 2006 for Latin American swine are not realistic for commercial swine operations in Brazil as they would not be economically sustainable. Compared with North American IPCC 2006 default values for body weight and VS excretion, use of the Latin American default values in weight adjusted calculations are not the most conservative values as they tend to overestimate VS excretion. VS values for each subgroup of swine are then calculated using country specific average bodyweight for that subgroup as a ratio of IPCC 2006 default bodyweight for that subgroup. This ratio is then multiplied by the IPCC 2006 default VS excretion rate for that subgroup of swine. In order to remain conservative, this approach uses IPCC default values and weight adjustments in the absence of country-specific data.[17]

In this case an anaerobic digester is considered the project activity and estimated emissions are determined as follows:

[16] http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_10_Ch10_Livestock.pdf , p. 10.42

[17] http://books.nap.edu/openbook.php?record_id=6016&page=111

Step 1 – Animal Population

Animal populations for the project activity sites are described in the tables below. To determine the population for Equation E.3, the most recent twelve months of animal inventory provided by the producer is used to calculate a monthly average per animal type, unless otherwise noted in Table E.1. The AWMS proposed for use on the farm is an anaerobic digester.

Table E1, Animal Populations

	Month/Yr	Animal Type				
		Sow	Gilt	Boar	Fin	Nurs
Fazenda Lage Cabeceira (26822)	Jan-05	751	142	15	4,451	2,744
	Feb-05	743	184	12	4,307	2,616
	Mar-05	748	140	13	4,250	2,743
	Apr-05	760	174	15	4,211	2,964
	May-05	750	127	15	3,959	3,073
	Jun-05	758	143	15	3,899	3,168
	Jul-05	802	79	15	4,049	2,843
	Aug-05	804	113	15	4,366	2,750
	Sep-05	801	78	14	4,157	2,909
	Oct-05	802	114	16	4,340	2,792
	Nov-05	805	156	15	4,512	2,724
	Dec-05	806	111	17	4,274	2,996

	Month/Yr	Animal Type				
		Sow	Gilt	Boar	Fin	Nurs
Fazenda Varginha Monte Alegre Sitio I (850031)	Projected Inventory	0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
	Since this is a new site that does not have animals yet, the inventory was conservatively estimated at 85% of capacity for baseline emission reduction estimates.					

	Month/Yr	Animal Type				
		Sow	Gilt	Boar	Fin	Nurs
Fazenda Varginha Monte Alegre Sitio II (850051)	Projected Inventory	0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
		0	0	0	3,434	0
	Since this is a new site that does not have animals yet, the inventory was conservatively estimated at 85% of capacity for baseline emission reduction estimates.					

	Month/Yr	Animal Type				
		Sow	Gilt	Boar	Fin	Nurs
Fazenda Posse - Granja Chapeau do Sol (21232)	Aug-04	502	55	7	0	0
	Sep-04	502	55	7	0	0
	Oct-04	502	55	7	0	0
	Nov-04	502	55	7	0	0
	Dec-04	502	55	7	0	0
	Jan-05	511	52	7	0	0
	Feb-05	511	52	7	0	0
	Mar-05	511	52	7	0	0
	Apr-05	511	43	6	0	0
	May-05	515	43	6	0	0
	Jun-05	515	43	6	0	0
	Jul-05	511	44	6	0	0
	Monthly animal inventories were estimated based upon the producer’s annual inventory average.					

	Month/Yr	Animal Type				
		Sow	Gilt	Boar	Fin	Nurs
Fazenda Posse - Granja Chapeu do Sol - Sitio 2 (21552)	Aug-04	0	0	0	1,989	1,715
	Sep-04	0	0	0	2,196	1,290
	Oct-04	0	0	0	1,096	1,493
	Nov-04	0	0	0	1,690	1,565
	Dec-04	0	0	0	1,948	1,379
	Jan-05	0	0	0	1,863	1,453
	Feb-05	0	0	0	1,859	1,645
	Mar-05	0	0	0	1,919	1,901
	Apr-05	0	0	0	2,279	1,751
	May-05	0	0	0	2,450	1,705
	Jun-05	0	0	0	2,337	1,427
	Jul-05	0	0	0	1,805	1,819

	Month/Yr	Animal Type				
		Sow	Gilt	Boar	Fin	Nurs
Fazenda Segatt - Granja Segatt - Finishers (850211)	Jul-04	0	0	0	2,733	2,654
	Aug-04	0	0	0	3,436	2,458
	Sep-04	0	0	0	3,803	2,641
	Oct-04	0	0	0	4,642	2,266
	Nov-04	0	0	0	4,556	2,375
	Dec-04	0	0	0	4,735	2,721
	Jan-05	0	0	0	5,140	2,577
	Feb-05	0	0	0	4,676	2,204
	Mar-05	0	0	0	6,301	2,782
	Apr-05	0	0	0	6,108	2,143
	May-05	0	0	0	6,423	2,473
	Jun-05	0	0	0	5,980	2,491

	Month/Yr	Animal Type				
		Sow	Gilt	Boar	Fin	Nurs
Fazenda Segatt - Granja Segatt - Sows (20072)	Jul-04	1,205	47	15	0	0
	Aug-04	1,221	60	15	0	0
	Sep-04	1,215	37	15	0	0
	Oct-04	1,234	63	14	0	0
	Nov-04	1,234	56	13	0	0
	Dec-04	1,216	48	13	0	0
	Jan-05	1,211	48	11	0	0
	Feb-05	1,201	44	11	0	0
	Mar-05	1,203	54	14	0	0
	Apr-05	1,194	42	13	0	0
	May-05	1,221	64	12	0	0
	Jun-05	1,192	50	11	0	0

	Month/Yr	Animal Type				
		Sow	Gilt	Boar	Fin	Nurs
Granja Orlando II (21912)	Aug-04	1,028	92	5	0	2,506
	Sep-04	1,016	139	5	0	3,094
	Oct-04	1,007	244	5	0	3,061
	Nov-04	1,051	213	5	0	1,711
	Dec-04	1,128	145	5	0	4,252
	Jan-05	1,122	143	5	0	3,214
	Feb-05	1,115	130	5	0	2,761
	Mar-05	1,102	122	5	0	6,511
	Apr-05	1,093	135	5	0	3,046
	May-05	1,080	147	5	0	3,120
	Jun-05	1,079	162	5	0	3,276
	Jul-05	1,079	168	5	0	2,875
	Nurser inventory was calculated by taking the monthly number of weaned piglets and multiplying them by 1.5 since the nurser stage is 45 days.					

Step 2 – Emission Factors

The emission factor for the animal group is:

$$EF_i = VS_i * n_m * B_{0i} * 0.67kg/m3 * MCF_{jk} * MS\%_{ijk}$$

Equation E2[18]

Where:

EF_i = emission factor (kg) for animal type i (e.g., swine, weight adjusted),

VS_i = Volatile solids excreted in kg/day for animal type i, max Vs is 0.5 kg/head/day (adjusted as $VS=(W_{site}/W_{default}{}^{19})*VS_{IPCC}$)

n_m = Number of days animals present,

B_o = Maximum methane producing capacity (m^3/kg of *VS*) for manure produced by animal type i,

MCF_{jk} = Methane conversion factor for each manure management system j by climate region k; and

$MS\%_{ijk}$. = fraction of animal type i's manure handled using manure system j in climate region k.

The amount of methane emitted can be calculated using:

$$CH_{4a} = EF_i * Population_{year}$$

Equation E3[20]

Where:

CH_{4a} = methane produced in kg/yr for animal type i,

EF_i = emission factor (kg) for animal type i (e.g., swine),

$Population_{year}$ = yearly average population of animal type i.

E.1.2.2 Describe the formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities

In accordance with the baseline methodology, leakage calculations are not required.

