AWMS METHANE RECOVERY PROJECT MX07-S-22, DURANGO, MÉXICO

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

AgCert

DOCUMENT ID: MX07-S-22
VER 1, 18 JUN 07

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

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• 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.
04	18 May 2007	• III.D/Version 12; Incorporated Sectoral Scope 15

SECTION A. General description of small-scale project activity

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

AWMS Methane Recovery Project MX07-S-22, DURANGO, México, Ver 1, 18 June 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_4) and nitrous oxide (N_2O) 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 a dairy cattle operation located in Durango, México. 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: Establishing a positive model for livestock operations is essential. In the years 1993 to 2004, Mexican dairy cattle population grew by approximately 37%. In 2004, the dairy cattle inventory in México was 2,234,246.[1] Producers in Durango make up approximately 12% of that inventory.

Dairy cattle produce about 195 lbs of raw manure per day.[2] The proper handling of this large quantity of animal waste is critical to protecting human health and the environment. Because of the practices employed by farmers, the design, location, and management practices of livestock operations are critical components in ensuring an adequate level of protection of human health and the environment.[3]

Solid separators are currently used on some dairy farms to separate high-cellulose bedding material from flushed (liquid) manure. These separators are typically placed to extract the bedding material from the liquid manure before it enters the anaerobic lagoon. Many Mexican government agencies have issued directives to farms to collect as much manure as possible and dispose of it in anaerobic lagoons. To

---

[1] http://www.siea.sagarpa.gob.mx/ar_compec_pobgan.html

[2] Weida, William J. "A Citizens Guide to the Regional Economic and Environmental Effects of Large Concentrated Dairy Operations," GRACE Factory Farm Project November, 19, 2000, Table II-2

[3] 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.

comply with these directives, dairy farms are now scraping manure from areas where there are no facilities for removal by flushing mechanisms. Some farms have installed mixing basins (called "carcamos" in Spanish) to mix scraped manure with the liquid manure from flushing. On such sites, all manure mixed in this manner can flow through the solid separator.

This methane recovery project activity will upgrade livestock operations infrastructure. The infrastructure improvement is in direct alignment with Mexico's national goals and objectives for agriculture, livestock, rural development, fishing and nutrition as outlined in the Mexican government's *Plan Nacional de Desarrollo, 2001 –2006* (National Development Plan, 2001 -2006).[4]

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 México, 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 Mexican government's 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.

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

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
México (host)	• AgCert International plc • AgCert México Servicios Ambientales, S. de R.L. de C.V.	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):

[4] http://www.sagarpa.gob.mx/Dgg/sectorial.htm

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

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

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

A.4.1.3. City/Town/Community etc:

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

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 Figure A1 and listed in Table A1.

Rancho Lucero SPR de RL owns 3 dairy cattle operation(s) in, Durango, Mexico:

- Paralelo (31852) had approximately 9,051 animals on site between July 2005 and June 2006. Containment areas include 11 corrals with paved feed lanes, 1 milking room, and 1 holding area. From these areas, manure is removed by tractor or scraper. It is then routed to the site's AWMS, which consists of 1 primary open lagoon. The lagoon is approximately 5.5m (depth) x 40m (diameter). Effluent is disposed of from the lagoon through the surface irrigation and surface spread method. Construction of the proposed anaerobic digester is expected to be complete by August 1, 2007. The digester will be shared with Carrusel 99 (31872) and Carrusel 60 (31882).

  Carrusel 99 (31872) had approximately 4,599 animals on site between July 2005 and June 2006. Containment areas include 3 corrals with paved feed lanes, 1 milking parlor, and 1 holding area. From these areas, manure is removed by tractor and scraper for 3 areas, and flush for the other 2 areas. It is then routed to the site's AWMS, which consists of 1 primary open lagoon. The lagoon is approximately 5.2m (depth) x 40m (diameter). Effluent is disposed of from the lagoon through the surface irrigation method. Construction of the proposed anaerobic digester is expected to be complete by August 1, 2007. The digester will be shared by sites Paralelo (31852) and Carrusel 60 (31882).

  Carrusel 60 (31882) had approximately 3,496 animals on site between July 2005 and June 2006. Containment areas include 5 corrals with paved feed lanes, 1 holding area, and 1 milking parlor. From these areas, manure is removed by tractor and scraper for 5 areas, and an automatic scraper is used for the other 2 areas. It is then routed to the site's AWMS, which consists of 1 primary open lagoon. The lagoon is approximately 5.2m (depth) x 40m (diameter). Effluent is disposed of from the lagoon through the surface and subsurface irrigation method. Construction of the proposed anaerobic digester is expected to be complete by August 1, 2007. The digester will be shared by sites Paralelo (31852) and Carrusel 99 (31872).

