

**AWMS METHANE RECOVERY PROJECT BR07-S-34,  
BAHIA, ESPIRITO SANTO, MINAS GERAIS, AND SÃO  
PAULO, BRAZIL**

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



**DOCUMENT ID: BR07-S-34  
VER 5, 14 NOV 2007**

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| <p><b>CLEAN DEVELOPMENT MECHANISM<br/>PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)<br/>Version 03 - in effect as of: 22 December 2006</b></p> |
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**CDM – Executive Board****Revision history of this document**

| <b>Version Number</b> | <b>Date</b>      | <b>Description and reason of revision</b>  |
|-----------------------|------------------|--|
| 01                    | 21 January 2003  | Initial adoption   |
| 02                    | 8 July 2005      | <ul style="list-style-type: none"><li>• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.</li><li>• As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <a href="http://cdm.unfccc.int/Reference/Documents">http://cdm.unfccc.int/Reference/Documents</a>.</li></ul> |
| 03                    | 22 December 2006 | <ul style="list-style-type: none"><li>• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.</li></ul>   |

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**SECTION A. General description of small-scale project activity****A.1 Title of the small-scale project activity:**

AWMS Methane Recovery Project BR07-S-34, Bahia, Espirito Santo, Minas Gerais, and Sao Paulo, Brazil, Ver 05, 14 NOV 2007.

**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<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) resulting from both aerobic and anaerobic decomposition processes.

**Explanation of GHG emission reductions:** 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 Bahia, Minas Gerais, and Sao Paulo, 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*,<sup>1</sup> 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.<sup>2</sup>

<sup>1</sup> <http://www.ambientebrasil.com.br>

<sup>2</sup> 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

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Establishing a positive model for livestock operations is essential. In 2005, the swine population in Brazil was 34,063,934.<sup>3</sup> In 2005, the swine population of Bahia, Minas Gerais, and Sao Paulo, was approximately 7.49 million heads.<sup>4</sup> Considering that a typical hog produces 5.8 kilograms of effluent daily (Table A1), some 15.86 million metric tons of hog waste is produced annually in Bahia, Minas Gerais, and Sao Paulo, alone. Introducing progressive AWMS practices throughout Bahia, Minas Gerais, and Sao Paulo, has the potential to reduce approximately 5.0 million tonnes<sup>5</sup> of carbon dioxide equivalent (CO<sub>2</sub>e) each year.

**Table A1. Daily production of effluent by type of porcine<sup>6</sup>**

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

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.<sup>7</sup>

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

<sup>3</sup> [ftp://ftp.ibge.gov.br/Producao\\_Pecuaria/Producao\\_da\\_Pecuaria\\_Municipal\\_%5Banual%5D/2004/grandes\\_regioes\\_Ufs.zip](ftp://ftp.ibge.gov.br/Producao_Pecuaria/Producao_da_Pecuaria_Municipal_%5Banual%5D/2004/grandes_regioes_Ufs.zip)

<sup>4</sup> [ftp://ftp.ibge.gov.br/Producao\\_Pecuaria/Producao\\_da\\_Pecuaria\\_Municipal\\_%5Banual%5D/2004/grandes\\_regioes\\_Ufs.zip](ftp://ftp.ibge.gov.br/Producao_Pecuaria/Producao_da_Pecuaria_Municipal_%5Banual%5D/2004/grandes_regioes_Ufs.zip)

<sup>5</sup> Approximate calculation using IPCC model and emission factors.

<sup>6</sup> 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.

<sup>7</sup> 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.

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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 (*)<br>(host) indicates a host Party | Private and/or public entity(ies)<br>project participants (*)<br>(as applicable)             | Kindly indicate if<br>the Party involved<br>wishes to be<br>considered as<br>project participant<br>(Yes/No) |
|---|--|--|
| Brazil (host)   | <ul style="list-style-type: none"> <li>AgCert Do Brasil Solucoes Ambientais Ltda.</li> </ul> | 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 **Bahia, Minas Gerais, and São Paulo**.

**A.4.1.3. City/Town/Community etc:**

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

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

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

**João Gilberto Mário Van Den Broek** owns one site in Mogi Mirim, São Paulo:

- Fazenda Esmeralda (30412) is a farrow to finish operation. This site had approximately 3,981 animals on site between January and December, 2006. The producer plans to add approximately 502 sows and 517 finishers over the next three years. There are seven containment areas at this site which house the animals. Waste is removed as the animals stand on an elevated floor and it can drop down underneath. It is then routed to the site's AWMS, which consists of one concrete basin. The basin is approximately 3.3m x 27.8m. Effluent is disposed of from the basin through surface spread. Construction of the proposed anaerobic digester is expected to be complete on 10 May, 2007.

**Leila Maria Souza Vicente Araujo** owns one site in Piranga, Minas Gerais:

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- Granja Bemvindo Miranda - Fazenda Pimenta (10965) is a farrow to finish operation. This site had approximately 5,191 animals on site between March 2006 and February 2007. There are ten containment areas at this site which house the animals. Waste is removed from the containment areas via flush method. It is then routed to the site's AWMS, which consists of two concrete basins, a secondary lagoon and four tertiary lagoons. One concrete basin lagoon is approximately 12.2m x 2.95m x 1.2m; the second is approximately 21.6m x 2.95m x 1.2m. Each lagoon is approximately 20m x 20m x 2m, 49m x 20m x 2m, 28.3m x 22m x 2m, 24.1m x 23m x 2m, & 63m x 25.35m x 2m. Effluent is disposed of from the lagoons through surface spread. Construction of the proposed anaerobic digester was completed on 18 March, 2006.

**Granja Courotex Ltda** owns one site in Candeias, Bahia:

- Granja Courotex Ltda (21522) is a farrow to finish operation. This site had approximately 2,814 animals on site between August 2004 and July 2005. This site has a total of fifteen containment areas; eight of which use the flush method of manure removal; one uses the pull plug method, and the remaining six use the scraper method. Waste flows from all the containment areas through two natural earth depreciations as this site's AWMS. The first depreciation is approximately 100m x 40m x 2m and the second is 60m x 30m x 2m. Construction of the proposed anaerobic digester was completed on 1 September, 2006.

**Saulo de Deus Vieira** owns one site in Patos de Minas, Minas Gerais:

- Granja Esperanca (27512) is a farrow to finish operation. This site had approximately 2,812 animals on site between October 2004 and September 2005. There are five containment areas at this site which house the animals. Waste is removed from the containment areas via the pull plug method. It is then routed to the site's AWMS, which consists of two primary lagoons, one secondary lagoon and one tertiary lagoon. Three lagoons are approximately 2m x 7m and the final lagoon is approximately 12m x 27m x 3m. Effluent is disposed of from the lagoons through irrigation. Construction of the proposed anaerobic digester was completed on 12 December, 2005.



**Figure A1. Project Activity in Bahia, Minas Gerais, and Sao Paulo Brazil**

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Figure A1.A Project Activity Site in Bahia, Brazil