E.1.2.3 The sum of E.1.2.1 and E.1.2.2 represents the small-scale project activity emissions:

[18] 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Page 10.41, Equation 10.23 and Page 10.77, Table 10A-4.

[19] Obtained from 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Table 10A-7, page 10.81

[20] Adapted from 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Page 10.41.

To estimate total yearly methane emissions the selected emission factors are multiplied by the associated animal population and summed.

$$PE = [CH_{4a} + FE] * GWP_{CH4} / 1000$$

Equation E4[21]

<u>Where:</u>

PE	=	Project activity carbon dioxide equivalent emission in metric tons per year,
CH_{4a}	=	annual methane produced in kg/yr for animal type i,
FE	=	annual methane emitted from flare due to inefficiency
GWP_{CH4}	=	global warming potential of methane (21).

Table E2. Project Activity Emissions

Fazenda Lage Cabeceira (26822)							***Year 1***
	$Population_{year}$	**N_m**	**Days OB**	**Default BW**	**Ave Bw, kg**	**EF_i**	**CH_4 annual**
Sows:	778	365	0	198	215	6.37	4,958.29
Gilts:	130	365	0	198	112	3.32	431.59
Boars:	15	365	0	198	234	6.94	104.04
Finishers:	4,231	365	0	46	68	4.69	19,822.88
Nur/Wean:	2,860	365	0	46	15	1.03	2,955.78
Digester CH_4:							28,272.59
Direct Emissions (Flare) CH_4:							3,901.62
Total Annual CH_4:							32,174.21
PE (CO_2e/year):							675.66

Fazenda Lage Cabeceira (26822)										
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	
Project Emissions (CO2e/year)	675.7	675.7	675.7	675.7	675.7	675.7	675.7	675.7	675.7	675.7	**6,756.6**

[21] Adapted from Equation 9, page 12, AM0016/version 02, 22 October 2004/UNFCCC/CDM Methodology Panel

Fazenda Posse - Granja Chapeau do Sol (21232)							*Year 1*
	Population$_{year}$	N_m	Days OB	Default BW	Ave Bw, kg	EF_i	CH_4 annual
Sows:	508	365	0	198	215	6.37	3,237.55
Gilts:	50	365	0	198	112	3.32	166.00
Boars:	7	365	0	198	234	6.94	48.55
Finishers:	0	365	0	46	68	4.69	0.00
Nur/Wean:	0	365	0	46	15	1.03	0.00

Digester CH_4:	3,452.10	
Direct Emissions (Flare) CH_4:	469.49	
Total Annual CH_4:	3,921.58	
PE (CO_2e/year):		82.35

Fazenda Posse - Granja Chapeau do Sol (21232)											
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	*0%*	*20%*	*20%*	*10%*	*10%*	*10%*	*10%*	*10%*	*10%*	*10%*	
Project Emissions (CO2e/year)	82.4	98.8	118.6	130.4	143.5	157.8	173.6	191.0	210.1	231.1	**1,537.3**

Fazenda Posse - Granja Chapeu do Sol - Sitio 2 (21552)							*Year 1*
	Population$_{year}$	N_m	Days OB	Default BW	Ave Bw, kg	EF_i	CH_4 annual
Sows:	0	365	0	198	215	6.37	0.00
Gilts:	0	365	0	198	112	3.32	0.00
Boars:	0	365	0	198	234	6.94	0.00
Finishers:	1,953	365	0	46	68	4.69	9,150.10
Nur/Wean:	1,595	365	0	46	15	1.03	1,648.42

Digester CH_4:	10,798.52	
Direct Emissions (Flare) CH_4:	1,468.60	
Total Annual CH_4:	12,267.12	
PE (CO_2e/year):		257.61

Fazenda Posse - Granja Chapeu do Sol - Sitio 2 (21552)											
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	
Project Emissions (CO2e/year)	257.6	257.6	257.6	257.6	257.6	257.6	257.6	257.6	257.6	257.6	**2,576.1**

Fazenda Segatt - Granja Segatt - Finishers (850211)							*Year 1*
	$Population_{year}$	N_m	Days OB	Default BW	Ave Bw, kg	EF_i	CH_4 annual
Sows:	0	365	0	198	215	6.37	0.00
Gilts:	0	365	0	198	112	3.32	0.00
Boars:	0	365	0	198	234	6.94	0.00
Finishers:	4,878	365	0	46	68	4.69	22,854.17
Nur/Wean:	2,482	365	0	46	15	1.03	2,565.12

Digester CH_4:	25,419.30	
Direct Emissions (Flare) CH_4:	3,507.86	
Total Annual CH_4:	28,927.16	
PE (CO_2e/year):		607.47

Fazenda Segatt - Granja Segatt - Finishers (850211)											
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	
Project Emissions (CO2e/year)	607.5	607.5	607.5	607.5	607.5	607.5	607.5	607.5	607.5	607.5	**6,074.7**

Fazenda Segatt - Granja Segatt - Sows (20072)							*Year 1*
	$Population_{year}$	N_m	Days OB	Default BW	Ave Bw, kg	EF_i	CH_4 annual
Sows:	1,212	365	0	198	215	6.37	7,724.22
Gilts:	51	365	0	198	112	3.32	169.32
Boars:	13	365	0	198	234	6.94	90.17
Finishers:	0	365	0	46	68	4.69	0.00
Nur/Wean:	0	365	0	46	15	1.03	0.00

Digester CH_4:	7,983.71	
Direct Emissions (Flare) CH_4:	1,101.75	
Total Annual CH_4:	9,085.47	
PE (CO_2e/year):		190.79

Fazenda Segatt - Granja Segatt - Sows (20072)											
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	*0%*	*10%*	*10%*	*10%*	*10%*	*10%*	*10%*	*10%*	*10%*	*10%*	
Project Emissions (CO2e/year)	190.8	209.9	230.9	253.9	279.3	307.3	338.0	371.8	409.0	449.9	**3,040.8**

Fazenda Varginha Monte Alegre Sitio I (850031)							*Year 1*
	$Population_{year}$	N_m	Days OB	Default BW	Ave Bw, kg	EF_i	CH_4 annual
Sows:	0	365	0	198	215	6.37	0.00
Gilts:	0	365	0	198	112	3.32	0.00
Boars:	0	365	0	198	234	6.94	0.00
Finishers:	3,434	365	0	46	68	4.69	16,088.81
Nur/Wean:	0	365	0	46	15	1.03	0.00

Digester CH_4:	16,088.81	
Direct Emissions (Flare) CH_4:	2,220.26	
Total Annual CH_4:	18,309.07	
PE (CO_2e/year):		384.49

Fazenda Varginha Monte Alegre Sitio I (850031)											
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	
Project Emissions (CO2e/year)	384.5	384.5	384.5	384.5	384.5	384.5	384.5	384.5	384.5	384.5	**3,844.9**

Fazenda Varginha Monte Alegre Sitio II (850051)							*Year 1*
	$Population_{year}$	N_m	Days OB	Default BW	Ave Bw, kg	EF_i	CH_4 annual
Sows:	0	365	0	198	215	6.37	0.00
Gilts:	0	365	0	198	112	3.32	0.00
Boars:	0	365	0	198	234	6.94	0.00
Finishers:	3,434	365	0	46	68	4.69	16,088.81
Nur/Wean:	0	365	0	46	15	1.03	0.00

Digester CH_4:	16,088.81	
Direct Emissions (Flare) CH_4:	2,220.26	
Total Annual CH_4:	18,309.07	
PE (CO_2e/year):		384.49

Fazenda Varginha Monte Alegre Sitio II (850051)											
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	
Project Emissions (CO2e/year)	384.5	384.5	384.5	384.5	384.5	384.5	384.5	384.5	384.5	384.5	**3,844.9**