Figure A1. Project Activity Sites in Durango, México

Table A1. Detailed physical location and identification of project sites

Farm/Site Name	AgCert ID	Address	Town / State	Contact	Phone	GPS Coord
Rancho Lucero SPR de RL	Main Office	Londres 210 Col. San Isidro	Torreón, Coahuila	Felipe López Negrete Mirra	(52) 871-717-6614	N/A
Paralelo	31852	Carretera Gregorio García Tlahualilo Km 16	Municipio Gómez Palacio, Durango	Gabriel Romero	(52) 871-723-8705	25°54'22.02"N103°22'31.83"W
Carrusel 99	31872	Carretera Gregorio García Tlahualilo km 16	Gómez Palacio, Durango	Gabriel Romero	(52) 871-723-8705	25°54'21.82"N103°22'31.69"W
Carrusel 60	31882	Carretera Gregorio García Tlahualilo km 16	Gómez Palacio, Durango	Gabriel Romero	(52) 871-723-8705	25°54'47.17"N103°22'13.09"W

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 Type III, Other Project Activities, Category III.D./Ver. 12, Methane recovery in agricultural and agro-industrial activities.

The project activity will capture and combust methane gas produced from the decomposing manure of dairy cattle farms located in Durango, México.

The AWMS is comprised of a lined, covered lagoon and an automated flare system to capture and combust the biogas. Processed effluent from the digester(s) is routed, as needed, to a secondary and tertiary lagoon system. Special maintenance procedures are followed to ensure proper handling and disposition of the digester sludge. The digester design permits solids residue removal without breaking the gas retention seal. The captured biogas is routed to a highly efficient combustion system to destroy the methane gas produced.

The covered lagoon creates an anaerobic digester with sufficient capacity and Hydraulic Retention Time (HRT) to greatly reduce the volatile solids loading in the effluent. The lagoon is lined and covered by a synthetic high density polyethylene (HDPE) geomembrane. The liner is secured to the cover by an anchor trench around the lagoon perimeter. HDPE is well suited for this use as it the most commonly used geomembrane in the world and is UV, ozone, and chemical resistant.

The flaring combustion system includes a flow meter and automated flare to ensure all biogas from the digester is combusted. An inline pressure control device within the gas handling system maintains proper biogas flow to the combustion system. An ignition system, continuously sparking approximately every 3 seconds, ensures methane combustion whenever biogas is present at the flare; two (2) sparking electrodes provide operational redundancy. If biogas is not present, the igniter sparks harmlessly. The ignition system is powered by a robust solar module (solar-charged battery system) operating independently from the electrical power grid. With a fully charged battery, the module will provide igniter power for up to two weeks without sunlight. Functionality of the component parts are verified on a periodic basis in accordance with manufacturer and other technical specifications.

Technology and know-how transfer:

AgCert, as 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, staff training, ongoing monitoring (by the project developer) and developing/implementing a complete Monitoring Plan. 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 and technically feasible.

By working so closely with the facility staff on an ongoing 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 staff over many years, the project developer will ensure that the staff acquires appropriate expertise and resources to operate the system on an ongoing/continuous basis.

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

ESTIMATED AMOUNT OF EMISSION REDUCTIONS OVER THE 10 YEAR CREDITING PERIOD

A.4.3 - Estimated Emission Reductions over chosen Crediting Period	
Years	**Annual estimation of emission reductions in tonnes of CO_2e**
Year 1	53,869
Year 2	53,869
Year 3	53,869
Year 4	53,869
Year 5	53,869
Year 6	53,869
Year 7	53,869
Year 8	53,869
Year 9	53,869
Year 10	53,869
Total estimated reductions (tonnes CO_2e)	538,687
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	53,869

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[5], 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.

[5]http://cdm.unfccc.int/Projects/pac/howto/SmallScalePA/sscdebund.pdf

SECTION B. Application of a baseline and monitoring methodology

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

The project activity is applicable to Type III, Other Project Activities, Category III.D./Ver. 12, Methane recovery in agricultural and agro-industrial activities. The project is a small scale because project emission reductions will not exceed 60 kt CO_2eq per year.

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 dairy cattle farms located in Durango, México. This simplified baseline methodology is applicable to this project activity because without the proposed project activity, methane from the existing agro-industry AWMS would continue to be emitted into the atmosphere. The proposed project activity will change the current animal waste management practice to one that uses an anaerobic digestion system equipped with a methane recovery and combustion system. Based on historical animal inventories, baseline estimates and GHG emissions calculations estimated using internationally accepted IPCC guidance, the estimated emission reductions of the project activity will not exceed 60 kt CO_2e in any year of the crediting period as shown in Section A.4.3.

B.3. Description of the project boundary:

A typical project boundary is shown in Figure B1. The proposed project boundary is the physical geographical site of the methane recovery facility (project activity).

