For the attention of Mr. José Domingos Miguez, Chair of the Executive Board
UNFCCC
Project Based Mechanisms
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Submission on AM0006 Methodology revision related to Animal Waste Management Systems.

Dear Members of the Executive Board,

According to the final agreements made from the 24th Meeting Executive Board, the Board considered the recommendation from the Meth Panel and requested it to continue the review of AM0006 in light of the observations by the Board members for the purpose of consolidation. According to this decision, the Board has invited to send submissions for the revision of AM0006. Poch Ambiental S.A. kindly requests the EB to consider the following submission.

Poch Ambiental is an environmental consultancy company committed in managing and evaluating Clean Development Mechanism (CDM) projects, and delivering technological and managing solutions for environmental concerns. Along with Agrosuper, we had the responsibility to develop the approved CDM baseline methodology AM0006, and also the opportunity of being involved in several feasibility studies and Project Design Documents (PDD's) for CDM project activities. These documents have been posted for public comment on the main official home page of the United Nations Framework Convention of Climate Change (UNFCCC) in http://cdm.unfccc.int/.

As former developers of AM0006, we would like to explain through this document our present point of view of the merits and defects of this methodology.

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1. STRENGTHS

AM0006 is a methodology capable of representing the baseline or project scenario upon any potential manure management chain. Any feasible CDM project activity should be represented based on justified data representative to each type of waste management technology as a component of the whole manure management system. A complete set of possible manure management systems are listed in the 1996 Revised IPCC Guidelines (Chapter 4, Table 4.8) and in the IPCC Good Practice Guidance and Uncertainty Management (Chapter 4, Table 4.10 and 4.11). In drawing up a list of possible scenarios, combinations of different Animal Waste Management Systems (AWMS) should be taken into account.

Another consideration that should be kept in mind as an advantage of AM0006 is that it preserves the compliance with the required environmental legislation for the baseline and the project scenario, as an explicit applicability condition.

Also the additionality concept and the baseline scenario identification are quite appropriate tools of the original version of AM0006 methodology, and are still up to date with the accomplishment of these concepts. These subjects will be considered as sufficiently achieved by AM0006, so they will not be modified.

2. WEAKNESS AND ADDITIONAL ASPECTS THAT SHOULD BE INCLUDED

Even though AM0006 is rather a flexible baseline methodology with its virtues, we consider that it can be upgraded by implementing the following additional components and remarks. This upgrade hopes to filter and separate those CDM project activities that achieve measurable and reliable emission reductions from those project that are not sustainable enough.

2.1 Regarding baseline definition

In order to reassure that any anaerobic lagoon defined as the potential baseline scenario is strictly anaerobic, every following consideration should be requested as main design characteristics:

- A total height of the lagoons not less than 2.5 m (Zhang, 2001), and
- A monthly average temperature in anaerobic lagoons greater than 10ºC. Any period with a monthly temperature less than 10ºC should not be considered in the emission reduction calculation, assuming that there isn't enough anaerobic activity, and
- The total retention time of the lagoons for the baseline scenario must be at least of 50 days (Zhang, 2001), and
- The lagoon's volume of treatment must be designed in accordance to a range of volatile solids loading rate, according to the national and technical requirements, including ambient temperature. For example, a loading rate of 0.05 to 0.11

kgSV/m^3/day (USDA, 1996)[1]. Every additional component of the baseline's general design must be clearly and transparently presented as part of the economic evaluation.

The validator should have access to the lagoon's main design properties that explain the baseline scenario's economic evaluation and its anaerobic potential.

Because the baseline scenario is represented from a theoretical view, these considerations should be taken as the main properties for the lagoon's design.
These concerns should do not have to be interpreted as a restriction for any other waste management systems, for being the baseline scenario.

2.2 Weighted average of animal weights

It is common and feasible to compromise farms that include a diverse mixture of raise stages in confinement. The original version of AM0006 considers the monitoring of a representative average weight for the stock of animals, but does not assume that these can include different raise stages. In order to clarify this concern, the proposed monitoring plan of this document considers monitoring sock and average weight of animals for each type of raise stage. Afterwards, the total stock and the weighted average of animal weights are calculated as follows:

$$TS_m = \Sigma S_{r,m}$$

Where:

TS_m: Total stock of animals in the farm, in the month m
$S_{r,m}$: Total stock of animals for the raise stage r, in the month m

$$WA_m = \Sigma (S_{r,m} * W_{r,m})/ \Sigma S_{r,m}$$

Where:

WA_m: Weighted average of animals weight in the farm, in the month m
$W_{r,m}$: Average weight for the raise stage r, in the month m

2.3 Quantification of effective operation days for AWMS

AM0006 lacks of a variable to represent the effective days of operation for the project activity. In order to consider this variable as a relevant parameter in the monitoring plan and in the emission reduction calculation, equations (1), (3), (6), (8), (10) and (11) must be arranged in AM0006, as shown:

[1] Lagoons are sized based on organic loading rate or retention time. These are related to the temperature of the lagoons, which in turn are decided by the local climatic conditions. The allowable organic loading rate is higher for the lagoons located in warmer climates. According to the current engineering design standard published by American Society of Agricultural Engineers (ASAE) and the design method published by USDA-NRCS, the organic loading rate of lagoons is the amount of volatile solids loaded per unit of lagoon treatment volume per day. Loading rate should be reduced approximately 50% where (a) odors must be minimized and (b) in mountainous areas. 2. Loading rate may be increased approximately 50% for dairy and beef cattle waste when the solids have been removed.

Original equation (1)

$$E_{CH4,mm,1,y}=GWP_{CH4}*MCF_1*D_{CH4}*\mathbf{365}*\Sigma\ VS_{population}*B_{o,\ population}*N_{population}/1000$$

New equation (1)

$$E_{CH4,mm,1,y}=GWP_{CH4}*MCF_1*D_{CH4}*\mathbf{D_{1,y}}*\Sigma\ VS_{population}*B_{o,\ population}*N_{population}/1000$$

Where

$D_{1,y}$: Effective operation days of the first stage of manure treatment in the project scenario, during year y.

The same modification to equation (1) must be done to equation (6).

Original equation (3)

$$E_{CH4,mm,i,y}=0.25*GWP_{CH4}*MCF_i*\mathbf{365}*F_{i,y}*BOD_{lt,i,y}/10^6$$

New equation (3)

$$E_{CH4,mm,i,y}=0.25*GWP_{CH4}*MCF_i*\mathbf{D_{i,y}}*F_{i,y}*BOD_{lt,i,y}/10^6$$

Where

$D_{i,y}$: Effective operation days of stage i of manure treatment in the project scenario, during year y.

Fi,y : Is the average daily manure flow to the treatment stage i, in m^3.