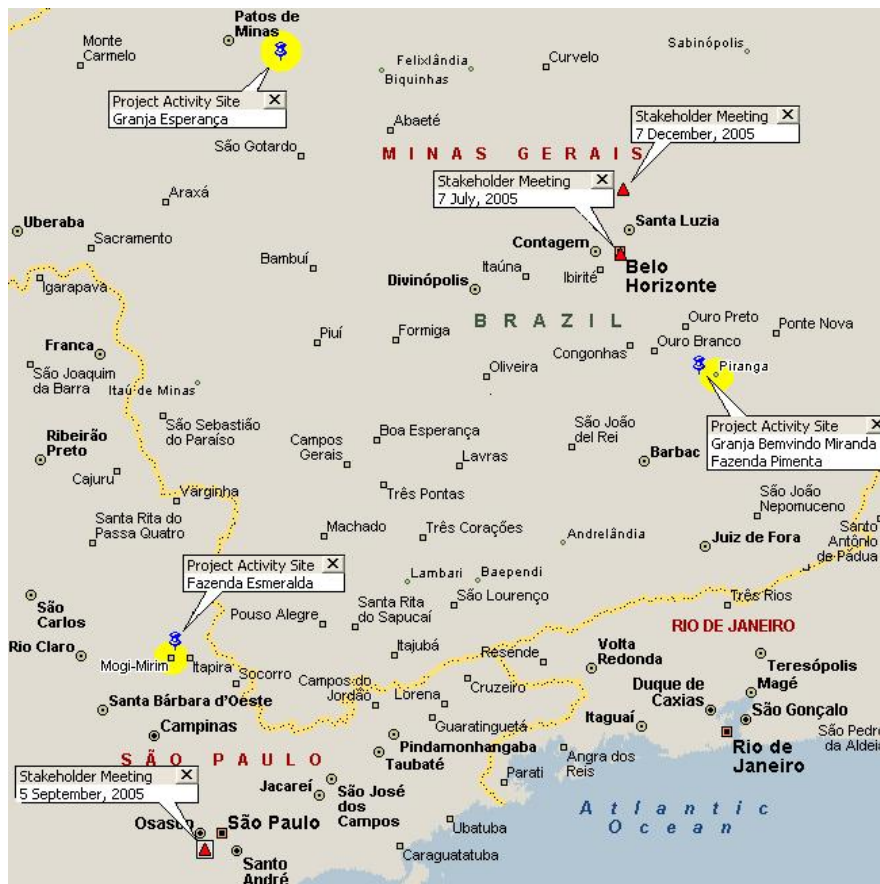


Figure A1.B Project Activity Sites in Minas Gerais and Sao Paulo, Brazil



**CDM – Executive Board****Table A2. Detailed physical location and identification of project sites**

| Farm/Site Name                            | AgCert ID | Address   | Town / State                 | Contact                                | Phone           | GPS Coord            |
|---|-----------|---|------------------------------|--|-----------------|----------------------|
| Fazenda Esmeralda                         | 30412     | Fazenda Esmeralda Lote 38                             | Mogi Mirim, Sao Paulo        | João Gilberto Mário Van Den Broek      | 55 19 9192-6062 | 22.561S<br>46.9627W  |
| Granja Bemvindo Miranda - Fazenda Pimenta | 10965     | Rodovia Piranga á Senhora de Oliveira , Km 10         | Piranga, Minas Gerais        | Leila Maria Souza Vicente Araújo       | 55 31 3746-1257 | 20.71S<br>43.56W     |
| Granja Courotex Ltda                      | 21522     | Núcleo Colonial Landulfo Alves S/N ) A. do Ipê km 590 | Candeias, Bahia              | Antonio Carlos Alves dos Santos Junior | 55 75 3622-0333 | 12.6599S<br>38.4858W |
| Granja Esperança                          | 27512     | Granja Esperanca, Zona Rural                          | Patos de Minas, Minas Gerais | Saulo Vieira                           | 55 34 3821-9928 | 18.6190S<br>46.3203W |

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### A.4.2. Type and category(ies) and technology/measure 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 farms located in Bahia, Minas Gerais, and Sao Paulo, 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 a highly 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 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.

**CDM – Executive Board****A.4.3 Estimated amount of emission reductions over the chosen crediting period:****ESTIMATED AMOUNT OF EMISSION REDUCTIONS OVER THE 7 YEAR CREDITING PERIOD**

| <b>A.4.3 - Estimated Emission Reductions over chosen Crediting Period</b>                           |  |
|---|--|
| <b>Years</b>  | <b>Annual estimation of emission reductions in tonnes of CO<sub>2</sub>e</b> |
| Year 1  | 8,036  |
| Year 2  | 8,257  |
| Year 3  | 8,516  |
| Year 4  | 8,821  |
| Year 5  | 8,821  |
| Year 6  | 8,821  |
| Year 7  | 8,821  |
| <b>Total estimated reductions (tonnes CO<sub>2</sub>e)</b>  | <b>60,093</b>  |
| <b>Total number of crediting years</b>  | <b>7</b>   |
| <b>Annual average over the crediting period of estimated reductions (tonnes of CO<sub>2</sub>e)</b> | <b>8,585</b>   |

**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 large scale project activity:**

Based on paragraph 2 of Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities,<sup>8</sup> this project is not debundled. There are no other registered large-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 and monitoring methodology**

<sup>8</sup><http://cdm.unfccc.int/Projects/pac/howto/SmallScalePA/sscdebund.pdf>

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**B.1. Title and reference of the approved baseline and monitoring 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 CO<sub>2</sub>eq.

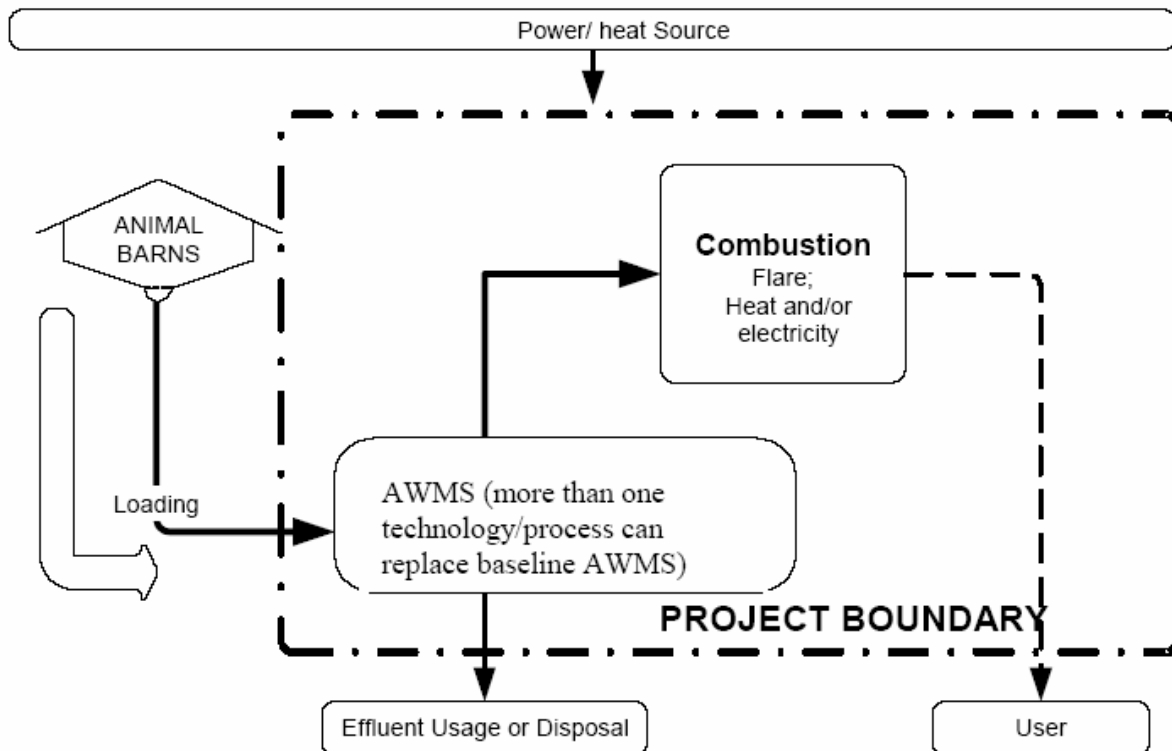
**B.2 Justification of the choice of the project category:**

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 farms located in Bahia, Minas Gerais, and Sao Paulo, 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. The proposed project activity will change the current animal waste management practice to that which uses an anaerobic digestion system equipped with a methane recovery and combustion system. Based on historical animal inventories and baseline estimates, the estimated emission reductions of the project activity will not exceed 60 kt CO<sub>2</sub>e in any year of the crediting period as shown in Section A.4.3.

**B.3. Description of the project boundary:**

The project boundary is 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 practices, including the GHG resulting from the capture and combustion of biogas using the technology described in Section A.4.2.

**CDM – Executive Board****Figure B1. Project Boundary**

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 biogas which is then combusted. Based on the methodology, the anaerobic digester is the physical boundary of the methane recovery facility.

**B.4. Description of 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 Section 10.44 through 10.47 of the 2006 IPCC Guidelines for National GHG Inventories.

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

**Step 1 – Livestock Population**

Animal populations for the project activity sites are described in Annex 3. The AWMS used on the farms is an open lagoon, unless otherwise noted in Section A.4.1.4.