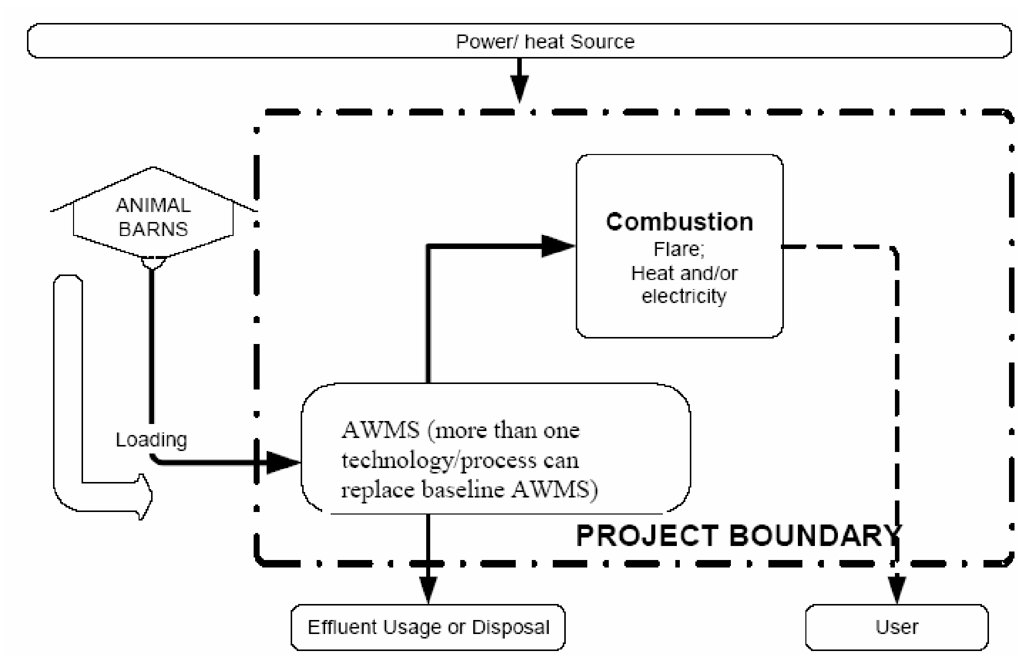

Figure B1. Typical Project Boundary

B.4. Description of baseline and its development:

The baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter are left to decay anaerobically within the project boundary and methane is emitted to the atmosphere. Baseline emissions (BE_y) are calculated ex ante using the amount of the waste or raw material that would decay anaerobically in the absence of the project activity, Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories III.D. Methane recovery in agricultural and agro industrial activities with the most recent IPCC tier 2 approach (please refer to the chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories).

In this case, an open lagoon is considered the baseline and estimated emissions are determined as shown in the following steps:

Step 1 – Livestock Population

Animal populations for the project activity sites are provided 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:

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

Equation B1[6]

Where:

EFi	=	Emission factor (kg) for animal type i (e.g., dairy cows, weight adjusted)
VSi	=	Volatile solids excreted in kg/day for animal type i, default volatile solids value in Section B.6.2, Table B.2 (adjusted as $Vs = (W_{site}/W_{default}{}^{7})*VS_{IPCC}$)
n_m	=	Number of days animals present
B_{oi}	=	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
$MS\%_{ijk}$.	=	Fraction of animal type i's manure handled using manure system j in climate region k

Step 3 – Total Baseline Emissions

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

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

[6] 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Page 10.41, equation 10.23 and Page 10.77, Table 10A-4.

[7] Obtained from 2006 IPCC, Table 10A-4, page 10.77

Equation B2[8]

Where:

CH_{4a}	=	Methane produced in kg/yr for animal type i
EF_i	=	Emission factor (kg) for animal type i (e.g., dairy cows)
$Population_{year}$	=	Yearly average population of animal type i

The carbon dioxide equivalent is calculated as follows:

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

Equation B3[9]

Where:

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

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 regulatory requirements that govern GHG emissions from agro-industry operations (specifically, dairy production activities) as outlined in this PDD. However, the regional governments of several states do have recommendations that producers use open lagoons for manure management systems in order to maintain and improve the prevention, control and eradication of illness among the animals, with an emphasis on those that affect public health:

The Durango state government has also released a statement through its Secretary of Agriculture, Cattle and Rural Development saying:

> "… *(the government) recommends that farms take the necessary actions for the control and treatment of the waste produced by the development of dairy cattle through the construction and operation of anaerobic lagoons, as these systems avoid, as much as possible, the inconvenient impacts to the environment.*"
>
> -Dr. José de Jesús Muñoz Ramos, Secretario de Agricultura, Ganadería y Desarollo Rural en el Estado (Durango)

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

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

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 the recommended open air anaerobic lagoon. The following paragraphs discuss the Mexican dairy 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 costs involved in the investment compared to other available systems.