Original equation (8)

$$E_{N20,mm,i,y}=GWP_{N20}*EF_{N2O,mm,i}*CF_{N2O\text{-}N,N}*\Sigma NEX_{population}*\mathbf{365}*N_{population}/1000$$

New equation (8)

$$E_{N20,mm,i,y}=GWP_{N20}*EF_{N2O,mm,i}*CF_{N2O\text{-}N,N}*\Sigma NEX_{population}*\mathbf{D_{i,y}}*N_{population}/1000$$

Where

$NEX_{population}$ Is daily average nitrogen excretion per animal of the defined livestock population in kg N/animal/day.

$D_{i,y}$: Effective operation days of stage i of manure treatment in the project scenario, during year y.

Original equation (10)

$$E_{N20,mm,i,y}=GWP_{N20}*EF_{N2O,mm,i}*N_{i,y}*\mathbf{365}*F_{i,y}$$

New equation (10)

$$E_{N20,mm,i,y}=GWP_{N20}*EF_{N2O,mm,i}*N_{i,y}*\mathbf{D_{i,y}}*F_{i,y}$$

Where

$D_{i,y}$: Effective operation days of stage i of manure treatment in the project scenario, during year y.

Fi,y : Is the average daily manure flow to the treatment stage i, in m^3.

The same modification to equation (10) must be done to equation (11).

2.4 Regarding the use of IPCC default values

IPCC values where created in order to develop national inventories for greenhouse emissions. Although they do not comply with representing particular cases, they are useful references in order to quantify emissions for each scenario of animal waste management system. The parameters recommended as references from AM0006 are Bo (maximum methane generation potential), VS (volatile solids on raw manure) whenever this value cannot be monitored, and MCF (methane conversion factor) for each particular component in the manure management chain. Each of these parameters is analyzed in order to assure their reliability.

2.4.1. Bo (volume of methane per mass unit of volatile solids):

This parameter represents the physicochemical state of volatile solids in manure, for it should not depend on the type of country or the common manure management system. Bo depends on animal species, ration, manure age, storage conditions and biodegradability. Bo should not depend on the country were the waste is generated. If there is any representative monitored data available for the type of waste considered, project proponent should include it in the calculations. In other case, IPCC default values provided from the 1996 Revised IPCC Guidelines can be used. These values are differentiated for each type of country (developed, developing), although it has been mentioned that Bo does not depend on the country were the waste exists. Project proponents can use appropriate IPCC default values for developed countries, only if the following conditions are met:

- The genetic source of the production operations livestock originate from developed country genetic roots for high production standards.
- The project specific average animal weights are more similar to developed country IPCC default values.
- Diets in the project are similar to diets in developed countries. Farm use formulated feed rations (FFR) are optimized to maximize production and minimize costs for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics, or
- Architecture and structural characteristics of the barns should be in accordance with developed country’s design standard, in order to guarantee that IPCC default values are representative.
- Productivity parameters in order to evidence that they fit in the range of developed countries standard. For example, for swine consider a referential productivity range of 8.5 to 10 animals per litter (USDA, 2006).

The validator should have access to the background supporting these conditions.

2.4.2. Volatile solids as a function of feed intake

In AM0006, methane emissions from each stage of treatment are quantified by monitoring organic matter content or with the use of a corrected default value of volatile solids. We recommend adding an additional alternative to represent this parameter. This can also be represented based on the animal's diet, monitoring the energetic content of the feed, alimentation yield and its moisture. The following equation can represent volatile solids content of raw manure:

Equation 15 of the IPCC Guidelines Reference Manual
VS_{dm} (kg dm/day) = Intake (MJ/day) • (1 kg/ 18.45 MJ) • (1 - DE%/100) • (1 - ASH%/100)

Where:

VS_{dm} = VS excretion per day on a dry weight basis;

dm = dry matter;

Intake = the estimated daily average feed intake in MJ/day;

DE% = the digestibility of the feed in per cent;

ASH% = the ash content of the manure in per cent.

Site specific information of diet characteristics is preferable for the use of this equation, although project proponents may complete unknown feed variables with IPCC default values for developed countries (presented in Table B-1 and B-2 of Appendix B in IPCC Guidelines Reference Manual) if the following conditions are met:

- The genetic source of the production operations livestock originate from developed country genetic roots for high production standards.
- The project specific average animal weights are more similar to developed country IPCC default values.
- Diets in the project are similar to diets in developed countries. Farm use formulated feed rations (FFR) are optimized to maximize production and minimize costs for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics.
- Architecture and structural characteristics of the barns should be in accordance with developed country's design standard, in order to guarantee that IPCC default values are representative.
- Productivity parameters in order to evidence that they fit in the range of developed countries standard. For example, for swine consider a referential productivity range of 8.5 to 10 animals per litter (USDA, 2006).

The validator should have access to the background supporting these conditions.

The use of this alternative to represent volatile solids does not consider a weight correction.

2.4.3. Volatile solids from corrected IPCC default values.

It has been reminded that AM0006 considers the use of corrected IPCC default values, although it is not explained any clear criteria for their use. We recommend a conservative approach, choosing the lowest corrected IPCC default value of volatile solids calculated.

Equation 2 of AM0006 explains the way to correct these default values:

$$VS_{site} = \left(\frac{W_{site}}{W_{default}} \right) \cdot VS_{default}$$

where:

VS_{site} Is the adjusted volatile solid excretion per day on a dry-matter basis for a defined livestock population at the project site in kg-dm/animal/day.
w_{site} Is the average animal weight of a defined population at the project site in kg. This example considers a site specific average weight of 72 kg.
$w_{default}$ Is the default average animal weight of a defined population in kg.
$VS_{default}$ Is the default value (IPCC or US-EPA) for the volatile solid excretion per day on a drymatter basis for a defined livestock population in kg-dm/animal/day.

The following table represents an example with the different IPCC referential default values for volatile solids rate in swine and their respective corrected value (using equation 2 of AM0006):

Region	**Livestock Category**	**Mass (kg)**	**Volatile Solids (kg/h/day)**	**Site specific average weight (kg)**	**Corrected Volatile solids rate (kg/h/day)**
Developing Countries	Swine	28	0.34	72	0.87
Developed Countries	Swine	82	0.50	72	0.44

From this table it can be seen that in developing countries, animals are assumed to gain less weight and contain a larger amount of volatile solids per mass of animal in their excretes, in comparison to developed country livestock. This seems to be reasonable because productivity in more developed operations should have the purpose of maximizing animal weight as a function of feed rations.

Using these last results as example, it should be considered 0.44 kg/h/day as the conservative corrected IPCC default value, to use as part of the final methane estimation.

None of the volatile solids calculation procedures presented in this document as alternatives to the original version of AM0006, has more priority, for each project proponent must choose the criteria for volatile solids estimation that best fits to its context and boundary.