Granja Orlando II (21912)								Year 1
	Population$_{year}$	N_m	Days OB	Default BW	Ave Bw, kg	EF_i	CH_4 annual	
Sows:	1,075	365	0	198	215	6.37	6,851.11	
Gilts:	153	365	0	198	112	3.32	507.95	
Boars:	5	365	0	198	234	6.94	34.68	
Finishers:	0	365	0	46	68	4.69	0.00	
Nur/Wean:	3,286	365	0	46	15	1.03	3,396.05	
Digester CH_4:							10,789.79	
Direct Emissions (Flare) CH_4:							1,488.99	
Total Annual CH_4:							12,278.78	
PE (CO_2e/year):								257.85

Granja Orlando II (21912)										
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Project Emissions (CO2e/year)	257.9	257.9	257.9	257.9	257.9	257.9	257.9	257.9	257.9	257.9	**2,578.5**

E.1.2.4 Describe the formulae used to estimate the anthropogenic emissions by sources of GHGs in the baseline using the baseline methodology for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities:

Table E3. Baseline Emissions

Fazenda Lage Cabeceira (26822)								Year 1
	Population$_{year}$	N_m	Days OB	Default BW	Ave Bw, kg	EF_i	CH_4 annual	
Sows:	778	365	0	198	215	50.35	39,170.48	
Gilts:	130	365	0	198	112	26.23	3,409.59	
Boars:	15	365	0	198	234	54.80	821.95	
Finishers:	4,231	365	0	46	68	37.01	156,600.76	
Nur/Wean:	2,860	365	0	46	15	8.16	23,350.66	
Total Annual CH_4:							223,353.45	
BE (CO_2e/year):								4,690.42

Fazenda Lage Cabeceira (26822)										
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Baseline Emissions (CO2e/year)	4,690.4	4,690.4	4,690.4	4,690.4	4,690.4	4,690.4	4,690.4	4,690.4	4,690.4	4,690.4	**46,904.2**

Fazenda Posse - Granja Chapeau do Sol (21232)							*Year 1*
	Population$_{year}$	N_m	Days OB	Default BW	Ave Bw, kg	EF_i	CH_4 annual
Sows:	508	365	0	198	215	49.71	25,252.86
Gilts:	50	365	0	198	112	25.90	1,294.78
Boars:	7	365	0	198	234	54.10	378.72
Finishers:	0	365	0	46	68	36.54	0.00
Nur/Wean:	0	365	0	46	15	8.06	0.00

Total Annual CH_4: 26,926.36

BE (CO_2e/year): 565.45

Fazenda Posse - Granja Chapeau do Sol (21232)											
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	*0%*	*20%*	*20%*	*10%*	*10%*	*10%*	*10%*	*10%*	*10%*	*10%*	
Baseline Emissions (CO2e/year)	565.5	678.5	814.3	895.7	985.2	1,083.8	1,192.1	1,311.4	1,442.5	1,586.7	**10,555.7**

Fazenda Posse - Granja Chapeu do Sol - Sitio 2 (21552)							*Year 1*
	Population$_{year}$	N_m	Days OB	Default BW	Ave Bw, kg	EF_i	CH_4 annual
Sows:	0	365	0	198	215	49.71	0.00
Gilts:	0	365	0	198	112	25.90	0.00
Boars:	0	365	0	198	234	54.10	0.00
Finishers:	1,953	365	0	46	68	36.54	71,370.81
Nur/Wean:	1,595	365	0	46	15	8.06	12,857.64

Total Annual CH_4: 84,228.45

BE (CO_2e/year): 1,768.80

Fazenda Posse - Granja Chapeu do Sol - Sitio 2 (21552)											
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	
Baseline Emissions (CO2e/year)	1,768.8	1,768.8	1,768.8	1,768.8	1,768.8	1,768.8	1,768.8	1,768.8	1,768.8	1,768.8	**17,688.0**

Fazenda Segatt - Granja Segatt - Finishers (850211)							*Year 1*
	$Population_{year}$	N_m	Days OB	Default BW	Ave Bw, kg	EF_i	CH_4 annual
Sows:	0	365	0	198	215	50.35	0.00
Gilts:	0	365	0	198	112	26.23	0.00
Boars:	0	365	0	198	234	54.80	0.00
Finishers:	4,878	365	0	46	68	37.01	180,547.98
Nur/Wean:	2,482	365	0	46	15	8.16	20,264.46
Total Annual CH_4:							200,812.44
BE (CO_2e/year):							4,217.06

Fazenda Segatt - Granja Segatt - Finishers (850211)										
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	
Baseline Emissions (CO2e/year)	4,217.1	4,217.1	4,217.1	4,217.1	4,217.1	4,217.1	4,217.1	4,217.1	4,217.1	4,217.1	**42,170.6**

Fazenda Segatt - Granja Segatt - Sows (20072)							*Year 1*
	$Population_{year}$	N_m	Days OB	Default BW	Ave Bw, kg	EF_i	CH_4 annual
Sows:	1,212	365	0	198	215	50.35	61,021.36
Gilts:	51	365	0	198	112	26.23	1,337.61
Boars:	13	365	0	198	234	54.80	712.36
Finishers:	0	365	0	46	68	37.01	0.00
Nur/Wean:	0	365	0	46	15	8.16	0.00
Total Annual CH_4:							63,071.33
BE (CO_2e/year):							1,324.50

Fazenda Segatt - Granja Segatt - Sows (20072)											
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	*0%*	*10%*	*10%*	*10%*	*10%*	*10%*	*10%*	*10%*	*10%*	*10%*	
Baseline Emissions (CO2e/year)	1,324.5	1,456.9	1,602.6	1,762.9	1,939.2	2,133.1	2,346.4	2,581.1	2,839.2	3,123.1	**21,109.1**

Fazenda Varginha Monte Alegre Sitio I (850031)							*Year 1*
	Population$_{year}$	N_m	Days OB	Default BW	Ave Bw, kg	EF_i	CH_4 annual
Sows:	0	365	0	198	215	50.35	0.00
Gilts:	0	365	0	198	112	26.23	0.00
Boars:	0	365	0	198	234	54.80	0.00
Finishers:	3,434	365	0	46	68	37.01	127,101.63
Nur/Wean:	0	365	0	46	15	8.16	0.00
Total Annual CH_4:							127,101.63
BE (CO_2e/year):							2,669.13

Fazenda Varginha Monte Alegre Sitio I (850031)											
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	
Baseline Emissions (CO2e/year)	2,669.1	2,669.1	2,669.1	2,669.1	2,669.1	2,669.1	2,669.1	2,669.1	2,669.1	2,669.1	**26,691.3**

Fazenda Varginha Monte Alegre Sitio II (850051)							*Year 1*
	Population$_{year}$	N_m	Days OB	Default BW	Ave Bw, kg	EF_i	CH_4 annual
Sows:	0	365	0	198	215	50.35	0.00
Gilts:	0	365	0	198	112	26.23	0.00
Boars:	0	365	0	198	234	54.80	0.00
Finishers:	3,434	365	0	46	68	37.01	127,101.63
Nur/Wean:	0	365	0	46	15	8.16	0.00
Total Annual CH_4:							127,101.63
BE (CO_2e/year):							2,669.13

Fazenda Varginha Monte Alegre Sitio II (850051)											
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	
Baseline Emissions (CO2e/year)	2,669.1	2,669.1	2,669.1	2,669.1	2,669.1	2,669.1	2,669.1	2,669.1	2,669.1	2,669.1	**26,691.3**