   Mexican dairy producers face the same economic challenges as farmers in other nations due to increased worldwide production and low operating margins. Farm owners focus on the bottom line. Odour benefits, potential water quality enhancements, and the incremental savings associated with heating cost avoidance, are rarely enough to compel farmers to upgrade to an (expensive) advanced AWMS system.[10] Unless the AWMS upgrade activity affords the producer the means to (partially) offset the practice change cost (via the sale of Certified Emission Reduction (CER) credits, for instance) the open lagoon will remain the common AWMS practice *– and all AWMS GHG biogas will continue to be emitted*.

   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.

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 if not all methane from the manure. These systems become progressively more expensive on a 'per animal' basis as farm animal population (i.e., farm size) is decreased. Moreover, operations and maintenance requirements involved with this technology, including a detailed monitoring program to maintain system performance levels, must also be considered.

c) *Barriers due to prevailing practice*: The implementation of this project activity by these farms highly exceeds current Mexican regulations for dairy waste treatment. Apart from existing legislation in México that establishes water quality parameters that require that water supplies be protected from contamination and recommendations that producers use open lagoons to collect and process all manure produced on site, there is no legislation in place that requires specific dairy manure treatment as it relates to the emission of GHG.

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*: Due to the *significant* investments required, there is no future expectation the Mexican legislation will require digesters use or will pass any legislation which deals with the GHG emissions. Indeed, the developer is aware of no Latin American or other worldwide location requiring either the use of digesters or the constraints of agricultural GHG emissions. Qualitatively, this is the most likely "risk" area associated with possible changes in the baseline scenario. Overarching environmental regulations have to balance creating a legislative framework that enables agricultural production against social pressures to make industrialized

[10] DiPietre, Dennis, PhD, Agricultural Economist, (18 June 2003) Private communication

livestock operations "good neighbours." México has successfully grown this sector, building upon low operating costs and technically expert labour.

b) *Common practice*: While past practices cannot predict future events, it is worth noting that sites included in this project activity have been in existence for many years using open lagoons. Local agriculture officials/inspectors confirmed, at the stakeholders' meeting(s), that open lagoons are the prevailing AWMS practice.

The anaerobic lagoon systems are economically feasible, reliable, effective, and satisfy regulatory and social requirements. Because of this, there is no reason to expect any changes to these conditions 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 Volume 4, Chapter 10 of the 2006 IPCC Guidelines for National GHG Inventories.

The project emissions for this project activity consist of CO_2 emissions from use of fossil fuels or electricity for the operation of the facility. In this case an anaerobic digester is considered the project activity and estimated emissions are determined in the following steps:

Step 1 – Emissions Factors

$$PE_y = PE_{y,ff} + PE_{y,elec}$$

Where:

PE_y	=	Project CO2e emissions from use of fossil fuels or electricity for operation of the facility, metric tonnes CO2e per year
$PE_{y,ff}$	=	Project CO2e emissions from use of fossil fuels for operation of the facility, metric tonnes CO2e per year
$PE_{y,elec}$	=	Project CO2e emissions from use of electricity for operation of the facility, metric tonnes CO2e per year

Step 2 – Project Activity Emissions

According to the methodology, a project emission consists of CO_2 emissions from the use of fossil fuels and/or electricity for the operation of the facility. For dairy farms in Mexico, a standard equipment configuration is shown in Table B1.

Table B1, Equipment configuration for dairy site

Equipment	Total HP Rating	kW equivalent	Hours in operation per day	kWh per day consumption	# days in operation per year	kWh consumption per year
Digester mixer (s)	10	7.46	24	178.97	365	65,323
Manure heating recirculation pump	10	7.46	24	178.97	365	65,323
Boiler/heat exchanger recirculation pump	3	2.24	24	53.69	365	19,597
Blower	1	0.75	24	17.90	365	6,532
					Total:	**156,776**

HP to kWh conversion = HP x hours per day x days a year (365) x 0.7457[11]

As such, the electrical consumption per year per anaerobic digester for a dairy farm in Mexico is approximately 287,423 kWh/yr. To convert this number into metric tonnes of CO_2e per year, the following formulae is applied:

kWh to CO_2e conversion = (kwh (287,423) x country specific emission factor (0.531)[12]*) / 1000*

Therefore, for each anaerobic digester, approximately 152.62 metric tonnes of CO_2e 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 include a conservative 10% discount to compensate for intrinsic digester emissions

Step 3 - Estimated Emission Reductions Ex-ante

The emission reduction achieved by the project activity can be estimated ex-ante as follows:

$$ER_{y,estimated} = BE_y - PE_y - Leakage$$

Equation 13[13]

Where:

$ER_{y,estimated}$ Calculated emission reductions, metric tonnes CO_2e per year

BE_y Baseline carbon dioxide equivalent emission, metric tonnes CO_2e per year

PE_y CO_2 emissions from use of fossil fuels or electricity for the operation of the facility, metric tonnes CO_2e per year

Leakage Leakage emissions, metric tonnes CO_2e per year

Actual (during Crediting Period)

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

[11] .7457 is the standard scientific conversion factor from horsepower (HP) to Kilowatt Hours (kWh) based on Ohm's Law

[12] 0.531kg CO_2 / kwh. Obtained from registered CDM project 0646: Methane Recovery and Electricity Generation Project GCM 9.