2.4.4. MCF (Methane Conversion Factor)

This parameter represents the conversion factors of CH_4, for each manure management system and its context. This parameter quantifies the amount from the maximum methane generation potential that would be liberated from each type of waste management component. It is a function of the depth or height of the waste treatment system and the temperature. It also varies depending if it's a dry or liquid management of manure. In the original version of AM0006, the MCF was referenced from the 1996 Revised IPCC Guidelines and the IPCC Good Practice Guidance and Uncertainty Management. Both of these documents have proved to be useful references for national inventories development. Although AM0006 covers a wide scope of technologies and management systems, it is not as precise and representative for different particular climatic contexts. The Methane Conversion Factor is an emission factor that is a function of the manure's temperature, but this is not conservatively covered in AM0006. AM0016 proposes using the Van't Hoff.-Arrhenius formulae that calculates available volatile solids variability for each month, as a function of the temperature and the volatiles solids consumption from the previous month, considering the load in the lagoon. The original Van't Hofff.-Arrhenius methodology for MCF estimation does not consider any correction factor for uncertainty or variability in the lagoon's load. This should be kept in mind in order to be representative (see http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/LHOD5MJTB4/$File/2003-final-inventory_annex_m.pdf). The applicability requirements for the baseline definition to any anaerobic lagoon have been improved as detailed in 2.1 of this document, for these have the purpose of guaranteeing appropriate anaerobic conditions and make the Van't Hofff-Arrhenius formulae representative. It must be considered that this representation of the MCF is only applicable to anaerobic lagoons. Other type of lagoons are not anaerobic or not anaerobic enough to be represented by this relation.

The following equations are used as part of the Van't Hofff-Arrhenius formulae:

$$MCF_{t,annual} = \frac{\sum_{m=1}^{12} CH_{4,m}}{B_o * \sum_{m=1}^{12} VS_m}$$

$$CH_{4,m} = B_0 * VS_m * f_{t,monthly}$$

$$f_{t,monthly} = \exp\left[\frac{E * (T_2 - T_1)}{R * T_1 * T_2}\right]$$

where

$CH_{4,m}$ estimated monthly methane production
B_0 is the maximum methane producing potential of organic waste
VS_m monthly volatile solids available for degradation.
$f_{t,monthly}$ Monthly conversion efficiency of VS to CH_4 due to temperature. Months were the average temperature is less than 10 ° C, $f_{t,monthly} = 0$. The value of $f_{t,monthly}$ cannot exceed unity.
E Activation energy constant (15,175 cal/mol).
T_2 Ambient temperature (Kelvin) for the climate.

T_1 303.16 = (273.16° + 30°).
R Ideal gas constant (1.987 cal/ K mol).

The $f_{t,monthly}$ is calculated as follows:

(1) The monthly average temperature for the area is obtained from published national weather service information.
(2) Monthly temperatures are used to calculate a monthly 'f_t' factor above. A minimum temperature of 10° C is used.
(3) Estimate monthly production of volatile solids (VS_m) added to the system, with the use of default values if appropriate.
(4) The amount of volatile solids available for conversion to methane is assumed to be equal to the amount of volatile solids produced during the month (from step 3). The amount of volatile solids available also includes volatile solids that may remain in the system from previous months.
(5) The amount of volatile solids consumed during the month is equal to the amount available for consumption multiplied by the 'f_t' factor.
(6) For anaerobic lagoons, the amount of volatile solids carried over from one month to the next equals to the amount available for conversion minus the amount consumed and minus the amount removed from the lagoon. In the case of the emptying of the lagoon, the accumulation of volatile solids restarts with the next inflow. For partial removal (e.g., dewatering for irrigation) the volatile solid carryover should be reduced by an amount that is proportional to the partial fraction (of the lagoon's storage capacity or 'HRT') that is removed.
(7) The estimated amount of methane generated ($CH_{4,m}$) during the month is equal to the monthly volatile solids consumed multiplied by the maximum methane potential (B_0).

Project proponent has to monitor the time period when the lagoon is cleaned. Carry on calculations are limited to a maximum of one year. In case the residence time is less than one year carry-on calculations are limited to this period where the sludge resides in the lagoon. Project participants should provide evidence of the residence time of the wastewater in the lagoon. Residence time of the lagoon and design temperature of the climate should be shown and presented to the validator, as part of the fundaments for the economic evaluation needed for the baseline definition from AM0006.

2.4.5. Fraction of volatile solids degraded and nitrogen content removal in AWMS treatment

AM0006 provides a comprehensive reference to estimate the potential volatile solids and nitrogen content removal from each waste management component. The reference is from EPA CAFO documents, and can be found on the link (http://epa.gov/ost/guide/cafo/devdoc.html). This reference does not cover every technology available, for the project proponent must deliver to the validator reliable data to justify an appropriate value for the technology's performance. The latter is also applicable when the reference gives a range of performance and not a unique value.
Although AM0006 is wide enough to include as potential baseline or project scenarios, any management systems listed in the 1996 Revised IPCC Guidelines (Chapter 4, Table 4.8) and the IPCC Good Practice Guidance and Uncertainty Management (Chapter 4, Table 4.10 and 4.11), new manure management systems are always appearing. For this

reason we recommend to consider any technology whatsoever for manure management as a potential baseline or project scenario, restricted to detailed design conditions for the studied context.

2.5 Regarding nitrous oxide emissions from irrigation.

Although the final version of AM0006 did not include nitrous oxide emissions for irrigation after the manure management chain, its original predecessor (NM0022) did consider this source of emissions in the baseline and the project scenario. These are composed upon nitrous oxide emissions from infiltration and run-off. There are no relevant methane emissions from this source, for irrigation will not be considered an appropriate anaerobic context for methanogenic bacteria and the degradation of inflow residual organic matter of waste.

Activated sludge technology is capable of mitigating most of the nitrous oxide emissions from the last manure management stage and for the irrigation stage, because it transforms and removes the nitrogen content in the treated manure. This emission reduction source should be included, in order to value aerobic technology as a way of mitigating nitrous oxide emissions from irrigation activities.

We do not agree in interpreting these emissions as a source “outside the project boundary”. Because the complete manure management chain ends where the manure is finally deposited, and due to the effects of any advanced technology or manure management upgrade in the final effluent, irrigation will be part of the boundary of the project. This can also be justified because irrigation costs are part of the components that should be included in the economic evaluation for baseline identification.

The following equations are appropriate to estimate this emission component.

$$E_y = (E_{P,N2O} - E_{B,N2O})$$

Where

$E_{P,N2O}$ Are the N_2O emissions released during project activity from land application of the treated waste water, in tCO_2e/year.
$E_{B,N2O}$ Are the N_2O emissions released during baseline scenario from land application of the treated waste water, in tCO_2e/year.