**Step 2 – Emission Factors**

The emission factor for the animal group is:

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$$EF_i = VS_i * n_m * B_{oi} * 0.67 \text{kg/m}^3 * MCF_{jk} * MS\%_{ijk}$$

Equation B1<sup>9</sup>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 $Vs = (W_{\text{site}}/W_{\text{default}})^{10} * VS_{\text{IPCC}}$ ) |
| $n_m$        | = | Number of days animals present,  |
| $B_o$        | = | Maximum methane producing capacity ( $\text{m}^3/\text{kg}$ 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:

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

Equation B2<sup>11</sup>Where:

|                            |   |   |
|----------------------------|---|---|
| $CH_{4a}$                  | = | methane produced in kg/yr for animal type i,          |
| $EF_i$                     | = | emission factor (kg) for animal type i (e.g., swine), |
| $Population_{\text{year}}$ | = | 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.

$$BE = [CH_{4a} * GWP_{CH_4}]/1000$$

Equation B3<sup>12</sup>

<sup>9</sup> 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Equation 10.23, p.10.41 and Annex 10A.2, Tables 10A-7 and 10A-8, p. 10.80 and 10.81

<sup>10</sup> Obtained from 2006 IPCC, Annex 10A.2, Tables 10A-7 and 10A-8, p. 10.81 and 10.82

<sup>11</sup> Adapted from 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Equation 10.23, p. 10.41.

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Where:

|              |   |  |
|--------------|---|--|
| $BE$         | = | Baseline carbon dioxide equivalent emission in metric tons per year, |
| $CH_{4a}$    | = | annual methane produced in kg/yr for animal type i,                  |
| $GWP_{CH_4}$ | = | global warming potential of methane (21),                            |

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

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 Cláudio 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."*<sup>13</sup>

- 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

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<sup>12</sup> Adapted from Equation 9, page 12, AM0016/version 02, 22 October 2004 / UNFCCC / CDM Meth Panel

<sup>13</sup> [http://www.jornalexpress.com.br/noticias/detalhes.php?id\\_jornal=2&id\\_noticia=5802](http://www.jornalexpress.com.br/noticias/detalhes.php?id_jornal=2&id_noticia=5802)

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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.

Per local and state officials as well as the project developer's legal counsel, 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.6. Emission reductions:

#### B.6.1. Explanation of methodological choices:

##### Baseline Emissions

Baseline emissions are calculated as described in section B.4.

##### Project Emissions

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

##### Step 1 – Livestock Population

Livestock populations for the project activity sites are described in Annex 3. The AWMS proposed for use on the farm is an anaerobic digester.

##### Step 2 – Emission Factors

The emission factor for the animal group is:

$$EF_i = VS_i * n_m * B_{0i} * 0.67\text{kg/m}^3 * MCF_{jk} * MS\%_{ijk}$$



---

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*Equation B4<sup>14</sup>*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 $Vs = (W_{site}/W_{default})^{15} * VS_{IPCC}$ ) |
| $n_m$        | = | 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 B5<sup>16</sup>*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.           |

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

$$PE = [CH_{4a} + FE] * GWP_{CH_4} / 1000$$

*Equation B6<sup>17</sup>*Where:

|           |   |  |
|-----------|---|--|
| $PE$      | = | 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                        |

---

<sup>14</sup> 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Page 10.41, Equation 10.23 and Page 10.77, Table 10A-4.

<sup>15</sup> Obtained from 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Annex 10A.2, Table 10A-7 and Table 10A-8, p. 10.80 and 10.81

<sup>16</sup> Adapted from 2006 IPCC Guidelines for National Greenhouse Gas Inventories, p. 10.41.

<sup>17</sup> Adapted from Equation 9, page 12, AM0016/version 02, 22 October 2004/UNFCCC/CDM Methodology Panel

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$GWP_{CH_4}$  = global warming potential of methane (21)

### Leakage

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

### Emission Reductions

The ex-ante baseline emissions calculated as described in section B.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.

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

*Equation B7*

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, the standard equipment configuration consists of one 2 horsepower (HP) biogas blower that operates 24 hours per day per anaerobic digester.

$$HP \text{ to kWh conversion} = HP (2) \times \text{hours per day (24)} \times \text{days a year (365)} \times 0.7457^{18}$$

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 CO<sub>2</sub>e per year, the following formula is applied:

$$kWh \text{ to CO}_2\text{e conversion} = (kWh (13,065) \times \text{country specific emission factor (0.2677)}^{19}) / 1000$$

Therefore, for each anaerobic digester, approximately 3.5 metric tonnes of CO<sub>2</sub>e are produced per year as a result of the project activity.

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 includes a conservative 10% discount to compensate for intrinsic digester emissions.

|   |
|---|
| <b>B.6.2. Data and parameters that are available at validation:</b> |
|---|

<sup>18</sup> .7457 is the standard scientific conversion factor from horsepower (HP) to Kilowatt Hours (kWh) based on Ohm's Law

<sup>19</sup> .2677kg CO<sub>2</sub> / kWh, Obtained from and calculated ex-ante from AM0015 and registered CDM project 0190 titled: Moema Bagasse Cogeneration Project (MBCP).

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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 operation and enable the farm to maximize both productivity and profitability. AgCert uses some data collected from this system (referred to as “Data collected on the AgCert Form B” in Table B.1.). AgCert has a rigorous QA/QC system that ensures data security and data integrity. Spot audits of data collection activities are conducted on a regular basis.

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. Table B.1. details data and parameters available at the time of validation.

**Table B.1. Data / Parameter Values and References**

|  |  |
|--|--|
| Data / Parameter:  | <b>GWP CH<sub>4</sub></b>  |
| Data unit:   |  |
| Description:   | Global Warming Potential of Methane  |
| Source of data used:   | Intergovernmental Panel on Climate Change, <i>Climate Change 1995: The Science of Climate Change</i> (Cambridge, UK: Cambridge University Press, 1996) |
| Value applied:   | 21   |
| Justification of the choice of data or description of measurement methods and procedures actually applied: |  |
| Comments:  |  |

|  |   |
|--|---|
| Data / Parameter:  | <b>Population<sub>year</sub></b>  |
| Data unit:   | Number of animals   |
| Description:   | Annual average population of animal type  |
| Source of data used:   | Data collected on the AgCert Form B (Baseline data collection).   |
| Value applied:   | See Annex 3 Animal Inventory  |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | Animal population used to estimate baseline and project emission estimates was based on a 12 month period of actual or projected operation production data. |
| Comments:  |   |

|  |   |
|--|---|
| Data / Parameter:  | <b>n<sub>m</sub></b>  |
| Data unit:   | Number of days  |
| Description:   | Days animals resident in system per year                                |
| Source of data used:   | Data collected on the AgCert Form B (Baseline data collection).         |
| Value applied:   | See Table B2 for Baseline Activity<br>See Table B3 for Project Activity |
| Justification of the choice of data or description of measurement methods and procedures actually applied: |   |
| Comments:  |   |

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|  |   |
|--|---|
| Data / Parameter:  | <b>MS%<sub>ijk</sub></b>  |
| Data unit:   | Fraction or percentage  |
| Description:   | Percent of animal effluent used in system.                      |
| Source of data used:   | Data collected on the AgCert Form B (Baseline data collection). |
| Value applied:   | 100%  |
| Justification of the choice of data or description of measurement methods and procedures actually applied: |   |
| Comments:  |   |

|  |   |
|--|---|
| Data / Parameter:  | <b>VS<sub>i market</sub></b>                                |
| Data unit:   | Kg/day  |
| Description:   | Volatile solids excreted for animal type (market swine)     |
| Source of data used:   | Obtained from 2006 IPCC, Annex 10A.2, Table 10A-7, p. 10.80 |
| Value applied:   | 0.27  |
| Justification of the choice of data or description of measurement methods and procedures actually applied: |   |
| Comments:  |   |

|  |   |
|--|---|
| Data / Parameter:  | <b>VS<sub>i breeding</sub></b>                              |
| Data unit:   | Kg/day  |
| Description:   | Volatile solids excreted for animal type (breeding swine)   |
| Source of data used:   | Obtained from 2006 IPCC, Annex 10A.2, Table 10A-8, p. 10.81 |
| Value applied:   | 0.50  |
| Justification of the choice of data or description of measurement methods and procedures actually applied: |   |
| Comments:  |   |

|  |  |
|--|--|
| Data / Parameter:  | <b>B<sub>oi</sub></b>  |
| Data unit:   | m <sup>3</sup> /kg of VS   |
| Description:   | Maximum methane producing capacity for manure produced by animal type            |
| Source of data used:   | Obtained from 2006 IPCC, Annex 10A.2, Tables 10A-7 and 10A-8, p. 10.80 and 10.81 |
| Value applied:   | 0.48   |
| Justification of the choice of data or description of measurement methods and procedures actually applied: |  |
| Comments:  |  |

|                   |   |
|-------------------|---|
| Data / Parameter: | <b>MCF<sub>jk</sub></b>                                     |
| Data unit:        |   |
| Description:      | Methane conversion factor for each manure management system |