[13] http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_J1AKSDH7M0OX0NEW8IH2CBSVW7ZV3E

$$ER_{y,calculated} = MD_y - PE_y - Leakage$$

Equation 13[14]

Where:

$ER_{y,calculated}$	Calculated emission reductions, tonnes CO_{2e} year^{-1}
MD_y	Methane captured and destroyed by the project activity in the year "y", tonnes CO_{2e}
PE_y	CO_2 emissions from use of fossil fuels or electricity for the operation of the facility
Leakage	Leakage emissions

The actual methane captured and destroyed by the project activity is measured and monitored using the conditions of the flaring process as follows:

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

Equation 13[15]

Where:

MD_y	Methane captured and destroyed by the project activity in the year "y", tonnes CO_{2e}
$BG_{burnt,y}$	Biogas[16] flared or used as fuel in the year "y" (m^3)
$w_{CH4,y}$	Methane content in biogas in the year "y", tonnes CO_{2e}
$D_{CH4,y}$	Density of methane at the temperature and pressure of the biogas in the year "y" (tonnes/m^3)
FE	Flare efficiency in the year "y" (fraction)
GWP_{CH4}	Methane global warming potential (21)

Leakage

In accordance with the baseline methodology, no leakage calculations are required.

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

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 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.2. details data and parameters available at the time of validation.

[14] http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_J1AKSDH7M0OX0NEW8IH2CBSVW7ZV3E

[15] http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_J1AKSDH7M0OX0NEW8IH2CBSVW7ZV3E

[16] Biogas and methane content measurement shall be on the same basis (wet or dry)

Table B.2. Data / Parameter Values and References

Data / Parameter:	**GWP CH_4**
Data unit:	
Description:	Global Warming Potential of Methane
Source of data used:	Intergovernmental Panel on Climate Change, *Climate Change 1995: The Science of Climate Change* (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:	**$Population_{year}$**
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:	**n_m**
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 B3
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Comments:	

Data / Parameter:	**$MS\%_{ijk}$**
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:	**VS_i**

Data unit:	Kg/day
Description:	Volatile solids excreted for animal type
Source of data used:	Obtained from 2006 IPCC, Annex 10A.2, Table 10A-4, p. 10.77 Obtained from 1996 IPCC, Appendix B, Table B-1, p.4.39
Value applied:	5.4 (Lactating cows) 3.47 (Dry cows) 2.86 (Heifers) 1.87 (Calves) 3.78 (Bulls)
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Comments:	

Data / Parameter:	$\mathbf{B_{oi}}$
Data unit:	m^3/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-4 and 10A-5, p. 10.77 and 10.78
Value applied:	.24 (Lactating) .19 (Dry cows) .19 (Heifers) .19 (Calves) .19 (Bulls)
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Comments:	

Data / Parameter:	$\mathbf{MCF_{jk}}$
Data unit:	
Description:	Methane conversion factor for each manure management system
Source of data used:	Obtained from 2006 IPCC, Table 10.17, p. 10.45
Value applied:	Refer to 2006 IPCC, Table 10.17, p. 10.45
Justification of the choice of data or description of measurement methods and procedures actually applied:	
Comments:	

Data / Parameter:	**Days OB**
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 B3
Justification of the choice of	

data or description of measurement methods and procedures actually applied:	
Comments:	

Data / Parameter:	**BW kg**
Data unit:	Kg
Description:	Body weight of animals in kilograms.
Source of data used:	Obtained from 2006 IPCC, Annex 10A.2, Table 10A.2, p. 10.72 and 10.73
Value applied:	See Table B3
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.4. To estimate total yearly baseline methane emissions, the selected emission factors are multiplied by the associated animal population and summed.