N_2O emissions should be estimated as follows, for baseline and project scenario:

$$E_{N2O} = GWP_{N2O} * 1/1000 * (E_{N2O,land} + E_{N2O,runoff})$$

Whenever there are no values of monitored nitrogen concentration, the following equations should be used (Option B from AM0006):

$$E_{N2O,land} = EF_1 * (1-F_{GASM}) * (1-R_N) \Sigma NEX_{LT} * N_{LT} * CF_{N20-N,N}$$

$$E_{N2O,runoff} = EF_5 * (1-F_{GASM}) * F_{leach} * (1-R_N) \Sigma NEX_{LT} * N_{LT} * CF_{N20-N,N}$$

where,

$E_{N2O,land}$ Direct nitrous oxide emission from application of manure waste, in Kg N_2O-N/year.

$E_{N2O,runoff}$ Nitrous oxide emission due to leaching and run-off, in Kg N_2O-N/year.
F_{gasm} Fraction of animal manure N that volatizes as NH_3 and NO_X in kg NH_3-N and NO_X-N per kg of N, use IPCC default as per Table 4.19 of IPCC 1996 Revised Inventory reference book.
N_{LT} Number of animals of type LT in stock for the whole year y
NEX_{LT} Average annual N excretion per head per animal category LT in kg - N/animal-year.
EF_1 Emission factor for direct emission of N_2O from soils in Kg N_2O-N/kg N, use IPCC defaults.
EF_5 Emission factor for indirect emission of N_2O from runoff in Kg N_2O-N/kg N, use IPCC defaults as per Table 4.24 of IPCC 1996 Revised Inventory reference book.
F_{leach} Fraction of N that is leached or is in runoff. Use IPCC default as per Table 4.24 of IPCC 1996 Revised Inventory reference book.
$CF_{N20-N,N}$ Conversion factor (= 44/28).
$R_{N,n}$ Fraction of NEX in manure waste that is reduced in the AWMS scenario. The relative reduction of nitrogen depends on the treatment technology and should be estimated in a conservative manner.

EF_1 and EF_5 should be estimated with site-specific, regional or national data if such data is available. Otherwise, default values from Table 4.17 and Table 4.18, respectively, of the IPCC GPG 2000 may be used.

Whenever there are values of monitored nitrogen concentrations available, the following equations should be used (Option A from AM0006):

$$E_{N2O,land} = EF_1 * (1-F_{GASM}) * \Sigma N_{DM} * Q_{DM} * CF_{N20-N,N} /1000$$

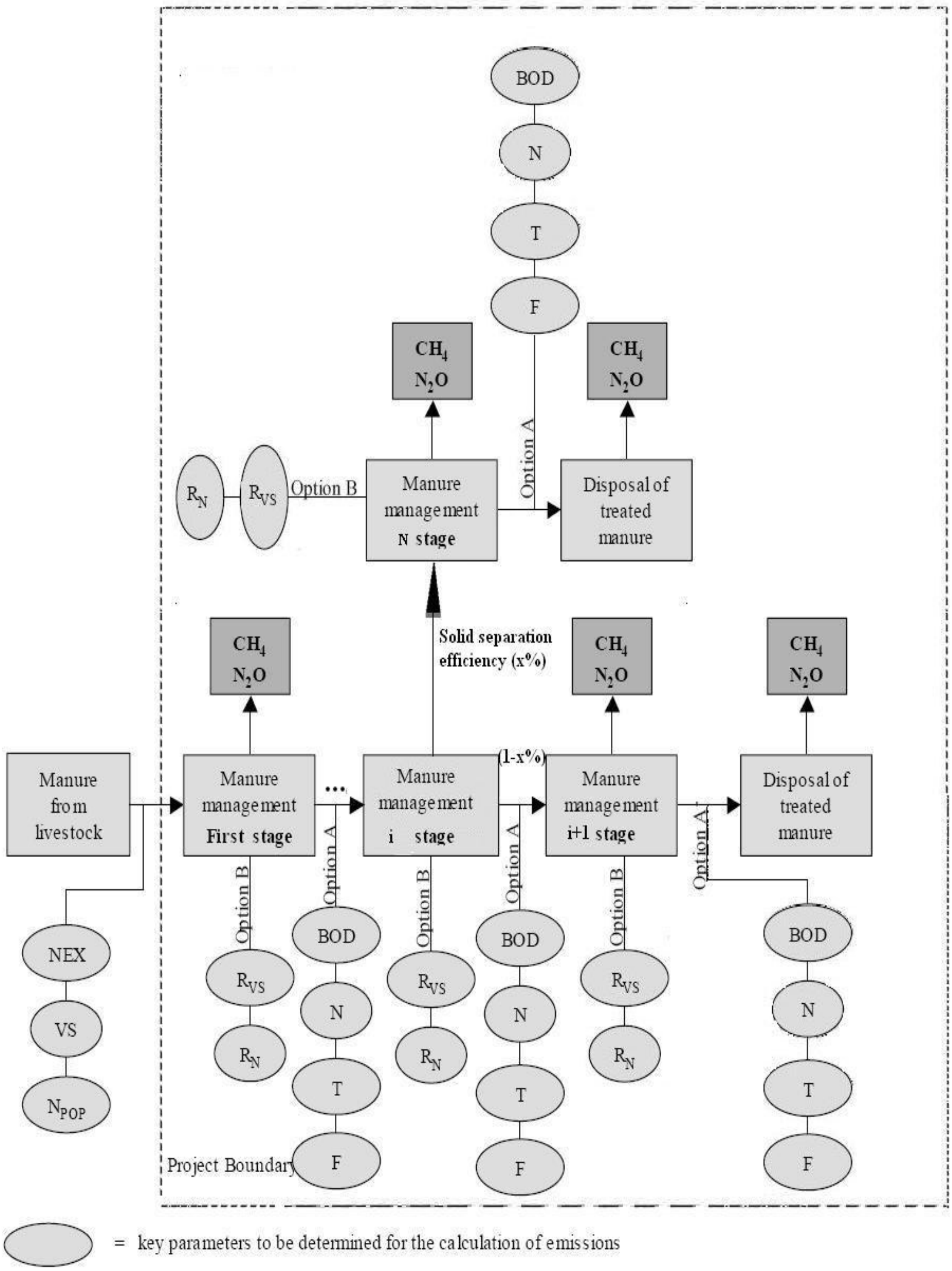
$$E_{N2O,runoff} = EF_5 * (1-F_{GASM}) * F_{leach} * \Sigma N_{DM} * Q_{DM} * CF_{N20-N,N} /1000$$

where
N_{DM} is the measured N concentration in manure disposed as irrigation, measured for each batch disposed, in mg N/l^3 effluent
$CF_{N20-N,N}$ Conversion factor (= 44/28).
Q_{DM} is the yearly quantity of each batch of manure disposed as irrigation. (m^3/year).

2.6 Animal manure management chains

The original version of AM0006 is capable of representing several combined waste management systems or technologies that are components of a complete sequence, for the baseline or project scenarios. Even though this is a very flexible standpoint of AM0006, it is not clear how the methodology gathers the inclusion of a solid separation stage as an independent road, divided from the main manure management chain.