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|  |   |
|--|---|
| Source of data used:   | Obtained from 2006 IPCC, Table 10.17, p. 10.45 for Baseline Activity<br>Obtained from 2006 IPCC, Table 10.17, p. 10.46 for Project Activity |
| Value applied:   | Refer to 2006 IPCC, Table 10.17, p. 10.45 for Baseline Activity<br>Refer to 2006 IPCC, Table 10.17, p. 10.46 for Project Activity           |
| Justification of the choice of data or description of measurement methods and procedures actually applied: |   |
| Comments:  |   |

|  |   |
|--|---|
| Data / Parameter:  | <b>Days OB</b>  |
| Data unit:   |   |
| Description:   | Days out of barn  |
| Source of data used:   | Data collected on the AgCert Form B (Baseline data collection).         |
| Value applied:   | See Table B2 for Baseline Activity<br>See Table B3 for Project Activity |
| Justification of the choice of data or description of measurement methods and procedures actually applied: |   |
| Comments:  |   |

|  |   |
|--|---|
| Data / Parameter:  | <b>BW kg</b>  |
| Data unit:   | <b>Kg</b>   |
| Description:   | Body weight of animals in kilograms.  |
| Source of data used:   | Obtained from 2006 IPCC, Annex 10A.2, Table 10A.7 and Table 10A-8, p. 10.80 and 10.81 |
| Value applied:   | See Table B2 for Baseline Activity<br>See Table B3 for Project Activity               |
| Justification of the choice of data or description of measurement methods and procedures actually applied: |   |
| Comments:  |   |

**B.6.3 Ex-ante calculation of emission reductions:**

Emission factors for the baseline are calculated as described in Section B.3. To estimate total yearly baseline methane emissions, the selected emission factors are multiplied by the associated animal population and summed.

**CDM – Executive Board**Table B.2. Baseline Emissions (Methane shown in metric tonnes of CO<sub>2</sub>e)

| Fazenda Esmeralda (30412)      |                            |                |         |            |            |                 | Year 1                 |  |
|--------------------------------|----------------------------|----------------|---------|------------|------------|-----------------|------------------------|--|
|                                | Population <sub>year</sub> | N <sub>m</sub> | Days OB | Default BW | Ave Bw, kg | EF <sub>i</sub> | CH <sub>4</sub> annual |  |
| Sows:                          | 496                        | 365            | 0       | 198        | 215        | 49.71           | 24,643.90              |  |
| Gilts:                         | 20                         | 365            | 0       | 198        | 112        | 25.90           | 517.91                 |  |
| Boars:                         | 3                          | 365            | 0       | 198        | 234        | 54.10           | 162.31                 |  |
| Finishers:                     | 2,309                      | 365            | 0       | 46         | 68         | 36.54           | 84,380.54              |  |
| Nur/Wean:                      | 1,151                      | 365            | 0       | 46         | 15         | 8.06            | 9,278.46               |  |
| Total Annual CH <sub>4</sub> : |                            |                |         |            |            |                 | 118,983.13             |  |
| BE (CO <sub>2</sub> e/year):   |                            |                |         |            |            |                 | 2,498.65               |  |

| Fazenda Esmeralda (30412)                   |         |         |         |         |         |         |         |          |
|---|---------|---------|---------|---------|---------|---------|---------|----------|
| Year  | 1       | 2       | 3       | 4       | 5       | 6       | 7       | Total    |
| Expected Growth %                           | 0%      | 10%     | 11%     | 12%     | 0%      | 0%      | 0%      |          |
| Baseline Emissions (CO <sub>2</sub> e/year) | 2,498.6 | 2,757.5 | 3,060.3 | 3,417.0 | 3,417.0 | 3,417.0 | 3,417.0 | 21,984.5 |

| Granja Bemvindo Miranda - Fazenda Pimenta (10965) |                            |                |         |            |            |                 | Year 1                 |  |
|---|----------------------------|----------------|---------|------------|------------|-----------------|------------------------|--|
|   | Population <sub>year</sub> | N <sub>m</sub> | Days OB | Default BW | Ave Bw, kg | EF <sub>i</sub> | CH <sub>4</sub> annual |  |
| Sows:   | 548                        | 365            | 0       | 198        | 215        | 49.71           | 27,241.27              |  |
| Gilts:  | 80                         | 365            | 0       | 198        | 112        | 25.90           | 2,071.65               |  |
| Boars:  | 15                         | 365            | 0       | 198        | 234        | 54.10           | 811.55                 |  |
| Finishers:  | 3,160                      | 365            | 0       | 46         | 68         | 36.54           | 115,479.64             |  |
| Nur/Wean:   | 1,388                      | 365            | 0       | 46         | 15         | 8.06            | 11,188.97              |  |
| Total Annual CH <sub>4</sub> :                    |                            |                |         |            |            |                 | 156,793.08             |  |
| BE (CO <sub>2</sub> e/year):                      |                            |                |         |            |            |                 | 3,292.65               |  |

| Granja Bemvindo Miranda - Fazenda Pimenta (10965) |         |         |         |         |         |         |         |          |
|---|---------|---------|---------|---------|---------|---------|---------|----------|
| Year  | 1       | 2       | 3       | 4       | 5       | 6       | 7       | Total    |
| Expected Growth %                                 | 0%      | 0%      | 0%      | 0%      | 0%      | 0%      | 0%      |          |
| Baseline Emissions (CO <sub>2</sub> e/year)       | 3,292.7 | 3,292.7 | 3,292.7 | 3,292.7 | 3,292.7 | 3,292.7 | 3,292.7 | 23,048.6 |

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| Granja Courotex Ltda (21522)                     |                                  |                      |                |                   |                   |                       | Year 1                       |                 |
|--|----------------------------------|----------------------|----------------|-------------------|-------------------|-----------------------|------------------------------|-----------------|
|  | <b>Population<sub>year</sub></b> | <b>N<sub>m</sub></b> | <b>Days OB</b> | <b>Default BW</b> | <b>Ave Bw, kg</b> | <b>EF<sub>i</sub></b> | <b>CH<sub>4</sub> annual</b> |                 |
| Sows:  | 275                              | 365                  | 0              | 198               | 215               | 50.35                 | 13,845.61                    |                 |
| Gilts:   | 19                               | 365                  | 0              | 198               | 112               | 26.23                 | 498.32                       |                 |
| Boars:   | 10                               | 365                  | 0              | 198               | 234               | 54.80                 | 547.97                       |                 |
| Finishers:                                       | 1,728                            | 365                  | 0              | 46                | 68                | 37.01                 | 63,957.96                    |                 |
| Nur/Wean:  | 781                              | 365                  | 0              | 46                | 15                | 8.16                  | 6,376.53                     |                 |
| Total Annual CH <sub>4</sub> :                   |                                  |                      |                |                   |                   |                       | 85,226.38                    |                 |
| BE (CO <sub>2</sub> e/year):                     |                                  |                      |                |                   |                   |                       | 1,789.75                     |                 |
| Granja Courotex Ltda (21522)                     |                                  |                      |                |                   |                   |                       |                              |                 |
| Year   | 1                                | 2                    | 3              | 4                 | 5                 | 6                     | 7                            | Total           |
| <b>Expected Growth %</b>                         | 0%                               | 0%                   | 0%             | 0%                | 0%                | 0%                    | 0%                           |                 |
| <b>Baseline Emissions (CO<sub>2</sub>e/year)</b> | 1,789.8                          | 1,789.8              | 1,789.8        | 1,789.8           | 1,789.8           | 1,789.8               | 1,789.8                      | <b>12,528.3</b> |