Granja Orlando II (21912)								*Year 1*
	Population$_{year}$	N_m	Days OB	Default BW	Ave Bw, kg	EF_i	CH_4 annual	
Sows:	1,075	365	0	198	215	50.35	54,123.73	
Gilts:	153	365	0	198	112	26.23	4,012.83	
Boars:	5	365	0	198	234	54.80	273.98	
Finishers:	0	365	0	46	68	37.01	0.00	
Nur/Wean:	3,286	365	0	46	15	8.16	26,828.77	
	Total Annual CH_4:						85,239.31	
				BE (CO_2e/year):				1,790.03

Granja Orlando II (21912)										
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	
Baseline Emissions (CO2e/year)	1,790.0	1,790.0	1,790.0	1,790.0	1,790.0	1,790.0	1,790.0	1,790.0	1,790.0	1,790.0	**17,900.3**

E.1.2.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:

The ex-ante baseline emissions calculated in section E.1.2.4 of this PDD will be compared to the actual monitored amount of methane captured and combusted by the project activity. The lesser of these values will be used as the project emission reductions of the crediting period.

$$ER_{net} = BE - (PE + DE)$$

Where:

BE = Baseline carbon dioxide equivalent emission in metric tons per year,

PE = Project activity carbon dioxide equivalent emission in metric tons per year,

DE = direct emissions from use of fossil fuels or electricity for operation of facility

According to the methodology, direct emissions from the use of fossil fuels and/or electricity for the operation of the facility must be considered as part of the project emissions. For swine farms in Brazil, a standard equipment configuration consists of one 2 horsepower (HP) biogas blower that operates 24 hours per day per anaerobic digester.

HP to kWh conversion = HP (2) x hours per day (24) x days a year (365) x 0.7457[22]

As such, the electrical consumption per year per anaerobic digester for a swine farm in Brazil is approximately 13,065 kWh/yr. To convert this number into metric tonnes of CO2e per year, the following formulae is applied:

kWh to CO_2e conversion = (kwh (13,065) x country specific emission factor (0.2677)[23]) / 1000

Therefore, for each anaerobic digester, approximately 3.5 metric tonnes of CO2e are produced per year as a result of the project activity.

For this particular project with eight project activity sites and a corresponding eight anaerobic digesters, the totals are as follows:

Source	Est kWh consumed / produced per year	Kg CO2e emitted per kWh produced	Metric Tonnes CO2e per year
Direct emissions from use of electricity or fossil fuel	104,517	0.2677	27.98

Because the digester is a sealed system, all methane is captured and flared, leaving none to be released to the atmosphere via physical leakage. In addition, the methane conversion factor of the emission reduction calculations include a conservative 10% discount to compensate for intrinsic digester emissions.

[22] .7457 is the standard scientific conversion factor from horsepower (HP) to Kilowatt Hours (kWh) based on Ohm's Law

[23] 0.2677kg CO2 / kwh, Obtained from AM0015 and registered CDM project 0190. (Consumed by Project Activity Equipment based on design). Calculated ex-ante.

Table E4. Total Emission Reductions

Table E4. Total Emission Reductions										
Year	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Total Baseline Emissions (BE)	19,695	19,940	20,221	20,463	20,729	21,021	21,343	21,697	22,086	22,514
Total Project Emissions (PE)	2,841	2,876	2,917	2,952	2,990	3,033	3,079	3,130	3,187	3,249
Direct emissions from electricity/fossil fuel (DE)	28	28	28	28	28	28	28	28	28	28
Total Emission Reductions (ER_{net} = BE - (PE + DE))	**16,826**	**17,036**	**17,276**	**17,483**	**17,711**	**17,961**	**18,236**	**18,539**	**18,872**	**19,238**

E.2 Table providing values obtained when applying formulae above:

Table E5

Parameter/Factor	Value	Source/Comment
Baseline		
GWP CH_4	21	Intergovernmental Panel on Climate Change, *Climate Change 1995: The Science of Climate Change* (Cambridge, UK: Cambridge University Press, 1996)
$Population_{year}$	Table E1	Animal population used to estimate baseline and project emission estimates was based on a 12 month period of actual or projected operation production data.
n_m	Table E1	Days resident in system
$MS\%_{ijk}$	100%	Percent of effluent used in system.
$VS_{i, market}$	0.27	Obtained from 2006 IPCC, Annex 10A.2, Table 10A-7, p. 10.81
$VS_{i, breeding}$	0.50	Obtained from 2006 IPCC, Annex 10A.2, Table 10A-8, p. 10.82
B_{oi}	0.48	Obtained from 2006 IPCC, Annex 10A.2, Tables 10A-7 and 10A-8, p. 10.81 and 10.82
MCF_{jk}	Table 10.17	Obtained from 2006 IPCC, Table 10.17, p. 10.46
Project Activity		
GWP CH_4	21	Intergovernmental Panel on Climate Change, *Climate Change 1995: The Science of Climate Change* (Cambridge, UK: Cambridge University Press, 1996)
$Population_{year}$	Table E1	Animal population used to estimate baseline and project emission estimates was based on a 12 month period of actual or projected operation production data.
n_m	Table E1	Days resident in system
$MS\%_{ijk}$	100%	Percent of effluent used in system
$VS_{i, market}$	0.27	Obtained from 2006 IPCC, Annex 10A.2, Table 10A-7, p. 10.81
$VS_{i, breeding}$	0.50	Obtained from 2006 IPCC, Annex 10A.2, Table 10A-8, p. 10.82

Parameter/Factor	Value	Source/Comment
B_{oi}	0.48	Obtained from 2006 IPCC, Annex 10A.2, Tables 10A-7 and 10A-8, p. 10.81 and 10.82
MCF_{jk}	Table 10.17	Obtained from 2006 IPCC, Table 10.17, p. 10.46

Table E6

Uncertainty Parameter for GHG Mitigation Project Estimates	
Uncertainty:	**How Addressed:**
o Data collection inaccuracies o Animal type o Animal population, group/type, mortality rates o Genetics o Choice of appropriate emission coefficients o Data security o Animal health o Flare efficiency	o Accurate data collection is essential. The farms included in this project activity use a Standardized industry database package which captures a wide range of incremental production data to manage operations and enable the farm to maximize both productivity and profitability. AgCert uses some data points collected via this system. o AgCert has a rigorous QA/QC system that ensures data security and data integrity. AgCert performs spot audits data collection activities. o AgCert has a data management system capable of interfacing with producer systems to serve as a secure data repository. Project activity data related uncertainties will be reduced by applying sound data collection quality assurance and quality control procedures. o Any significant mortality rates will be visible from the Monthly Monitoring Form and addressed accordingly. o The monitoring plan addresses emergency operating procedures.

SECTION F.: Environmental impacts:

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

An environmental impact analysis is not required for this type of GHG project activity.

Environment:

There are no negative environmental impacts resulting from the proposed project activity.

Beyond the principal benefit of mitigating GHG emissions (the primary focus of the proposed project); the proposed activities will also result in positive environmental co-benefits. They include:

- Reducing atmospheric emissions of Volatile Organics Compounds (VOCs) that cause odour,
- Lowering the population of flies and associated enhancement to on-farm bio-security thus reducing the possible spread of disease.

The combination of these factors will make the proposed project site more “neighbour friendly” and environmentally responsible.

SECTION G. Stakeholders' comments:

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

Stakeholders meetings for this project activity were held in Goiânia, Goiás on December 6, 2005 and in Rio Verde, Goiàs on January 26, 2005.

AgCert invited stakeholders to the meetings to explain the UNFCCC CDM process and proposed project activity, presided over by Paulo Furtado in Goiania and Hellen Souza de Macedo in Rio Verde. Invitations were sent via electronic mail and postal directly to project participants, federal, state and local officials prior to the meetings.

The CDM Project Stakeholders Meeting information was published in the municipal newspaper in the region of the CDM project activity:

a) *O Mercador*, January 18, 2005

b) *O Popular*, Goiânia, December 2, 2005

A slide presentation was given, in Portuguese, and attendees were afforded the opportunity to ask questions and provide comments. On other occasions, representatives from AgCert also met with and explained project details to local and state government officials.