The following figure represents the modification proposed in this document, in order to represent the several components of a manure management chain that can contain solid separation stages.



This representation of the manure management chain is appropriate to consider the solid separation stage as an independent phase that can guarantee an effective emission reduction if solids are treated aerobically as for example composting. For example, in the diagram, *Manure management i stage* has been considered as the solids separation phase, although it could also fit as the first stage. Also, in accordance with the inclusion of nitrous oxide emission estimation from irrigation and land deposition, these components have been included as part of the project and baseline boundary, considering it as the final step in manure management.

2.7 Regarding flare efficiency

This is one of the most discussed matters during the EB24th meeting, and one of the main concerns with AWMS CDM project activities and AM0006. There are no major technical differences in the flares used for landfills, respect to flares used in anaerobic digesters for wastewater treatment system, so a general criteria can be established in order to a make consistent judgment along different type of CDM projects that flare biogas.

If flare efficiency fails to comply with the design range criteria, then it can be assumed that part of the captured methane from the digester is not being burned, for it is being vented as a fugitive emission source of GHG.

The combustion of biogas methane may give rise to significant methane emissions as a result of incomplete or inefficient combustion. The three predominant potential routes for the destruction of methane are:

- Biogas flaring;
- Biogas use in heating systems;
- Biogas use for on site electricity generation.

In order to comply with a representative quantification of emission reductions, the following equation must be used:

$$PE_{CH4\_IC} = GWP_{CH4} * C_{CH4\_r} * D_{CH4} * \sum_{r} (V_r * (1 - f_r))$$

where:

r index for flaring, heat generation and power generation

V_r biogas supplied to combustion process r, expressed in volume (Nm_3)

C_{CH4} (percentage) methane concentration in biogas, expressed as fraction. This can be calculated from the average concentration of carbon dioxide in biogas. It should be calculated as this:

$$C_{CH4} = (1 - \%CO_2)$$

f_r Efficiency of combustion in process r. Default efficiency for efficiency of heat and electricity generation can be assumed as 99.5%, as per IPCC. Below is described the criteria develop to choose a representative value for the biogas combustion efficiency.

2.7.1. Open Candlestick Flares efficiency criteria

Flares are generally categorized in two ways: (1) by the height of the flare tip (i.e., ground or elevated), and (2) by the method of enhancing mixing at the flare tip (i.e., steam-assisted, air-assisted, pressureassisted, or non-assisted).

In most flares, combustion occurs by means of a diffusion flame. A diffusion flame is one in which air diffuses across the boundary of the fuel/combustion product stream toward the center of the fuel flow, forming the envelope of a combustible gas mixture around a core of fuel gas. This mixture, on ignition, establishes a stable flame zone around the gas core above the burner tip. This inner gas core is heated by diffusion of hot combustion products from the flame zone.

Open flaring is a VOC combustion control process in which the VOC are piped to a remote, usually elevated, location and burned in an open flame in the open air using a specially designed burner tip, auxiliary fuel, and steam or air to promote mixing for nearly complete VOC destruction (> 98%). Completeness of combustion in a flare is governed by flame temperature, residence time in the combustion zone, turbulent mixing of the gas stream components to complete the oxidation reaction, and available oxygen for free radical formation. Combustion is complete if all VOC are converted to carbon dioxide and water (EPA Fact Sheet).

Incomplete combustion results in some of the VOC being unaltered or converted to other organic compounds such as aldehydes or acids. Cracking can occur with the formation of small hot particles of carbon that give the flame its characteristic luminosity. If there is an oxygen deficiency and if the carbon particles are cooled o below their ignition temperature, smoking occurs (smoking is an evidence of low efficiency). In large diffusion flames, combustion product vortices can form around burning portions of the gas and shut off the supply of oxygen. This localized instability causes flame flickering, which can be accompanied by soot formation. As in all combustion processes, an adequate air supply and good mixing are required to complete combustion and minimize smoke. The various flare designs differ primarily in their accomplishment of mixing.

Moderate winds increase the efficiency of industrial open candlestick flares by enhanced mixing but no one doubts that there exist gale force winds that are sufficient to blow out any flame or that an unlit flare has zero efficiency.

Flare efficiency depends on flame stability. A flare operated within the envelope of stable operating conditions will exhibit high efficiency (98%) unless too much steam or air assist is used. A flare operated outside its stable flame envelope becomes unstable; this can result in combustion and destruction efficiency below 98%. The stable flame operating envelope is specific to flare head design and gas composition. Operating conditions that have the largest influence on flame stability for a given flare head are the gas exit velocity and heating value. However, depending on flare type, levels of steam, air or pilot assist can also affect flame stability and destruction and combustion efficiency. Additionally, flare gases of equivalent heating value but different composition can have different stable flame operating envelopes when flared from the same flare. A minimum gas handling skid instrumentation and an adequate control logical program (commonly named as CLP) should guarantee appropriate flaring conditions of biogas, principally because pilot operation, biogas flow and pressure from blower can be continually monitored.

While the stability of large flares is well known to exceed that of small laboratory-scale model flares, the stability scaling physics and chemistry are poorly understood. All flare efficiency combustion studies beginning even before the studies of the early-to-mid-1980s and including the most recent full scale remote sensing field tests have consistently demonstrated the high efficiency of properly designed and operated industrial flares. Exceptions result when flares are improperly operated by being, for example, subjected to liquid carryover, or to over-steaming or to over-aeration; or in an effort to establish the limits of "proper operation" are purposely tested to the verge of extinction (IFC, 2003).

The efficiency argument resolves itself into what it means to be "properly designed and operated" and whether or not the USEPA's 40CFR60.18 General Requirements for Flares that were intended to ensure "proper design and operation" do in fact ensure the by now more than well established high-efficiency operation of industrial flares (IFC, 2003).

Applicable codes and guidelines for flares were incorporated in the "good well flare concept design". These can guarantee a minimum combustion efficiency of **98%** for open candlestick flares, as it is presented in the EPA document ***40 CFR 60.18 General Control Device Requirements***. These are control requirements to achieve EPA air emission standards and specify:

1) No visible emissions (except for 5 minutes every 2 hours). This can be assisted by a controlled logical program (CLP), and the correct implementation of the minimum requirements of a gas handling skid.
2) Flame presence at all times when emissions are vented. This can be assisted by a controlled logical program (CLP), and the correct implementation of the minimum requirements of a gas handling skid.
3) Minimum gas quality (7.5 MJ/m3 – for an unassisted flare);
4) Maximum gas exit velocity as a function of flare type and gas quality (18.3 m/s for an Unassisted, variable quality). This can be assisted by a controlled logical program (CLP), and the correct implementation of the minimum requirements of a gas handling skid.
5) Flares must be monitored for design conformance; Interpreted as maintenance requirements
6) The pilot flame must be continuously monitored. Interpreted as maintenance requirements.