| Granja Esperanca (27512)                         |                                  |                      |                |                   |                   |                       | Year 1                       |                 |
|--|----------------------------------|----------------------|----------------|-------------------|-------------------|-----------------------|------------------------------|-----------------|
|  | <b>Population<sub>year</sub></b> | <b>N<sub>m</sub></b> | <b>Days OB</b> | <b>Default BW</b> | <b>Ave Bw, kg</b> | <b>EF<sub>i</sub></b> | <b>CH<sub>4</sub> annual</b> |                 |
| Sows:  | 233                              | 365                  | 0              | 198               | 215               | 49.71                 | 11,582.51                    |                 |
| Gilts:   | 14                               | 365                  | 0              | 198               | 112               | 25.90                 | 362.54                       |                 |
| Boars:   | 1                                | 365                  | 0              | 198               | 234               | 54.10                 | 54.10                        |                 |
| Finishers:                                       | 1,926                            | 365                  | 0              | 46                | 68                | 36.54                 | 70,384.11                    |                 |
| Nur/Wean:  | 638                              | 365                  | 0              | 46                | 15                | 8.06                  | 5,143.06                     |                 |
| Total Annual CH <sub>4</sub> :                   |                                  |                      |                |                   |                   |                       | 87,526.32                    |                 |
| BE (CO <sub>2</sub> e/year):                     |                                  |                      |                |                   |                   |                       | 1,838.05                     |                 |
| Granja Esperanca (27512)                         |                                  |                      |                |                   |                   |                       |                              |                 |
| Year   | 1                                | 2                    | 3              | 4                 | 5                 | 6                     | 7                            | Total           |
| <b>Expected Growth %</b>                         | 0%                               | 0%                   | 0%             | 0%                | 0%                | 0%                    | 0%                           |                 |
| <b>Baseline Emissions (CO<sub>2</sub>e/year)</b> | 1,838.1                          | 1,838.1              | 1,838.1        | 1,838.1           | 1,838.1           | 1,838.1               | 1,838.1                      | <b>12,866.4</b> |

Emission factors for the project activity are calculated as described in Section B.6.1. To estimate total yearly project methane emissions, the selected emission factors are multiplied by the associated animal population and summed.

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Table B.3 Project Activity Emissions (Methane shown in metric tonnes of CO<sub>2</sub>e)

| Fazenda Esmeralda (30412)                  |                            |                |         |            |            |                 | Year 1                 |  |
|--|----------------------------|----------------|---------|------------|------------|-----------------|------------------------|--|
|  | Population <sub>year</sub> | N <sub>m</sub> | Days OB | Default BW | Ave Bw, kg | EF <sub>i</sub> | CH <sub>4</sub> annual |  |
| Sows:                                      | 496                        | 365            | 0       | 198        | 215        | 6.37            | 3,159.47               |  |
| Gilts:                                     | 20                         | 365            | 0       | 198        | 112        | 3.32            | 66.40                  |  |
| Boars:                                     | 3                          | 365            | 0       | 198        | 234        | 6.94            | 20.81                  |  |
| Finishers:                                 | 2,309                      | 365            | 0       | 46         | 68         | 4.69            | 10,818.02              |  |
| Nur/Wean:                                  | 1,151                      | 365            | 0       | 46         | 15         | 1.03            | 1,189.55               |  |
| Digester CH <sub>4</sub> :                 |                            |                |         |            |            |                 | 15,254.25              |  |
| Direct Emissions (Flare) CH <sub>4</sub> : |                            |                |         |            |            |                 | 2,074.58               |  |
| Total Annual CH <sub>4</sub> :             |                            |                |         |            |            |                 | 17,328.82              |  |
| PE (CO <sub>2</sub> e/year):               |                            |                |         |            |            |                 | 363.91                 |  |

| Fazenda Esmeralda (30412)                  |       |       |       |       |       |       |       |         |
|--|-------|-------|-------|-------|-------|-------|-------|---------|
| Year                                       | 1     | 2     | 3     | 4     | 5     | 6     | 7     | Total   |
| Expected Growth %                          | 0%    | 10%   | 11%   | 12%   | 0%    | 0%    | 0%    |         |
| Project Emissions (CO <sub>2</sub> e/year) | 363.9 | 401.6 | 445.7 | 497.7 | 497.7 | 497.7 | 497.7 | 3,201.8 |

| Granja Bemvindo Miranda - Fazenda Pimenta (10965) |                            |                |         |            |            |                 | Year 1                 |  |
|---|----------------------------|----------------|---------|------------|------------|-----------------|------------------------|--|
|   | Population <sub>year</sub> | N <sub>m</sub> | Days OB | Default BW | Ave Bw, kg | EF <sub>i</sub> | CH <sub>4</sub> annual |  |
| Sows:   | 548                        | 365            | 0       | 198        | 215        | 6.37            | 3,492.47               |  |
| Gilts:  | 80                         | 365            | 0       | 198        | 112        | 3.32            | 265.60                 |  |
| Boars:  | 15                         | 365            | 0       | 198        | 234        | 6.94            | 104.04                 |  |
| Finishers:  | 3,160                      | 365            | 0       | 46         | 68         | 4.69            | 14,805.08              |  |
| Nur/Wean:   | 1,388                      | 365            | 0       | 46         | 15         | 1.03            | 1,434.48               |  |
| Digester CH <sub>4</sub> :                        |                            |                |         |            |            |                 | 20,101.68              |  |
| Direct Emissions (Flare) CH <sub>4</sub> :        |                            |                |         |            |            |                 | 2,733.83               |  |
| Total Annual CH <sub>4</sub> :                    |                            |                |         |            |            |                 | 22,835.51              |  |
| PE (CO <sub>2</sub> e/year):                      |                            |                |         |            |            |                 | 479.55                 |  |

| Granja Bemvindo Miranda - Fazenda Pimenta (10965) |       |       |       |       |       |       |       |         |
|---|-------|-------|-------|-------|-------|-------|-------|---------|
| Year  | 1     | 2     | 3     | 4     | 5     | 6     | 7     | Total   |
| Expected Growth %                                 | 0%    | 0%    | 0%    | 0%    | 0%    | 0%    | 0%    |         |
| Project Emissions (CO <sub>2</sub> e/year)        | 479.5 | 479.5 | 479.5 | 479.5 | 479.5 | 479.5 | 479.5 | 3,356.8 |



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| Granja Courotex Ltda (21522)               |                                  |                      |                |                   |                   |                       | Year 1                       |        |
|--|----------------------------------|----------------------|----------------|-------------------|-------------------|-----------------------|------------------------------|--------|
|  | <b>Population<sub>year</sub></b> | <b>N<sub>m</sub></b> | <b>Days OB</b> | <b>Default BW</b> | <b>Ave Bw, kg</b> | <b>EF<sub>i</sub></b> | <b>CH<sub>4</sub> annual</b> |        |
| Sows:                                      | 275                              | 365                  | 0              | 198               | 215               | 6.37                  | 1,752.61                     |        |
| Gilts:                                     | 19                               | 365                  | 0              | 198               | 112               | 3.32                  | 63.08                        |        |
| Boars:                                     | 10                               | 365                  | 0              | 198               | 234               | 6.94                  | 69.36                        |        |
| Finishers:                                 | 1,728                            | 365                  | 0              | 46                | 68                | 4.69                  | 8,095.94                     |        |
| Nur/Wear:                                  | 781                              | 365                  | 0              | 46                | 15                | 1.03                  | 807.16                       |        |
| Digester CH <sub>4</sub> :                 |                                  |                      |                |                   |                   |                       | 10,788.15                    |        |
| Direct Emissions (Flare) CH <sub>4</sub> : |                                  |                      |                |                   |                   |                       | 1,488.76                     |        |
| Total Annual CH <sub>4</sub> :             |                                  |                      |                |                   |                   |                       | 12,276.91                    |        |
| PE (CO <sub>2</sub> e/year):               |                                  |                      |                |                   |                   |                       |                              | 257.82 |

| Granja Courotex Ltda (21522)                    |       |       |       |       |       |       |       |                |
|---|-------|-------|-------|-------|-------|-------|-------|----------------|
| Year  | 1     | 2     | 3     | 4     | 5     | 6     | 7     | Total          |
| <b>Expected Growth %</b>                        | 0%    | 0%    | 0%    | 0%    | 0%    | 0%    | 0%    |                |
| <b>Project Emissions (CO<sub>2</sub>e/year)</b> | 257.8 | 257.8 | 257.8 | 257.8 | 257.8 | 257.8 | 257.8 | <b>1,804.7</b> |