Minutes for these meetings have been compiled and include questions and answers for each of the meetings.

G.2. Summary of the comments received:

No negative issues were raised by local stakeholders. Comments voiced by individuals were positive and supporting of the project activity.

A complete listing of the comments and the individuals who made them is on file. The above comments were translated into English by AgCert.

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

Overall, there was good feedback from all participants about the project activity. The group pledged their support and offered to assist if needed in the facilitation and completion of the project. Several stakeholders voiced their appreciation for having the opportunity to participate in these project activities.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Project Participant and Developer:	
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Title:	Project Coordinator
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no official development assistance being provided for this project.

Annex 3

Monitoring Plan

PURPOSE

The purpose of this method specification is to describe the criteria for maintaining equipment, reporting equipment outages, and to provide detailed guidance for collection and processing of data that is used in the determination of Green House Gas (GHG) emissions.

SCOPE

This document applies to GHG Mitigation Project related activities. It applies to all personnel that operate and/or maintain project activity equipment and/or have an active role in data collection and processing.

ASSOCIATED DOCUMENTS

- UNFCCC approved monitoring methodology: AMS-III.D., Methane Recovery. http://cdm.UNFCCC.int/UserManagement/FileStorage/CDMWF_AM_LM875Z64MVHWOE3JVL4BGGIC4SRUBE

- Jody Zall Kusek, and Ray C. Rist, June 2004. Ten Steps to a Results-based Monitoring and Evaluation System: A Handbook for Development Practitioners, World Bank. http://www.worldbankinfoshop.org/ecommerce/catalog/product?item_id=3688663

- Component guides / manuals for:
    - Manure transfer system
    - Anaerobic digester
    - Biogas transfer system including a biogas flow-meter
    - Combustion system (Flare)
    - Optional combustion system
- MS004-F1, O & M Weekly Monitoring Checklist
- MS004-F2, O & M Monthly Monitoring Form
- MS004-F3, O & M Maintenance Log (en-br)
- MS004-F4, O & M Maintenance Log (sp-mx)
- MS008, Farm Data Collection Procedure
- MS008-F1, Animal Inventory Control

- MS008-F2, Monthly Inventory Reporting
- P004, Control of Nonconforming Product/Service
- P020, Monitoring & Measurement of Product/Processes
- P025, Control of Monitoring & Measurement Devices
- I025-1, Equipment Calibration & Verification
- P039, Competence, Training, and Awareness
- I031-2F11, Form B – Swine – IPCC (en)
- I031-2F13, Form B – IPCC – MX (sp)
- I031-2F16, Form B – Dairy – IPCC (en), (sp), (pt)
- I036-9, Bio-security and Safety
- Operations Manual CO_2 Analyzer
- EnviroCert Operations Management System (OMS)

OPERATION AND MAINTENANCE ACTIVITIES

System Overview

The Animal Waste Management System (AWMS) used in this project is shown in Figure 1. The system is made up of four (4) major system components:

- Manure transfer system which includes one lift station if needed
- Anaerobic digester cell(s)
- Biogas transfer system including a biogas flow-meter
- Combustion system (Flare)
- Optional combustion system

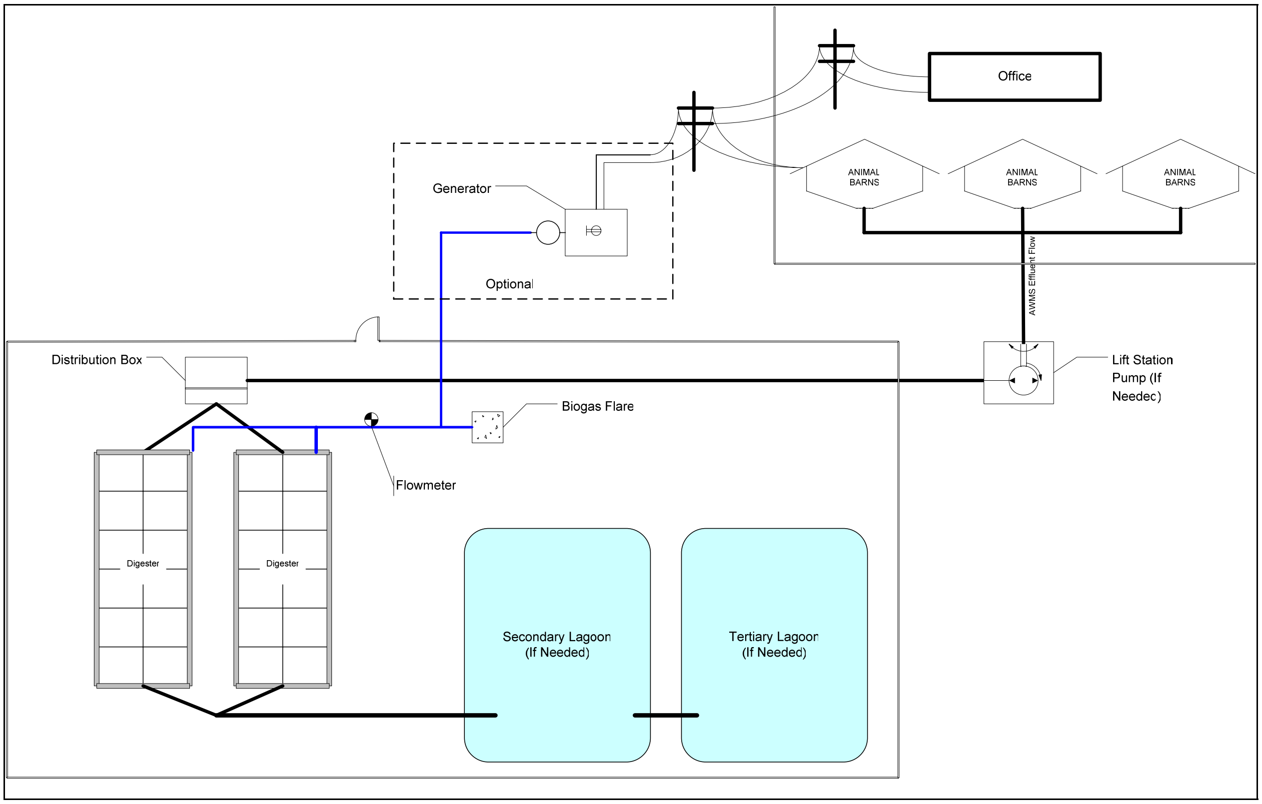

Figure 1. Typical GHG Mitigation Project System Overview

System Components Operation Requirements

Manure Transfer System

Training

Training on the Manure Transfer System shall be provided to the operations personnel by the system manufacturer and installer. Training shall include: system components, normal operation, emergency operations, maintenance, and request for warranty service. Training on reporting procedures shall be provided to the productions operations manager by AgCert.

Normal Operation

The system described in Figure 1 is a typical flush system with one optional lift station. Under normal conditions, farm hands clean the manure from the barns using water hoses and squeegees. This effluent is captured and then flushed from the barns periodically. Effluent from the barns is deposited in a lift station. Upon reaching predetermined threshold, the pump engages and routes the effluent to the digester cell. Upon being treated in the digester, the effluent is then routed from the digester to the storage lagoon. Liquid from the lagoon can then be used for irrigation.

Safety Issues and Emergency Preparedness

Care should be exercised when working around the lift station and distribution box (if installed) to avoid falling into the pit.