It has been shown that these control device requirements do not only depend in the flare operability, but also on a minimum instrumentation available for the gas handling skid. For example, the blower in the gas handling skid has the function of generating enough discharge pressure to burn the biogas and limit any air inflow from the flare to the digester. Therefore, the discussion regarding open flares burning efficiency is limited to the complete equipment settled for biogas extraction and burning (gas handling skid).

With the purpose of giving a representative consideration to the type, quality and operability in the flare operation, we propose the following modification to AM0006:

"If a project proponent wishes to consider a 98% biogas in burn efficiency for an open candlestick flare of an anaerobic digester, then it should comply with every one of the criteria established in the 40 CFR 60.18, EPA's General Control Device Requirements. This reference has been linked in the bibliography of the present document. Every evidence proving the applicability to 40 CFR 60.18, maintenance plan and minimum gas handling skid instrumentation designed to comply with the requirements of this EPA document, should be available to the validator. The existence and correct maintenance of a controlled logical program (CLP) and minimum components of a gas handling skid, should be enough to guarantee the compliance of EPA's General Control Device Requirements for open flares.
A complete gas handling skid should be composed of:

- Candlestick flare

- Flame arrester
- Safety shutoff valve
- Flame monitoring thermocouple
- Demister or gas filter
- Discharge pressure blade for biogas flow. For example a positive displacement blower
- Gas flow meter with pulse counter for mounting on system inlet
- Differential pressure gauge and monitoring across flame arrester, demister pad, inlet of system and blower outlet
- Automation Direct PLC logical supervision system

If it is not possible to follow up with these requirements, and still project proponent wish to use an open candlestick, then a default value of a 50% of combustion efficiency should be used. These types of flares cannot be adequately monitored."

It has been shown that the combustion flare efficiency discussion is not limited to the type of flare, but also gathers the complete equipment for biogas handling, the appropriate gas handling skid. This same approach is applicable to enclosed flares.

2.7.2. Enclosed Flares Efficiency criteria

An enclosed flare's burner heads are inside a shell that is internally insulated. The shell reduces noise, luminosity, and heat radiation and provides wind protection. Enclosed, or ground-based flares are generally used instead of elevated flares for aesthetic or safety reasons. A high nozzle pressure drop is usually adequate to provide the mixing necessary for smokeless operation and air or steam assistance is not required. In this context, enclosed flares can be considered a special class of pressure-assisted or non-assisted flares. The height must be adequate for creating enough draft to supply sufficient air for smokeless combustion and for dispersion of the thermal plume. These flares are always at ground level. Enclosed flares generally have less capacity than open flares and are used to combust continuous, constant flow vent streams, although reliable and efficient operation can be attained over a wide range of design capacity. Stable combustion can be obtained with lower heat content vent gases than is possible with open flare designs (1.9 to 2.2 MJ/sm3 (50 to 60 Btu/scf)), probably due to their isolation from wind effects. Enclosed flares are typically used at landfills to destroy landfill gas.

Some defaults values have been provided in the latest version of AM0016 and in the new draft version of the AWMS consolidated methodology, instead of monitoring efficiency. Monitoring efficiency procedures require highly specialized equipment and skills that are not available, producing results not reliable enough. This has been confirmed in the latest DNV's post regarding flare efficiency (April, 2006).

The amount of methane actually flared will be determined by monitoring the:
(i) The amount of biogas collected in the outlet of the Biodigester using a continuous flow meter.
(ii) Percentage of biogas that is methane, which should be measured either with continuous analyzer or alternatively with periodical measurement at 95% confidence level using calibrated portable gas meters and taking a statistically valid number of samples.

(iii) 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. Efficiency of the flaring process is defined as fraction of methane completely oxidized by the flaring process. (1- fraction of methane in exhaust gas of the flare) For this purpose, the methane content of the flare emissions should be measured at least quarterly.
(iv) If efficiency for the flares can't be measured a conservative destruction efficiency factor should be used – 99% for enclosed flares.

The present analysis has shown that an appropriate gas handling skid (well managed and maintained), will assure efficient biogas combustion, in open flares as well as in enclosed flares. If monitored biogas flow rate (shown in terms of emission equivalent) is lower than the estimated emission reductions, project participants should replace emission reduction estimate by the monitored methane captured and flared, multiplied by the flare efficiency
This concern is only applicable to projects with anaerobic digesters and irrigation.

2.8 Leakages - regarding solids management separated from the manure management chain

Advanced aerobic waste management systems such as the activated sludge technology, consider large generation of solids and the need of sludge management and end use. For this reason, and with the purpose of considering any potential leakage from this source, it is of main importance to add a criterion to define which types of sludge management are aerobic with insignificant methane and nitrous oxide emissions.

The following sludge management practices should be considered as potential sources of leakage, and therefore emissions must be quantified:

- Landfill
- Any type of sludge accumulation (longer than 30 days).
- Mono-fill

The following sludge management practices should not be considered as potential sources of leakage:

- Composting
- Land application (only if sludge is incorporated not in saturated soils and considering an appropriate agronomic incorporation rate)
- Land farming
- On site incineration

It is consistent to apply the following formulae in order to represent methane emissions from any potential source if leakage. This formula is considered more suitable than the one presented in AM0006, because is more common to monitor volatile solids in sludge rather than monitoring BOD or COD from these separated solids:

$$PE_{y,sludge} = S_y * VS_y * MCF_{sl} * Bo * 1 /1000 * GWP\_CH_4$$

where:

$PE_{y,sludge}$ Methane emissions in the anaerobic decay of the sludge generated in the wastewater system in the year "y" (tonnes of CO_2 equivalent)

S_y Metered amount of sludge generated by the wastewater treatment in the year y that is managed under anaerobic conditions (tonnes).
VS_y Volatile solids content of sludge from solid separation stage representative for the year y (kg/head/day).
MCF_{Sl} methane conversion factor (MCF) for the sludge stored in sludge pits or accumulated in anaerobic conditions. Project proponents can use a default value of 0.9 or use the procedure defined in Baseline emission section.
B_0 Methane producing capacity, tCH4/tCOD, IPCC default value of 0.21should be used.
GWP_CH_4 Global Warming Potential for CH4 (21).

It is more common to monitor and register the Volatile solids content of the sludge generated by the wastewater treatment VS, rather than the biochemical oxygen demand (BOD) or the chemical oxygen demand of the sludge COD, as it is required in AM0006.

2.9 Leakages - project and baseline emissions from the waste management system's energy consumption

Project proponents should take properly into account emissions from energy consumption in the operation of the complete Animal waste management system or manure management chain, for the baseline and the project scenario. There was not a guideline to quantify this emission component in the original version of AM0006, for it has been included in the present document. These emissions should be properly quantified as an emissions source, and added to the baseline and project scenario, respectively.

Energy consumption should be known to the project proponent, in order to develop an appropriate economic evaluation for each baseline and project scenario considered.