| Granja Esperanca (27512)                   |                                  |                      |                |                   |                   |                       | Year 1                       |        |
|--|----------------------------------|----------------------|----------------|-------------------|-------------------|-----------------------|------------------------------|--------|
|  | <b>Population<sub>year</sub></b> | <b>N<sub>m</sub></b> | <b>Days OB</b> | <b>Default BW</b> | <b>Ave Bw, kg</b> | <b>EF<sub>i</sub></b> | <b>CH<sub>4</sub> annual</b> |        |
| Sows:                                      | 233                              | 365                  | 0              | 198               | 215               | 6.37                  | 1,484.94                     |        |
| Gilts:                                     | 14                               | 365                  | 0              | 198               | 112               | 3.32                  | 46.48                        |        |
| Boars:                                     | 1                                | 365                  | 0              | 198               | 234               | 6.94                  | 6.94                         |        |
| Finishers:                                 | 1,926                            | 365                  | 0              | 46                | 68                | 4.69                  | 9,023.60                     |        |
| Nur/Wear:                                  | 638                              | 365                  | 0              | 46                | 15                | 1.03                  | 659.37                       |        |
| Digester CH <sub>4</sub> :                 |                                  |                      |                |                   |                   |                       | 11,221.32                    |        |
| Direct Emissions (Flare) CH <sub>4</sub> : |                                  |                      |                |                   |                   |                       | 1,526.10                     |        |
| Total Annual CH <sub>4</sub> :             |                                  |                      |                |                   |                   |                       | 12,747.42                    |        |
| PE (CO <sub>2</sub> e/year):               |                                  |                      |                |                   |                   |                       |                              | 267.70 |

| Granja Esperanca (27512)                        |       |       |       |       |       |       |       |                |
|---|-------|-------|-------|-------|-------|-------|-------|----------------|
| Year  | 1     | 2     | 3     | 4     | 5     | 6     | 7     | Total          |
| <b>Expected Growth %</b>                        | 0%    | 0%    | 0%    | 0%    | 0%    | 0%    | 0%    |                |
| <b>Project Emissions (CO<sub>2</sub>e/year)</b> | 267.7 | 267.7 | 267.7 | 267.7 | 267.7 | 267.7 | 267.7 | <b>1,873.9</b> |

Using Equation B7 from Section B.6.1, the ex-ante baseline emissions calculated as shown in Table B.2 of this PDD will be compared to the actual monitored amount of methane captured and combusted by the project activity shown in Table B.3. The lesser of these values will be used as the project emission reductions of the crediting period.

Using the standard equipment configuration of one 2 horsepower (HP) biogas blower that operates 24 hours per day per anaerobic digester, direct emissions from the use of fossil fuels and/or electricity for the operation of the facility are considered as part of the project emissions.

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

**Table B.4. Direct Emissions**

| Source   | Est kWh consumed /<br>produced per year | Kg CO <sub>2</sub> e emitted<br>per kWh produced | Metric Tonnes<br>CO <sub>2</sub> e per year |
|--|---|--|---|
| Direct emissions from use of<br>electricity or fossil fuel | 52,259                                  | 0.2677   | 13.99                                       |

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 includes a conservative 10% discount to compensate for intrinsic digester emissions.

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

**Table B.5. Total Emission Reductions**

| <b>Table B.5. Total Emission Reductions (tonnes CO<sub>2</sub>e)</b> |   |   |  |  |
|--|---|---|--|--|
| <i>Year</i>  | Estimation of<br>project activity<br>emissions (PE) | Estimation of<br>baseline<br>emissions (BE) | Direct emissions<br>from electricity /<br>fossil fuel (DE) | Estimation of overall<br>emission reductions (ER <sub>net</sub> =<br>BE - (PE + DE)) |
| 1  | 1,369   | 9,419                                       | 14   | 8,036  |
| 2  | 1,407   | 9,678                                       | 14   | 8,257  |
| 3  | 1,451   | 9,981                                       | 14   | 8,516  |
| 4  | 1,503   | 10,337                                      | 14   | 8,821  |
| 5  | 1,503   | 10,337                                      | 14   | 8,821  |
| 6  | 1,503   | 10,337                                      | 14   | 8,821  |
| 7  | 1,503   | 10,337                                      | 14   | 8,821  |
| <b>Total (tonnes<br/>CO<sub>2</sub>e)</b>                            | 10,237  | 70,428                                      | 98   | 60,093   |

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

#### B.7.1 Data and parameters monitored:

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

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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.

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  $\pm 1$  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 Bacharach Model Fyrite (or equivalent) gas analyzer. 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  $\pm 1$  percent.

See Table B.6 for specific parameters to be monitored.

**Table B.6. Data to be monitored**

|  |   |
|--|---|
| <b>Parameter:</b>  | <b>SIR</b>  |
| Unit:  | Numeric frequency   |
| Description:   | Sludge removal count  |
| Source of data:  | Data collected on the AgCert Monthly Monitoring Form, if required.  |
| Value of data:   |   |
| Brief description of measurement methods and procedures to be applied: | Measured as required. Sludge removal will be accomplished to ensure proper disposition so there is no resulting methane emissions.  |
| QA/QC procedures to be applied (if any):                               | AgCert employs an internal QA audit process that ensures monitoring activities are conducted in accordance with the monitoring plan and verifies the accuracy of data reported. |
| Any comment:   | Data will be archived electronically and kept for the duration of the project + 2 years.  |

|  |  |
|--|--|
| <b>Parameter:</b>  | <b>BGP</b>   |
| Unit:  | Volume of m <sup>3</sup>   |
| Description:   | Biogas produced (cumulative)   |
| Source of data:  | Data collected on the AgCert Monthly Monitoring Form.  |
| Value of data:   |  |
| Brief description of measurement methods and procedures to be applied: | Measured and recorded monthly. A biogas meter will continuously measure the amount of biogas produced. |
| QA/QC procedures to  | AgCert employs an internal QA audit process that ensures monitoring                                    |

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|                      |   |
|----------------------|---|
| be applied (if any): | activities are conducted in accordance with the monitoring plan and verifies the accuracy of data reported. |
| Any comment:         | Data will be archived electronically and kept for the duration of the project + 2 years.                    |

|  |  |
|--|--|
| <b>Parameter:</b>  | <b>MC</b>  |
| Unit:  | Percentage   |
| Description:   | Methane content of biogas  |
| Source of data:  | Data collected on the AgCert Monthly Monitoring Form.  |
| Value of data:   |  |
| Brief description of measurement methods and procedures to be applied: | Measured and recorded quarterly.   |
| QA/QC procedures to be applied (if any):                               | AgCert employs an internal QA audit process that ensures monitoring activities are conducted in accordance with the monitoring plan and verifies the accuracy of data reported.                          |
| Any comment:   | Data will be archived electronically and kept for the duration of the project + 2 years.<br>If significant deviations are observed, more frequent measurements will be taken until the values stabilize. |

|  |   |
|--|---|
| <b>Parameter:</b>  | <b>CEE</b>  |
| Unit:  | Percentage (fraction of time)   |
| Description:   | Combustion equipment efficiency (fraction of time in which gas is combusted)  |
| Source of data:  | Data collected on the AgCert Equipment Maintenance Log.   |
| Value of data:   |   |
| Brief description of measurement methods and procedures to be applied: | Measured and recorded quarterly. 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. |
| QA/QC procedures to be applied (if any):                               | AgCert employs an internal QA audit process that ensures monitoring activities are conducted in accordance with the monitoring plan and verifies the accuracy of data reported.                                   |
| Any comment:   | Data will be archived electronically and kept for the duration of the project + 2 years.  |

|  |   |
|--|---|
| <b>Parameter:</b>  | <b>EFP</b>  |
| Unit:  | Percentage  |
| Description:   | Efficiency of flaring process   |
| Source of data:  | Data collected on the AgCert Equipment Maintenance Log.   |
| Value of data:   |   |
| Brief description of measurement methods and procedures to be applied: | Measured and recorded upon initial installation. Maintenance will be performed annually after installation to ensure optimal operation. |
| QA/QC procedures to be applied (if any):                               | AgCert employs an internal QA audit process that ensures monitoring activities are conducted in accordance with the monitoring plan and |

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|              |  |
|--------------|--|
|              | verifies the accuracy of data reported.  |
| Any comment: | Data will be archived electronically or on paper and kept for the duration of the project + 2 years. |

**B.7.2 Description of the monitoring plan:**

A complete set of procedures and a Monitoring Plan (see Annex 4) 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.