Weekly Inspection

A periodic inspection shall include the following:

- Check for pipeline obstructions
- Check for leaks in exposed pipelines
- Check for corrosion at exposed joints

Alternative Operating Procedures

In the event the manure transport system becomes unusable, the farm manager shall notify AgCert in accordance with the Emergency Maintenance section of this annex. Both parties shall work together to reach an acceptable alternate method to route the effluent so that farm operations are not affected, and GHG continues to be captured. If maintenance or warranty service is required, AgCert shall contact the appropriate service provider. Upon restoration of the system the farm manager shall notify the Regional Maintenance Technician (RMT) (phone, e-mail, etc.).

Anaerobic Digester

WARNING

The gas contained in the digester cell is EXTREMELY flammable. Sources of ignition and smoking are not permitted within 10 meters of the cell and gas handling system.

Death or serious injury may result.

Training

Training on the Anaerobic Digester shall be provided to production operations personnel by the system manufacturer and installer. Training shall include: system components, start-up procedures, normal operation, emergency operations, maintenance, and request for service. Training on reporting procedures shall be provided to the productions operations personnel by AgCert.

Startup Procedures

Refer to the guide / manual for the anaerobic digester.

Loading Rate and Total Solids Content

Refer to the guide / manual for the anaerobic digester.

Normal Operation

Refer to the guide / manual for the anaerobic digester.

Safety Issues and Emergency Preparedness

- No open flame permitted within 10 meters of the digester

- Do not allow personnel to stand, sit, or lean against the digester cover
- Do not use sharp objects/tools in the vicinity of the cover

Weekly Inspection

A weekly inspection shall include the following:

- Cover material – check for cracks, tears, or points of distress around perimeter of digester cell.
- Check for excessive ballooning of cover or presence of odor
- Check seams for signs of gas leakage

Alternative Operating Procedures

In the event the digester cell becomes unusable, the farm manager shall notify AgCert in accordance with the Emergency Maintenance section of this annex. Both parties shall work together to reach an acceptable alternate method to treat the effluent so that farm operations are not affected, and GHG gas continues to be captured. If maintenance or warranty service is required, AgCert shall contact the appropriate service provider. Upon restoration of the system the Regional Maintenance Technician shall be notified (phone, e-mail, etc.).

Biogas Transfer System and Biogas Sensor/Flow-Meter

Training

Training on the Biogas Transfer System shall be provided to the operations personnel by the system manufacturer and installer. Training shall include: system components, normal operation, emergency operations, maintenance, and request for warranty service. Training on reporting procedures shall be provided to the production operations personnel by AgCert.

Figure 2. Roots biogas flowmeter

Normal Operation

Biogas produced in the anaerobic digester is trapped under a positive or negative pressure geomembrane cover installed over the digester cell. The biogas is routed from the digester to the flare via PVC tubing. A flow meter, which measures gas flow, is fitted in the biogas transfer system piping.

Safety Issues and Emergency Preparedness

Gas to the metering system should be disconnected prior to performing maintenance on the flow-meter. Care should be taken when digging in the area where the pipeline is buried.

Preventive Maintenance

Preventive maintenance shall be conducted in accordance with manufacturer's recommendations. NOTE: A record of the cumulative biogas reading must be recorded prior to zeroing the meter.

Weekly Inspection

The weekly inspection shall include the following:

- Check for leaks in exposed pipelines
- Check for proper operation of the flow-meter

Alternative Operating Procedures

In the event that the biogas transfer system becomes unusable; the farm manager shall **immediately** notify AgCert in accordance with the Emergency Maintenance section of this annex. Both parties shall work together to reach an acceptable alternate method to route the biogas so that farm operations are not affected and GHG gas emissions are mitigated. If maintenance or warranty service is required, AgCert shall contact the appropriate service provider. Upon restoration of the system the RMT shall be notified (phone, e-mail, etc.).

Combustion System (Flare)

Training

Training on the Flare Combustion System shall be provided by the system manufacturer and installer. Training shall include: system components, normal operation, emergency operations, maintenance, and request for warranty service. Training on reporting procedures shall be provided to the production operations personnel by AgCert.

Normal Operation

The flare system is designed to combust the biogas whenever it is present. AgCert's flaring combustion system is automated to ensure that all biogas that exits the digester and passes through the flare (and flow meter) is combusted. Pressure control devices within the gas handling system maintain proper biogas flow to the combustion system. A continuous ignition system ensures methane combustion whenever biogas is present at the flare. The continuous ignition system is powered by a robust solar module (solar-charged battery system) that operates independently from the power grid. These solar modules are designed for rigorous outdoor application in remote locations and are proven through many years of operational experience in ranch and farm settings similar to AgCert project sites. Two (2) sparking electrodes provide operational redundancy to ensure that a minimum of one (1) spark is produced at the flare burner every 3 seconds. If biogas is present in the flare, it is immediately ignited by the sparking system. If biogas is not present, the igniter sparks harmlessly.

Safety Issues and Emergency Preparedness

Prior to performing any maintenance on the flare system, the gas flow **must** be turned off. Care should be exercised when working around the flare system as components can be extremely hot.

Preventive Maintenance

Preventive maintenance shall be conducted at least yearly.

Weekly Inspection

The weekly inspection shall include a visual inspection to determine the flare is combusting gas.

- If no flame is visible, check to see if there is a heat signature or if the flare assembly itself is hot. Night time inspection should reveal a visible light from the unit.

Alternative Operating Procedures

In the event that the flare system becomes unusable, the farm manager shall **immediately** notify AgCert in accordance with the Emergency Maintenance section of this annex. Both parties shall work together to reach an acceptable alternate method to combust the biogas so that farm operations are not affected and GHG emissions are mitigated. If maintenance or warranty service is required, AgCert shall contact the appropriate service provider. Upon restoration of the system the RMT shall be notified (phone, e-mail, etc.).

Optional Combustion System

If optional combustion equipment is installed during the project crediting period, the project developer will submit a change to the registered monitoring plan as required by the UNFCCC Secretariat.

Training

Training on any optional combustion system, e.g., generator, space heater, etc., shall be provided by the system manufacturer and installer. Training shall include: system components, normal operation, emergency operations, maintenance, and request for warranty service. Training on reporting procedures shall be provided to the production operations personnel by AgCert.

Normal Operation

An optional combustion system is designed to take advantage of the biogas and convert it into renewable energy. The systems can be used to generate electricity, heat a barn, or any other process approved (in writing) by AgCert and the verifying designated operational entity (DOE).

Safety Issues and Emergency Preparedness

Prior to performing any maintenance on an optional combustion system, the gas flow **must** be turned off. Care should be exercised when working around the optional combustion system as components can be extremely hot and high voltage may be present (when operating).

Preventive Maintenance

Preventive maintenance shall be conducted in accordance with manufacturer's recommendations. NOTE: In any case where it is required to zero and/or remove a meter, ensure that the meter reading is noted prior to zeroing and/or removing the meter.

Alternative Operating Procedures

In the event that the generator system becomes unusable, the user shall notify AgCert in accordance with the Emergency Maintenance section of this annex. The flare shall be used as the only method to combust GHG biogas. The user shall take appropriate action to notify his service provider should maintenance or warranty service be required. Upon restoration of the system the RMT shall be notified (phone, e-mail, etc.).

Maintenance, Trouble Reporting and Documentation

Emergency Maintenance:

Situations requiring immediate attention due to failure of components of the digester or combustion system that could cause significant damage to the physical structure, or could result in the release of GHG or failure to capture GHG should be immediately reported to the Regional Maintenance Technician. If unavailable, contact the National Monitoring or Maintenance Manager of the country where the equipment is located or the International Operations and Maintenance Manager.