Table B.3. Baseline Emissions (Methane shown in metric tonnes of CO_2e)

Baseline										
	$Population_{year}$	N_m	Days OB	Default VSi	Default BW	Ave BW, kg	EF_i	CH_4 annual		Category:
Cows - Lactating:	9688	365	0	5.4000	600	635	264.99	2,567,180.26	<------------------------	Dairy cattle
Cows - Dry:	0	365	0	3.4700	500	600	152.85	0.00	<------------------------	Non-dairy cattle
Heifers:	0	365	0	2.8600	375	375	104.98	0.00	<------------------------	Non-dairy cattle
Calves:	0	365	0	1.8700	185	185	68.64	0.00	<------------------------	Non-dairy cattle
Bulls:	0	365	0	3.7800	800	800	138.75	0.00	<------------------------	Non-dairy cattle
			Total Annual CH_4:					2,567,180.26		
						BE (CO_2e/year):			53,910.79	

Paralelo (31852), Carrusel 99 (31872), Carrusel 60 (31882)											
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	
Baseline Emissions (CO2e/year)	53,910.8	53,910.8	53,910.8	53,910.8	53,910.8	53,910.8	53,910.8	53,910.8	53,910.8	53,910.8	**539,107.9**

Emission factors for the project activity are calculated as described in Section B.6.1.

Table B.4. Project Activity Emissions (Methane shown in metric tonnes of CO_2e)

Project										
	$Population_{year}$	N_m	Days OB	Default VSi	Default BW	Ave BW	EF_i	CH_4 annual		Category:
Cows - Lactating:	9688	365	0	5.4	600	635	0.00	0.00	<------------------------	Dairy cattle
Cows - Dry:	0	365	0	3.47	500	600	0.00	0.00	<------------------------	Non-dairy cattle
Heifers:	0	365	0	2.86	375	375	0.00	0.00	<------------------------	Non-dairy cattle
Calves:	0	365	0	1.87	185	185	0.00	0.00	<------------------------	Non-dairy cattle
Bulls:	0	365	0	3.78	800	800	0.00	0.00	<------------------------	Non-dairy cattle
			Digester CH_4:					0.00		
			Total Annual CH_4:					0.00		
							PE (CO_2e/year):		42.04	

Paralelo (31852), Carrusel 99 (31872), Carrusel 60 (31882)											
Year	1	2	3	4	5	6	7	8	9	10	**Total**
Expected Growth %	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	
Project Emissions (CO2e/year)	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	42.0	**420.4**

Emission reductions achieved by the project activity in each year will be assessed ex-post through direct measurement of the amount of methane fuelled or flared. The maximal emission reduction in any year is limited to the yearly methane generation potential calculated in the project design document for that year.

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

Table B.6. Total Emission Reductions

Table B.6. Total Emission Reductions (tonnes CO2e)				
Year	Estimation of project activity emissions (PE)	Estimation of baseline emissions (BE)	Estimation of Leakage	Estimation of overall emission reductions ($ER_{y,estimated}$)
1	42	53,911	0	**53,869**
2	42	53,911	0	**53,869**
3	42	53,911	0	**53,869**
4	42	53,911	0	**53,869**
5	42	53,911	0	**53,869**
6	42	53,911	0	**53,869**
7	42	53,911	0	**53,869**
8	42	53,911	0	**53,869**
9	42	53,911	0	**53,869**
10	42	53,911	0	**53,869**
Total (tonnes CO_2e)	420	539,108	0	**538,687**

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 implementation. Sophisticated tools have also been created to estimate/monitor the creation of high quality, permanent ERs using accepted UNFCCC methodologies.

By coupling these capabilities with an ISO-based quality and environmental management system, AgCert enables transparent data collection and verification. 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. All data will be archived electronically and kept for the duration of the project + 2 years.

Flow metering devices used are designed to continuously and accurately measure biogas flow and accumulate a running total. The wetted parts of the metering devices were designed to withstand corrosive environments, such as biogas. Meters are received from the factory fully-calibrated and retain calibration for the service life of the unit, making meter accuracy permanent. Accuracy is not affected by low or varying line pressures. The flow meters retain calibration within 1% of full scale for the service life of the unit. Periodic maintenance will be performed based on manufacturer specifications. Other equipment calibrations are accomplished using procedures developed by AgCert as part of the Monitoring Plan (Annex 4).

The automated flaring combustion system is designed as specified in Section A.4.2. Manufacturer specifications state the acceptable range of biogas flow is from 1 m^3/hour to 170 m^3/hour. In addition, the manufacturer states that at a combustion temperature greater than 200^o Celsius, the flare's methane destruction efficiency is equal to or greater than 90%. Flow rate and temperature will be monitored as specified in Table B.5 to ensure compliance with the manufacturer specifications.

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%.

See Table B.7 for specific parameters to be monitored.

Table B.7. Data to be monitored

Parameter:	**Sludge end use**
Unit:	
Description:	End use of final sludge generated
Source of data:	Data collected on the AgCert Monthly Monitoring Form.
Value of data:	
Brief description of measurement methods and procedures to be applied:	Proper soil application of the final sludge is defined as not resulting in methane emission. This will be measured and recorded as it occurs.
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.

Parameter:	$\mathbf{BG_{burnt,y}}$
Unit:	m^3
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 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.