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.

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

The final draft of the application of the methodology was completed on 14/11/2007.

The entity determining the baseline and monitoring methodology is AgCert International plc who is the project developer as well as a project participant. Contact information is listed in Annex 1.

**SECTION C. Duration of the project activity / crediting period****C.1 Duration of the project activity:****C.1.1. Starting date of the project activity:**

The starting date for this activity is 02/05/2005.

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

The expected life of this project is 24y – 6m.

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

The project activity will use a **renewable** crediting period

**C.2.1. Renewable crediting period****C.2.1.1. Starting date of the first crediting period:**

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The starting date of the crediting period is 01/11/2007.

**C.2.1.2. Length of the first crediting period:**

The length of the crediting period is **7y-0m**.

**C.2.2. Fixed crediting period:****C.2.2.1. Starting date:****C.2.2.2. Length:****SECTION D. Environmental impacts****D.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.

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

No action required.

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

Stakeholders meetings for this project activity were held in Sao Paulo, Sao Paulo on September 05, 2005; Belo Horizonte, Minas Gerais on December 7, 2005; Belo Horizonte, Minas Gerais on July 7, 2005; and Salvador, Bahia on November 22, 2005..

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AgCert invited stakeholders to the meetings to explain the UNFCCC CDM process and proposed project activity, presided over by AgCert Representatives David Vanni Jacob in Sao Paulo, Sao Paulo; Paulo Guilherme Furtado in Belo Horizonte, Minas Gerais; and Paulo Guilherme Furtado in Salvador, Bahia. 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:

1. *Jornal Estada, Suplem. Agrícola, August 31, 2005*
2. *O Comércio, Capa do Jornal, September 3, 2005*
3. *Sudoeste Paulista, Florestal, September 3, 2005*
4. *Estado de Minas, Agropecuário, July 4, 2005*
5. *A Tarde, Salvador, Bahia, November 17, 2005*
6. *Jornal Gazeta de Alagoas, Estado, AL, November 17, 2005 Caderno – Economia - Diário*
7. *Jornal Tribuna do Norte, Natal, RN, November 17, 2005*
8. *Diário do Nordeste, Fortaleza, CE, November 17, 2005 Caderno - Economia*
9. *Folha de Pernambuco, Recife, PE, November 17, 2005 Caderno - Economia*

A slide presentation was given, in Portuguese, and attendees were afforded the opportunity to ask questions and provide comments. The presentation which covered the following topics: purpose of meeting, background on global warming and the Kyoto Protocol, UNFCCC CDM process, process and responsibilities of the project, participants, equipment to be used for evaluation and audits, information management system, an example of project, benefits from the project (environmental and economic), and where to get further information. 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.

|   |
|---|
| <b>E.2. Summary of the comments received:</b> |
|---|

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.

|   |
|---|
| <b>E.3. Report on how due account was taken of any comments received:</b> |
|---|

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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.



**CDM – Executive Board****Annex 1****CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

| <b>Project Participant and Developer:</b> |  |
|---|--|
| Organization:                             | Agcert do Brasil Soluções Ambientais Ltda.         |
| Street/P.O. Box:                          | Rua James Joule, 92, 14th andar                    |
| Building:                                 |  |
| City:                                     | Cidade Monções                                     |
| State/Region:                             | São Paulo  |
| Postfix/ZIP:                              | 04576-080  |
| Country:                                  | Brasil   |
| Telephone:                                | +55 11 2127.0450                                   |
| FAX:                                      | +55 11 2127.0550                                   |
| E-Mail:                                   |  |
| URL:                                      | <a href="http://www.Agcert.com">www.Agcert.com</a> |
| Represented by:                           | David Lawrence                                     |
| Title:                                    | Project Coordinator                                |
| Salutation:                               |  |
| Last Name:                                | Lawrence   |
| Middle Name:                              |  |
| First Name:                               | David  |
| Department:                               |  |
| Mobile:                                   | +55 11 8412 3206                                   |
| Direct FAX:                               |  |
| Direct tel:                               |  |
| Personal E-Mail:                          | dlawrence@agcert.com                               |

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**Annex 2**

**INFORMATION REGARDING PUBLIC FUNDING**

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

**CDM – Executive Board****Annex 3****BASELINE INFORMATION**

|                           | Month/Yr | Animal Type |      |      |       |       |
|---------------------------|----------|-------------|------|------|-------|-------|
|                           |          | Sow         | Gilt | Boar | Fin   | Nurs  |
| Fazenda Esmeralda (30412) | Jan-06   | 519         | 21   | 3    | 2,467 | 1,346 |
|                           | Feb-06   | 498         | 21   | 3    | 2,357 | 1,241 |
|                           | Mar-06   | 502         | 18   | 3    | 2,566 | 1,171 |
|                           | Apr-06   | 482         | 20   | 3    | 2,429 | 1,325 |
|                           | May-06   | 475         | 21   | 3    | 2,256 | 1,186 |
|                           | Jun-06   | 466         | 25   | 3    | 2,261 | 1,180 |
|                           | Jul-06   | 493         | 32   | 3    | 2,063 | 1,140 |
|                           | Aug-06   | 517         | 29   | 3    | 2,220 | 1,079 |
|                           | Sep-06   | 498         | 17   | 3    | 2,191 | 1,004 |
|                           | Oct-06   | 502         | 13   | 3    | 2,360 | 1,038 |
|                           | Nov-06   | 504         | 14   | 3    | 2,335 | 1,120 |
|                           | Dec-06   | 493         | 9    | 3    | 2,199 | 978   |
|                           |          |             |      |      |       |       |

|   | Month/Yr | Animal Type |      |      |       |       |
|---|----------|-------------|------|------|-------|-------|
|   |          | Sow         | Gilt | Boar | Fin   | Nurs  |
| Granja Bemvindo Miranda - Fazenda Pimenta (10965) | Mar-06   | 547         | 58   | 16   | 2,927 | 1,328 |
|   | Apr-06   | 549         | 60   | 13   | 2,902 | 1,453 |
|   | May-06   | 542         | 67   | 17   | 3,056 | 1,231 |
|   | Jun-06   | 539         | 68   | 17   | 2,972 | 1,587 |
|   | Jul-06   | 539         | 83   | 17   | 3,146 | 1,225 |
|   | Aug-06   | 536         | 83   | 16   | 2,746 | 1,662 |
|   | Sep-06   | 544         | 75   | 14   | 3,011 | 1,630 |
|   | Oct-06   | 544         | 72   | 14   | 3,343 | 1,321 |
|   | Nov-06   | 548         | 75   | 14   | 3,246 | 1,363 |
|   | Dec-06   | 564         | 109  | 14   | 3,088 | 1,366 |
|   | Jan-07   | 559         | 101  | 14   | 3,668 | 1,007 |
|   | Feb-07   | 567         | 109  | 14   | 3,811 | 1,480 |
|   |          |             |      |      |       |       |