Title	Phone	e-mail
Regional Maintenance Technician (RMT)	Supplied during training	Supplied during training
Argentina National Monitoring Manager	(54) 348-844-6127	operationsar@agcert.com
Brazil National Monitoring Manager	(55) 212-704-50 ext 0490	operationsbr@agcert.com
Chile National Monitoring Manager	(56) 222-911-52	operationscl@agcert.com
International Monitoring Manager	(001) 321-409-7846	operations@agcert.com
Mexico National Monitoring Manager	(52) 552-122-0310	operationsmx@agcert.com
Canada National Monitoring Manager	(001) 780-409-9286	n/a

Unscheduled Maintenance:

Situations requiring maintenance (not resulting in the release or failure to capture GHG) should be reported to the Regional Maintenance Technician, normally within 1 to 24 hours of discovery.

Records Keeping

Maintenance and servicing of equipment shall be recorded.

MONITORING ACTIVITES

The following table summarizes key parameters monitored:

Table 1. Key parameters monitored

ID	Item	Applies to Project	Monitored		ER Calculation Data		Performed by	Comments
			Ex-ante	Ex-post	Primary	Secondary		
1	Sludge Removal (SlR)	✓		✓			RMT	Ensures proper disposition of sludge
2	Biogas Produced (BGP)	✓		✓		✓	FH, RMT	QA/QC
3	Methane Content (MC)	✓		✓		✓	RMT	QA/QC
4	Combustion System Operational Time (CEE)	✓		✓	✓		FH, RMT	Whenever the flare is observed to be out of service, any biogas metered from the last known operational point in time, shall be deducted from the total Biogas reading
5	Efficiency of Flare process (EFP)	✓		✓			EN	Ensures correct performance of combustion

Farm: FH – Farm Hand; DP – Data Processor; FM – Farm Manager;
AgCert: RMT – Regional Maintenance Technician, QA – Quality Assurance; OP – Operations, EN - Engineer

MONITORING WORK INSTRUCTIONS

Work instructions for the monitoring of key parameters can be found on the following pages:

Work Instruction for monitoring ID 1, Sludge Removal

Summary

Due to the physical characteristics of the manure, it becomes necessary at times to remove the sludge that has accumulated inside a biodigester. This helps ensure the digester system is operating nominally. It is important to ensure the removed sludge is disposed of properly.

This ID monitors the number of times sludge is removed from the digestor and ensures the sludge is disposed of properly.

References

- AgCert Preventive Maintenance Instruction GM001, Biodigestor Sludge, Removal and Disposal Instruction
- UNFCCC approved monitoring methodology: AMS-III.D, Ver 11., Methane Recovery.

Prerequisite(s)

Processes

- I036-9, Bio-security and Safety

Training of Monitoring Personnel

- Regional Monitoring Technicians shall be trained on data collection transfer processes.
- Operations personnel shall be trained on proper disposition practices.

Equipment, Materials and Tools

- GM001, Biodigester Sludge Removal and Disposal Instruction
- GM001-F1, Sludge removal record

Calibration

- None

Process

<table>
<tr><th>Step</th><th>Operator</th><th>Activity</th><th>Documentation</th><th>Comments</th></tr>
<tr><td>1</td><td>RMT</td><td>Determine need to remove sludge</td><td></td><td rowspan="6">Sludge is disposed of by applying to soil or some other aerobic process</td></tr>
<tr><td>2</td><td>RMT</td><td>Coordinate with Maintenance to schedule sludge removal</td><td>Electronic</td></tr>
<tr><td>3</td><td>M</td><td>Performs sludge removal in accordance with the PMI</td><td></td></tr>
<tr><td>4</td><td>M</td><td>Properly dispose of sludge</td><td></td></tr>
<tr><td>5</td><td>M</td><td>Document disposal method on maintenance form</td><td>Paper/electronic</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Farm: FH – Farm Hand; DP – Data Processor; FM – Farm Manager;
AgCert: RMT – Regional Maintenance Technician, QA – Quality Assurance; OP – Operations, EN – Engineer, M - Maintenance</td></tr>
</table>

RECORD ID	RECORD LOCATION	RETENTION TIME	DISPOSITION
GM001-F1	EnviroCert	Duration of project +2 years	Destroy

Work Instruction for monitoring ID 2, Biogas Produced

Summary

This ID monitors the volume and flow of biogas sent to the combustion system on a monthly basis. It is a quality control check to ensure proper operation of the anaerobic digester.

References

- UNFCCC approved monitoring methodology: AMS-III.D., Methane Recovery.
- Data collection forms (provided by farm manager)
- P025, Control of Monitoring and Measuring Device (MMD)
- MS004-F2, O & M Monthly Monitoring Form

Prerequisite(s)

Processes

- I036-9, Bio-security and Safety

Training of Monitoring Personnel

- Regional Maintenance Technicians and operations personnel shall be trained on data collection transfer processes.

Equipment, Materials and Tools

- Biogas Flow Meter

Calibration

- Prior to using a measuring device, ensure it is calibrated.

Process

Step	Operator	Activity	Documentation	Comments
1	RMT	Record reading in appropriate area of MS004-F2, Monthly Monitoring Form	MS004-F2, Monthly Monitoring Form	
2	RMT	Transmit data in-country operations	Fax, Electronic, etc	Enter data into EnviroCert
3	QA	Perform Quality Control Check for format, integrity, etc.		
4	OP	Confirm reading within expected limits IAW manufacturer guidelines.		
5	OP	Store Data		
Farm: FH – Farm Hand; DP – Data Processor; FM – Farm Manager; AgCert: RMT – Regional Monitoring Technician, QA – Quality Assurance; OP – Operations, EN – Engineer				

Records Control

RECORD ID	RECORD LOCATION	RETENTION TIME	DISPOSITION
MS004-F2, Monthly Monitoring Form	Document Control Center	Duration of project + 2 years	Destroy

<u>Work Instruction for monitoring ID 3, Methane Content</u>

Summary

This ID determines the methane content of the biogas. It is a snapshot of the AMWS methane production efficiency. Methane concentration is determined with a gas analyzer. The measuring equipment is calibrated in accordance with the manufacturer specifications.

References

- UNFCCC approved monitoring methodology: AMS-III.D., Methane Recovery
- P025, Control of Monitoring and Measuring Device (MMD)
- Operations Manual Gas Analyzer
- MS004-F2, Monthly Monitoring Form

- MS004-F3 or F4, O & M Maintenance Log

Prerequisite(s)

Processes

- I036-9, Bio-security and Safety

Training of Monitoring Personnel

- Operating the Gas Analyzer
- Regional Maintenance Technicians shall be trained on data collection transfer processes.
- Operations personnel shall be trained on data processing and storage

Equipment, Materials and Tools

- Gas Analyzer

Calibration

- As required by the manufacturer.

Process

Step	Operator	Activity	Documentation	Comments
1	RMT	Prepare the gas analyzer as directed in the operator manual.	Gas Analyzer Operations Manual	
2	RMT	Connect the gas analyzer to the system test port.		
3	RMT	Open valve on test port		
4	RMT	Take gas reading in accordance with Operations Manual		Take 5 readings and average the results.
5	RMT	Record gas readings in appropriate spaces of MS004-F2, Monthly Monitoring Form	MS004-F2, Monthly Monitoring Form	If there is greater than 10% points difference from previous reading, initiate appropriate maintenance actions.
6	RMT	Close valve on test port		
7	RMT	Disconnect hose in reverse order of connection		
8	RMT	Double check that biogas test port valve is closed prior to leaving area		
9	RMT	Transmit data in-country operations	Fax, Electronic, etc	Enter into EnviroCert
10	QA	Perform Quality Control Check for format, integrity, etc.		