Parameter:	**$w_{CH4,y}$**
Unit:	Percentage
Description:	Methane content in biogas
Source of data:	Gas analyzer
Value of data:	
Brief description of measurement methods and procedures to be applied:	Measured and recorded monthly. Methane concentration is determined with CO_2 content measurement and is obtained with a gas analyzer. A range of ± 10% points is sufficient to determine uncertainties. For example, the nominal percentage of CH_4 in biogas is approximately 65%. Readings between 55% and 75% indicate proper operation of the digester. Measuring equipment is calibrated in accordance with the manufacturer specifications.
QA/QC procedures to be applied (if any):	
Any comment:	

Parameter:	**FE**
Unit:	Percentage
Description:	Efficiency of flaring process
Source of data:	Data collected on the AgCert Equipment Maintenance Log.
Value of data:	0.90
Brief description of measurement methods and procedures to be applied:	Measured and recorded upon initial installation. Initial flare efficiency testing will be performed by trained personnel using calibrated equipment and a third-party verified test protocol. For enclosed flares, as per the methodology, a continuous check of compliance with the manufacturers' specification of the flare device (temperature, biogas flow rate) will be done. If in any specific hour any of the parameters is out of the range of specifications, 50% of the default value will be used for this specific hour. For open flares, 50% of the default value will be used since it is not possible to monitor flare efficiency. If at any given time the temperature of the flare is below 500^{o}C, 0% default value will be used for this period.
QA/QC procedures to be applied (if any):	
Any comment:	See the parameters listed under "Flaring Tool Required Parameters" which allow the 0.90 value to be used..

Parameter:	**$Temperature_{flare}$**

Unit:	Degrees Celsius
Description:	Temperature in the exhaust gas of the flare
Source of data:	Data collected on the AgCert Monitoring Form.
Value of data:	
Brief description of measurement methods and procedures to be applied:	Measured and recorded continuously. Temperature of the exhaust gas stream is measured by a Type N thermocouple. A temperature above 500^0C indicates that a significant amount of gases are still being burnt and that the flare is operating.
QA/QC procedures to be applied (if any):	Thermocouples should be replaced or calibrated annually.
Any comment:	Data will be archived electronically or on paper and kept for the duration of the project + 2 years.

Parameter:	**$Pressure_{biogas}$**
Unit:	Kg/cm^2
Description:	Pressure of biogas produced
Source of data:	Data collected on the AgCert Monitoring Form.
Value of data:	
Brief description of measurement methods and procedures to be applied:	Measured and recorded periodically
QA/QC procedures to be applied (if any):	
Any comment:	

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 06/15/2007.

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 06/16/2006.

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

The expected life of this project is 12y – 2m.

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

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

C.2.1. Renewable crediting period

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

C.2.1.2. Length of the first crediting period:

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

The starting date of the crediting period is 09/01/2007.

C.2.2.2. Length:

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

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:

AgCert invited stakeholders to meetings to explain the UNFCCC CDM process and proposed project activity. These meetings were held on February 10, 2006 in Torreon, COAHUILA, México.

AgCert issued invitations to government officials at the federal, state, and local levels. Furthermore, AgCert published announcements of the meetings in the newspaper, which cover Durango.

These public announcements appeared in:

1. ***EL SIGLO DE TORREON, Torreon*, Coahuila** on February 5, 2006

All invitations were in the Spanish language. The meeting was attended by project participants and farm representatives. A full list of attendees and the meeting minutes are available on request.

Alejandro Velarde of AgCert México gave a presentation, which covered the following topics: purpose of the 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.

AgCert has also participated as a speaker and described in detail this project in the Mexican government sponsored CDM workshops being presented throughout México.

E.2. Summary of the comments received:

After the presentations, attendees were afforded the opportunity to ask questions regarding the proposed project activities.

Overall, the comments from the attendees at the stakeholders’ meeting were positive and supportive of the project.

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

No action required.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Project Participant:	
Organization:	AgCert México Servicios Ambientales, S. de R.L. de C.V.
Street/P.O. Box:	Homero 1804-1405
Building:	Col. Chapultepec Morales
City:	México City
State/Region:	D.F.
Postfix/ZIP:	11570
Country:	México
Telephone:	
FAX:	
E-Mail:	
URL:	www.agcert.com
Represented by:	
Title:	
Salutation:	Mr.
Last Name:	Calenda
Middle Name:	
First Name:	Tony
Department:	Regulatory
Mobile:	
Direct FAX:	+1 (780) 423.2368
Direct tel:	+1 (321) 409.7848
Personal E-Mail:	regulatory@agcert.com
Project Developer and Participant:	
Organization:	AgCert International plc
Street/P.O. Box:	Blackthorn Road Sandyford
Building:	Apex Building
City:	Dublin 18
State/Region:	
Postfix/ZIP:	18
Country:	Ireland
Telephone:	
FAX:	
E-Mail:	
URL:	www.agcert.com
Represented by:	
Title:	CDM/JI Program Manager
Salutation:	Mr.
Last Name:	Perkowski
Middle Name:	S.
First Name:	Leo
Department:	Regulatory
Mobile:	+1 (321) 432.3081
Direct FAX:	+353 (0) 1 245-7450
Direct tel:	+353 (0) 1 245-7400
Personal E-Mail:	lperkowski@agcert.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