2.9.1. Emissions from energy consumption of the AWMS in the baseline scenario

The following equation represents the emissions from energy consumption of the AWMS in the baseline scenario:

$$BEC_{AWMS} = EG_y * CEF_{Bl,elec,,y}$$

Where
BEC_{AWMS} are the emissions from energy consumption in the baseline scenario due to the operation of the AWMS. This emission component should be included in the total baseline emissions.
EG_y is the amount of electricity in the year y that would be consumed at the project site in the absence of the project activity (MWh) for operating AWMS.
$CEF_{Bl,\ elec,y}$ is the carbon emissions factor for electricity consumed at the project site from the respective AWMS in the absence of the project activity (tCO_2/MWh)

Determination of $CEF_{Bl,elec}$:

- In cases where electricity consumed from the baseline AWMS would be generated in an on-site fossil fuel fired power plant, project participants should use for $CEF_{Bl,elec}$, the default emission factor for a diesel generator with a capacity of more than 200 kW for small-scale project activities (0.8 tCO_2/MWh, see AMS 1.D.1 in the simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories).
- In cases where electricity would, in the absence of the project activity, be purchased from the grid, the emission factor $CEF_{Bl,elec}$ should be calculated according to approved methodology ACM0002 ("Consolidated baseline methodology for grid-connected electricity generation from renewable sources"), or taken from any PDD of any project connected to the same grid for ex-ante estimation purposes. If electricity consumption is less than small scale threshold (15 GWh/yr), the default emission factor for a diesel generator with a capacity of more than 200 kW for small-scale project activities (0.8 tCO_2/MWh, see AMS 1.D.1 in the simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories).

2.9.2. Emissions from energy consumption of the AWMS in the project scenario

The following equation represents the emissions from energy consumption of the AWMS in the project scenario

$$PEC_{AWMS} = EL_{P,y} * CEF_{d} + HG_{PR,y} * CEF_{Pr,therm,y}$$

where,

PEC_{AWMS} are the emissions from energy consumption in the project scenario due to the operation of the AWMS. This emission component should be included in the total project emissions.

$EL_{P,y}$ is the amount of electricity in the year y that is consumed at the project site for the AWMS project activity (MWh).

CEF_{d} is the carbon emissions factor for the electricity consumed at the project site during the project activity (tCO_2/MWh), estimated as described below.

$HG_{PR,y}$ is the quantity of thermal energy consumed in year y at the project site due to the AMWS project activity (MJ).

$CEF_{Pr,therm,y}$ is the CO_2 emissions intensity for thermal energy generation (tCO_2e/MJ). It should be estimated considering the most common fuel source for this type of energy consumption. Factor is zero if biogas is used for generating thermal energy for the AWMS.

Determination of CEF_{d}:

- In case the electricity consumption is from an on-site fossil fuel fired power plant in the baseline, the default emission factor for a diesel generator with a capacity of more than 200 kW for small-scale project activities, should be used (0.8 tCO2/MWh, see AMS-I.D.1 in the simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories).
- In case the electricity consumption is from other power plants in the grid, CEF_{d} should be calculated according to methodology ACM0002 ("Consolidated baseline methodology for grid connected electricity generation from renewable sources") or taken from any PDD of any project

connected to the same grid for ex-ante estimation purposes. If electricity generation is less than small scale threshold (15 GWh/year), AMS-I.D.1 may be used.

- Where the project activity involves electricity consumption from a self supply biogas generation facility, CEF is zero.

2.10 Regarding emission reductions due to biogas consumption as a source for renewable energy.

In advanced waste management systems such as the anaerobic digester, biogas collection may be considered as a renewable fuel for heat and/or power generation. This incorporates an additional component to the emission reduction project. We recommend quantifying the emission reduction potential of this component as it is described in AMS-I.D and in ACM0002 (and as it has been taken in consideration in the AWMS consolidated methodology).

Project proponents need to estimate electricity component only if the captured methane is used for generation of electricity, which is at least as much as the project's requirement, and the Project participants wish to claim emissions reduction due to the same. Similarly if the Heat in project case is completely met by biogas and project participants do not wish to claim the credits, the CO2 emission from heat can be ignored. The following equation is considered in order to estimate CO2 baseline emissions from electricity and heat within the project boundary,

$$BE_{elec/heat} = EG_{d,y} * CEF_{grid} + HG_{BL,y} * CEF_{Bl,\ therm,y}$$

where,

$EG_{d,y}$ is the amount of electricity generated utilizing the biogas collected during project activity and exported to the grid during the year y (MWh). If part of this electricity is consumed by the Animal Waste Management System, this should not be considered.

CEF_{grid} is the carbon emissions factor for the grid in the project scenario (tCO_2/MWh)

$HG_{BL,\ y}$ is the quantity of thermal energy that would be generated by any steam or heat facility in year y at the project site using biogas from the project activity. (MJ). Energy consumption for the operation of the Animal Waste Management System should not be considered (for example a boiler fueled by biogas and heating an anaerobic digester).

$CEF_{Bl,\ therm}$ is the CO_2 emissions intensity for thermal energy generation (tCO_2 e/MJ)

Determination of CEF_{grid}:

- In case the generated electricity from the biogas displaces electricity that would have been generated in an on-site fossil fuel fired power plant in the baseline, the default emission factor for a diesel generator with a capacity of more than 200 kW for small-scale project activities (0.8 tCO_2/MWh, see AMS-I.D.1 in the simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories).
- In case the generated electricity from the biogas displaces electricity that would have been generated in other power plants in the grid in the baseline,

CEF_d should be calculated according to methodology ACM0002 ("Consolidated baseline methodology for grid connected electricity generation from renewable sources"), or taken from any PDD of any project connected to the same grid for ex-ante estimation purposes. If electricity generation is less than small scale threshold (15 GWh/year), AMS-I.D.1 may be used.

Determination of $CEF_{Bl,therm}$: The emission factor is estimated as product of (i) carbon emission factor for fuel used (tCO_2/MJ), and (ii) oxidation factor for the thermal device. Baseline electricity and thermal energy consumptions should be estimated as the average of the historical 3 years consumption.