Step	Operator	Activity	Documentation	Comments
11	OP	Confirm reading within expected limits IAW manufacturer guidelines.		
12	OP	Store Data		
Farm: FH – Farm Hand; DP – Data Processor; FM – Farm Manager; AgCert: RMT – Regional Monitoring Technician, QA – Quality Assurance; OP – Operations, EN - Engineer				

Records Control

RECORD ID	RECORD LOCATION	RETENTION TIME	DISPOSITION
MS004-F2, Monthly Monitoring Form	Document Control Center	Duration of project + 2 years	Destroy

Work Instruction for monitoring ID 4, Fraction of time Combustion Equipment Operates

Summary

This parameter is used to determine the fraction of time in which gas is combusted. The fraction of time will be determined as 100% less any time the flare is out of service and gas is flowing. Flare maintenance records will be used to make this determination.

References

- UNFCCC approved monitoring methodology: AMS-III.D., Methane Recovery
- MS004-F2, O & M Monthly Monitoring Form
- P025, Control of Monitoring and Measuring Device (MMD)

Prerequisite(s)

Processes

- I036-9, Bio-security and Safety

Training of Monitoring Personnel

- Regional Maintenance Technicians and operations personnel shall be trained on data collection transfer processes.

Equipment, Materials and Tools

Calibration

- Prior to using a measuring device, ensure it is calibrated.

Process

Step	Operator	Activity	Documentation	Comments
1	RMT	Record reading in appropriate area of MS004-F2, Monthly Monitoring Form	MS004-F2, Monthly Monitoring Form	
2	RMT	Transmit data to in-country operations	Fax, Electronic, etc	Enter data into EnviroCert
3	QA	Perform Quality Control Check for format, integrity, etc.		
4	OP	Confirm reading within expected limits IAW manufacturer guidelines.		
5	OP	Store Data		
Farm: FH – Farm Hand; DP – Data Processor; FM – Farm Manager; AgCert: RMT – Regional Maintenance Technician; QA – Quality Assurance; OP – Operations, EN - Engineer				

RECORD ID	RECORD LOCATION	RETENTION TIME	DISPOSITION
MS004-F2, Monthly Monitoring Form	Document Control Center	Duration of project + 2 years	Destroy

Records Control

Work Instruction for monitoring ID 5, Flare Efficiency

Summary

This parameter guarantees the correct performance of flaring process.

References

- Approved monitoring methodology: AMS-III.D., Methane Recovery.
- P025, Control of Monitoring and Measuring Devices
- MS004-F2, O & M Monthly Monitoring Form
- OM002, Flare Efficiency Test Instruction
- OM002-F1, Flare Efficiency Test Table

Prerequisite(s)

Processes

Efficiency is tested prior to installation and amount of methane combusted is calculated based on the efficiency rating. According to the methodology, the flare efficiency shall be calculated as fraction of time the gas is combusted in the flare multiplied by the efficiency of the flaring process.

The enclosed flaring combustion system is automated to ensure that all biogas that exits the digester and passes through the flare (and flow meter) is combusted. Pressure control devices within the gas handling system maintain proper biogas flow to the combustion system. A continuous ignition system ensures methane combustion whenever biogas is present at the flare. Two (2) sparking electrodes provide operational redundancy. If biogas is present in the flare, it is immediately ignited by the sparking system. If biogas is not present, the igniter sparks harmlessly. This continuous ignition system is powered by a robust solar module (solar-charged battery system) that operates independently from the power grid. The component parts are tested and verified functional on a periodic basis in accordance with manufacturer and other technical specifications.

A flare efficiency test will be performed for each new flare that is installed at an AgCert digester project site. Initial flare efficiency testing will be performed by trained personnel using calibrated equipment and a third-party verified test protocol. Both methane destruction determinations described in the flare efficiency testing protocol will be performed during the initial flare testing to ensure that the flare performs according to specifications. Results of the initial flare efficiency test will be kept on project file and will be made available to the verifying Designated Operational Entity (DOE). Subsequent operational testing shall be accomplished at least yearly using the verified test protocol.

Equipment, Materials and Tools

- Gas analyzer (a Landtec GA-90, GEM-500 or equivalent).

Calibration

- Prior to using a measuring device, ensure it is calibrated.

Process

Step	Operator	Activity	Documentation	Comments
1	EN	Perform procedures outlined in OM002.	OM002-F1, Flare Efficiency Test Table	
Farm: FH – Farm Hand; DP – Data Processor; FM – Farm Manager; AgCert: RMT – Regional Monitoring Technician, QA – Quality Assurance; OP – Operations, EN - Engineer				

Records Control

RECORD ID	RECORD LOCATION	RETENTION TIME	DISPOSITION
• OM002-F1, Flare Efficiency Test Table	EnviroCert	Duration of Project +2 years	Destroy

EMISSION REDUCTION CALCULATIONS

Calculating Methane (CH_4) Emissions

Step 1: Record biogas meter reading (ID2).

Step 2: Record the percentage of methane of the biogas (ID3).

Step 3: Multiply ID 2 and ID 3.

Step 4: Multiply ID4 and ID5.[24]

Step 5: Multiply the result of Step 3 and Step 4

[24] For the purposes of estimating ERs, the value of 98% was used based on EPA studies on flaring processes for the same type of enclosed flare used in this project: http://www.epa.gov/cmop/pdf/022red.pdf#search=%22EPA%20enclosed%20flare%20efficiency%22

Annex 4

Control of Measuring & Monitoring Devices (MMD)

PURPOSE

The purpose of this document is to ensure that all MMD’s used to demonstrate product conformity with specified requirements is identified, controlled and gauged at prescribed frequencies and that records for these activities are kept.

SCOPE

This document applies to all MMD’s as well as software, used to verify product conformity with specified requirements. It applies to all individuals responsible for the selection, maintenance, and use of MMD’s.

ASSOCIATED DOCUMENTS

MS004, O & M Manual
P005, Corrective and Preventative Action

DEFINITIONS

OM:	Operations and Maintenance
OPS:	Operations
QA:	Quality Assurance
RMT:	Regional Maintenance Technician
SUP:	MMD Supplier

PROCEDURE

Step	Responsibilities	Associated Documents
1 Identify the need for measuring and/or monitoring devices/software	OM, OPS, QA, SUP	A
↓		
2 Determine type of equipment based on required accuracy	OM, QA, SUP	A
↓		
3 Upon purchase and/or installation, initiate record for equipment.	OM, OPS, RMT, SUP	A
↓		
4 Establish frequency and calibration method or verification activity	OM, QA, SUP	A
↓		
5 Correct any "Out of Tolerance" conditions.	OM, RMT, SUP	A, B

NOTES

BOX 1. OM, OPS, and QA, together with SUP shall identify MMD's/Software that will be used to monitor equipment performance.

BOX 2. MMD's/Software will be selected/designed as best suited to ensure proper performance. Determination of MMD's/Software required shall be based on the measurements to be taken and the accuracy required.

BOX 3. Calibrated Devices will be labeled at a minimum with a unique identification number, status of calibration and date next calibration due. Records will be maintained that show the actual state of each piece of equipment, physical conditions of calibrating equipment and actual readings obtained from calibration and/or verification. Records will be maintained in accordance with section 7.0 Record Control.

BOX 4. Off-the-shelf equipment will be calibrated in accordance with the SUP recommended calibration cycle.

Custom-gauged equipment calibration intervals shall be defined by OM & SUP.
The calibration intervals can be adjusted based on the analysis of previous calibration results and at the discretion of OM & SUP.
Third Party Calibration Service will be managed as if activity was performed by company personnel. This will include requirement that all Qualifying Certifications and references to NIST Standards be submitted/maintained.

BOX 5. Devices found to be out of tolerance will be adjusted/repaired. An investigation will be conducted to determine the effect that the out of tolerance condition may have had on the ability to verify conformance of product to customer requirements and to determine what action, if any, should be taken.

RECORD CONTROL

RECORD ID	FILE LOCATION	RETENTION TIME	DISPOSITION
Equipment calibration records	Site of use	1 year after equipment has been removed from service	Destroyed