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

Annex 3

BASELINE INFORMATION

	Month/Yr	Animal Type				
		Lactating Cow	Dry Cow	Heifer	Calf	Bull
Paralelo (31852)	Jul-05	2,132	184	4,620	1,830	0
	Aug-05	2,105	233	4,695	1,830	0
	Sep-05	1,998	261	4,706	1,830	0
	Oct-05	1,962	308	4,720	1,830	0
	Nov-05	1,963	313	4,736	1,830	0
	Dec-05	1,884	414	4,892	1,830	0
	Jan-06	2,032	444	4,850	1,830	0
	Feb-06	2,071	454	4,856	1,830	0
	Mar-06	2,115	420	4,862	1,830	0
	Apr-06	2,118	435	4,879	1,830	0
	May-06	2,120	440	4,985	1,830	0
	Jun-06	2,119	437	4,890	1,830	0

	Month/Yr	Animal Type				
		Lactating Cow	Dry Cow	Heifer	Calf	Bull
Carrusel 99 (31872)	Jul-05	4,299	0	0	0	0
	Aug-05	4,429	0	0	0	0
	Sep-05	4,608	0	0	0	0
	Oct-05	4,642	0	0	0	0
	Nov-05	4,640	0	0	0	0
	Dec-05	4,638	0	0	0	0
	Jan-06	4,643	0	0	0	0
	Feb-06	4,655	0	0	0	0
	Mar-06	4,648	0	0	0	0
	Apr-06	4,659	0	0	0	0
	May-06	4,661	0	0	0	0
	Jun-06	4,661	0	0	0	0

		Animal Type				
	Month/Yr	Lactating Cow	Dry Cow	Heifer	Calf	Bull
Carrusel 60 (31882)	Jul-05	3,119	251	0	0	0
	Aug-05	3,105	249	0	0	0
	Sep-05	3,089	336	0	0	0
	Oct-05	3,088	392	0	0	0
	Nov-05	2,903	449	0	0	0
	Dec-05	2,945	534	0	0	0
	Jan-06	2,803	449	0	0	0
	Feb-06	2,760	534	0	0	0
	Mar-06	2,973	558	0	0	0
	Apr-06	2,854	521	0	0	0
	May-06	3,320	657	0	0	0
	Jun-06	3,500	565	0	0	0

Annex 4

MONITORING PLAN

Monitoring:

The calculation of emission reductions will be based on the amount of methane recovered and flared (monitored ex-post). In addition, the project emissions and leakage, if applicable, will be deducted from the emission reductions calculated from the methane recovered and combusted.

Project emissions are determined by multiplying the methane flow rate in the biogas with the flare efficiency. Flare efficiency is defined as the fraction of time in which the gas is combusted in the flare multiplied by the efficiency of the flaring process.

The monitoring methodology involves monitoring of the following parameters after project implementation.

For determination of project emissions:

- Methane (CH_4) recovered, fuelled or flared will be monitored using in-line flow meters.
- The fraction of methane in the gas will be measured periodically using a CO_2 gas analyzer.
- Temperature and pressure will be measured periodically to determine the density of methane combusted.
- The end-use (not resulting in methane emissions) of final sludge exiting the biodigester will be monitored to ensure proper disposition (soil application).
- Flare parameters are monitored as specified in the "Tool to determine project emissions from flaring gases containing methane (EB28, Annex 13)"[17]

For determination of flare efficiency:

- Flaring efficiency for open flares will be the 50% default value specified in the flaring tool since efficiency of open flares cannot be monitored.
    - If at any time the flare is not operational, a flare efficiency default value of 0% will be used for that time period.
- Flaring efficiency for the enclosed flare will be determined by using option (a) specified in the flaring tool. To use the 90% default value, continuous monitoring of compliance with manufacturer's specification of the flare (temperature and biogas flow rate) will be performed. To accomplish this, a thermocouple will be installed on the flare and will work in conjunction with the continuous flow meter.
    - If at any time the parameters are out of range of manufacturer specifications, a 50% default value will be used for that time period.
    - If at any time the flare is not operational, a flare efficiency default value of 0% will be used for that time period. Not operational is defined as any one of the following:
        - The flare is not burning.
        - There is no record of the temperature of the exhaust gas of the flare.
        - The recorded temperature of the exhaust gas of the flare is less than 500^{o}C.

[17] http://cdm.unfccc.int/EB/028/eb28_repan13.pdf