2.11 Monitoring parameters

The following parameters should be part of the revised version of AM0006's monitoring plan:

Parameters for Monitoring Plan							
Data variable	**Source of data**	**Data unit**	**Measured (m), calculated (c) or estimated (e)**	**Recordin g frequency**	**Proportion of data to be monitored**	**How will the data be archived? (electronic/ paper)**	**Comment**
Number	Daily stock	Heads	m & c	Weekly	100%	Paper and electronic	All of the pig barns have an exhaustive counting of the stock of pigs.
Mass	Average weight of animals	kg	m & c	Average of records of entrance and exit of animals to the barn	100%	Paper and electronic	Necessary for treatment stages with no monitored wastewater parameters available (Volatile solids, Nitrogen content, and biochemical oxygen demand). The average weight of animals from the last closed cycle should be considered representative. For those sectors where there is a combination of different production stages (ages of animals), the average weight can be calculated from a weighted average estimation of the different production stages, using the monitoring variables below.
Number	Sr,m: Total stock of animals for the raise stage r, in the month m	Heads	m	Weekly	100%	Paper and electronic	All of the pig barns have an exhaustive counting of the stock of pigs.
Weight	Wr,m : Average weight for the	kg	mc	Average of records of	100%	Paper and electronic	Necessary whenever there is a mixture of different raising stages.

	raise stage r, in the month m			entrance and exit of animals to the barn			
Volatile solid excretion per animal and day)	Corrected IPCC Default data or monitored values	kg dry matter / animal / day	c, m	monthly	100%	Electronic	Monitoring of this data is only required if measured site-specific data is used. Corrected IPCC default data of volatile solids excretion can be used, The correction is a function of the average animal weight.
Nitrogen excretion per animal and day)	Corrected IPCC Default data	kg dry matter / animal / day	c, m	monthly	100%	Electronic	Monitoring of this data is only required if measured site-specific data is used. Corrected IPCC default data of nitrogen excretion can be used, for it will not be necessary to measure this variable. The correction is a function of the average animal weight.
Methane Conversion Factor	Calculated based on Van't Hoff.-Arrhenius formulae if it is a lagoon, based on referential literature if other AWMS	Fraction	c				The Van't Hoff Arrhenius formula is a function of the ambient temperature. The latter is part of this monitoring plan and can be referenced from official statistical data.
Depth of AWMS		meters	e	At start of the project	100%	Electronic	This is relevant if a lagoon is the AWMS baseline. In case existing AWMS at the project site is different from the identified AWMS baseline, the depth should be based on design conditions or general depth of similar system in the area

T2; temperature	Ambient temperature at project site	ºC transformed to ºK	E	Monthly	100%	Electronic	This variable can be estimated taking as reference reliable statistics representative for the context in study. Monthly average temperature for the area is obtained from published national weather service information
Manure Flow	Manure flow to the aerobic post-treatment or to treatment stage i	m^3/day	M	Monthly	100%	Paper and electronic	Only applicable if option A in step 5 of AM0006 is chosen. This parameter is calculated with total inlet flow minus sludge volume. Total inlet flow is monitored from a flow meter installed before the activated sludge.
Concentration	5 days Biochemical Oxygen Demand (BOD) in storage lagoon after aerobic treatment	mg/L	m	Monthly	100%	Paper and electronic	Only applicable if option A in step 5 of AM0006 is chosen.
Concentration	Total Nitrogen content in any phase plant effluent.	mg/L	M	Monthly	100%	Paper and electronic	Only applicable if option A in step 5 of AM0006 is chosen.
Temperature	Temperature of manure in any phase plant effluent.	ºC	m	Monthly	100%	Paper and electronic	Only applicable if option A in step 5 of AM0006 is chosen.

Flow rate	Biogas flow extracted by digester	m^3/day	m	Every working day	100%	Paper and electronic	Only applicable for the inclusion of an anaerobic digester. This parameter shows the performance of the digester and gas recovery indicating operation*.
Percentile	CO2 concentration in gas flow	%	m	Every working day	100%	Paper and electronic	Only applicable for the inclusion of an anaerobic digester. This parameter shows the performance of anaerobic digestion*.
Percentile	Flare efficiency	%	m or e	-	100%	Paper and electronic	Efficiency combustion of open candlestick flares cannot be measured. 98% efficiency can be used if EPA 40 CFR 60.18 conditions can be met, or if the complete instrumentation of a gas handling skid is installed, including a CLP. Instead, use a default value of 50 %. For enclosed flares the following options are available: (1) Periodic measurement of methane content of flare exhaust gas. (2) Continuous measurement of operation time of flare (e.g. with temperature) If efficiency for the flares can't be measured a conservative destruction efficiency factor should be used – 99% for enclosed flares
Electricity	Electricity exported to the grid if the anaerobic digester is connected to a power generation	MWh	m	Annual	100%	Electronic	Only applicable if the project scenario considers an anaerobic digester and power generation unit.

	unit						
Emission Factor	Emission factor of exported electricity	tCO_2/MWh	c	Annual	100%	Electronic	Only applicable if the project scenario considers an anaerobic digester and power generation unit.
Di,y : Effective operation days of stage i of manure treatment in the project scenario, during year y.	Estimated according to effective operation days to each component of the AWMS.		e	Monthly or daily, depending on the AWMS		Electronic	If the component i is an anaerobic digester, consider the monitoring of biogas flow rate and carbon dioxide concentration in gas flow as evidence of the correct performance from the anaerobic digester. In the case of an aerobic treatment such as the activated sludge, consider that valid operation days should be represented by a minimum of 1 monthly average register for nitrogen concentration in treated manure, manure flow rate and BOD5 of treated flow rate. So if one month lacks one of these variables, the activated sludge should not be considered in operation, on that month.
D1,y : Effective operation days of the first stage of manure treatment in the project scenario, during year y	Estimated according to effective operation days to each component of the AWMS.		e	Monthly or daily, depending on the AWMS		Electronic	If the component i is an anaerobic digester, consider the monitoring of biogas flow rate and carbon dioxide concentration in gas flow as evidence of the correct performance from the anaerobic digester. In the case of an aerobic treatment such as the activated sludge, consider that valid operation days should be represented by a minimum of 1 monthly average register for nitrogen concentration in treated manure, manure

							flow rate and BOD5 of treated flow rate. So if one month lacks one of these variables, the activated sludge should not be considered in operation, on that month.

*: Either monitoring of biogas flow rate or carbon dioxide concentration on gas flow can be an evidence of the correct performance from the anaerobic digester.
All variables collected under this monitoring plan should be filed and stored for the crediting period plus two years.

Parameters for leakage estimation in Monitoring Plan							
Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
Flow of treated manure that is separated from the aerobic treatment system (S_Y)	Sludge transportation records	m^3/day or ton/day	m	monthly	100%	paper	Only required if treated solids are deposited under anaerobic conditions.
Volatile solids content in treated manure that is deposited under anaerobic conditions in the year y	Laboratory records	mg/l	m	Yearly	100%	paper	Only required if treated solids are deposited under anaerobic conditions.
Heat	Heat if the anaerobic digester is connected to a	MJ	m	At start of project	100%	Electronic	Only applicable if the project scenario considers an anaerobic digester and boiler. Estimation is based on three years data prior to start of the project.

	boiler						
Emission Factor	Emission factor of heat use/generation	tCO_2/MJ	c	At start of project	100%	Electronic	Only applicable if the project scenario considers an anaerobic digester and power generation unit.
EGy	Electricity consumption by baseline	MWh	e	At start of the project	100%	Electronic	
CEFbaseline, elec	Emission factor of baseline electricity use	tCO2/MWh	c		100%	Electronic	

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