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|                                    | Month/Yr | Animal Type |      |      |       |      |
|------------------------------------|----------|-------------|------|------|-------|------|
|                                    |          | Sow         | Gilt | Boar | Fin   | Nurs |
| Granja<br>Courotex Ltda<br>(21522) | Aug-04   | 279         | 11   | 10   | 1,747 | 796  |
|                                    | Sep-04   | 289         | 28   | 11   | 1,831 | 807  |
|                                    | Oct-04   | 281         | 25   | 11   | 1,981 | 799  |
|                                    | Nov-04   | 275         | 18   | 11   | 1,510 | 799  |
|                                    | Dec-04   | 271         | 8    | 11   | 1,369 | 733  |
|                                    | Jan-05   | 266         | 4    | 11   | 1,426 | 859  |
|                                    | Feb-05   | 269         | 13   | 10   | 1,932 | 535  |
|                                    | Mar-05   | 258         | 9    | 10   | 1,830 | 772  |
|                                    | Apr-05   | 256         | 6    | 10   | 1,819 | 828  |
|                                    | May-05   | 287         | 42   | 10   | 1,787 | 781  |
|                                    | Jun-05   | 285         | 40   | 10   | 1,768 | 856  |
|                                    | Jul-05   | 283         | 24   | 10   | 1,738 | 809  |
|                                    |          |             |      |      |       |      |

|                                | Month/Yr | Animal Type |      |      |       |      |
|--------------------------------|----------|-------------|------|------|-------|------|
|                                |          | Sow         | Gilt | Boar | Fin   | Nurs |
| Granja<br>Esperanca<br>(27512) | Oct-04   | 199         | 33   | 1    | 1,097 | 458  |
|                                | Nov-04   | 210         | 15   | 1    | 1,397 | 464  |
|                                | Dec-04   | 222         | 0    | 1    | 1,350 | 521  |
|                                | Jan-05   | 232         | 8    | 1    | 1,634 | 481  |
|                                | Feb-05   | 231         | 1    | 1    | 1,945 | 621  |
|                                | Mar-05   | 230         | 5    | 1    | 2,296 | 696  |
|                                | Apr-05   | 231         | 12   | 1    | 2,432 | 738  |
|                                | May-05   | 233         | 21   | 1    | 2,158 | 791  |
|                                | Jun-05   | 239         | 21   | 1    | 2,209 | 698  |
|                                | Jul-05   | 244         | 25   | 1    | 2,093 | 722  |
|                                | Aug-05   | 254         | 17   | 1    | 2,190 | 752  |
|                                | Sep-05   | 265         | 14   | 1    | 2,314 | 717  |
|                                |          |             |      |      |       |      |

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**Annex 4****MONITORING INFORMATION****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., Ver 11 Methane Recovery.  
[http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF\\_AM\\_LM875Z64MVHWOE3JVL4BG\\_GIC4SRUBE](http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_LM875Z64MVHWOE3JVL4BG_GIC4SRUBE)
- 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](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

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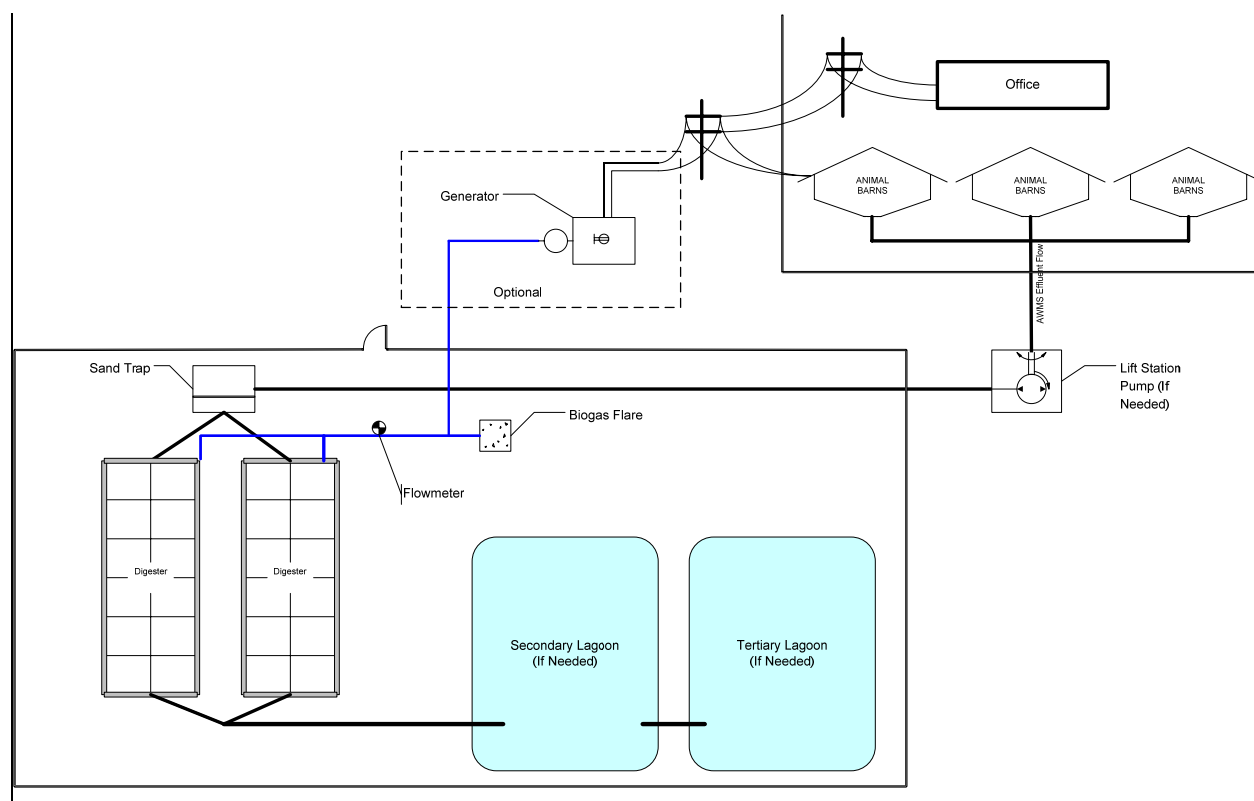
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- P025, Control of Monitoring & Measurement Devices
- I025-1, Equipment Calibration & Verification
- P039, Competence, Training, and Awareness
- I031-2F11, Form B – Swine – IPCC (en)
- I031-2F13, Form B – IPCC – MX (sp)
- I031-2F16, Form B – Dairy – IPCC (en), (sp), (pt)
- I036-9, Bio-security and Safety
- Operations Manual Gas 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

**CDM – Executive Board****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.

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### 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



## CDM – Executive Board

### 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 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.

### 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.



**Figure 2. Roots biogas flowmeter**

### 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

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## CDM – Executive Board

### 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.).

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**CDM – Executive Board****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.).

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**CDM – Executive Board**
**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.

**CDM – Executive Board****MONITORING ACTIVITIES**

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 (SIR)                     | ✓                  |           | ✓       |                     |           | RMT          | Ensures proper disposition of sludge   |
| 2  | Biogas Produced (BGP)                    | ✓                  |           | ✓       |                     | ✓         | FH, RMT      | QA/QC  |
| 3  | Methane Content (MC)                     | ✓                  |           | ✓       |                     | ✓         | RMT          | If significant deviations are observed, more frequent measurements will be taken until the values stabilize.   |
| 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;<br>AgCert: RMT – Regional Maintenance Technician, QA – Quality Assurance; OP – Operations, EN - Engineer |  |                    |           |         |                     |           |              |  |

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**CDM – Executive Board****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 digester and ensures the sludge is disposed of properly.

**References**

- AgCert Preventive Maintenance Instruction GM001, Biodigester 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

**CDM – Executive Board**Process

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

Record Control

| 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., Ver 11 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

## CDM – Executive Board

### 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 MLB 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;<br>AgCert: RMT – Regional Monitoring Technician, QA – Quality Assurance; OP – Operations, EN – Engineer |          |   |                                   |                            |

### Record 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 3, Methane Content

### 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., Ver 11 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



**CDM – Executive Board**

- 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 and continue to measure on a monthly basis until the readings stabilize. |
| 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 to MLB operations  | Fax, Electronic, etc              | Enter into EnviroCert   |
| 10   | QA       | Perform Quality Control Check for format, integrity, etc.                      |                                   |   |
| 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

Record Control

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

## CDM – Executive Board

### 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., Ver 11 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

- None

#### 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 MLB 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;<br>AgCert: RMT – Regional Maintenance Technician; QA – Quality Assurance; OP – Operations, EN - Engineer |          |   |                                   |                            |

#### Record Control

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

## CDM – Executive Board

### Work Instruction for monitoring ID 5, Flare Efficiency

#### Summary

This parameter guarantees the correct performance of digester and gas recovery.

#### References

- Approved monitoring methodology: AMS-III.D., Ver 11 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

**CDM – Executive Board**

| 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;<br>AgCert: RMT – Regional Monitoring Technician, QA – Quality Assurance; OP – Operations, EN - Engineer |          |                                       |                                       |          |

Record Control

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