Section D. Application of a monitoring methodology and plan:

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

This project activity utilizes the CDM approved baseline methodology AM0016/Version 02 entitled "*Greenhouse gas mitigation from improved Animal Waste Management Systems in confined animal feeding operations*."

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

This monitoring methodology was chosen because it offers a GHG emissions model that can be used to characterize baseline and project activity emissions. Specifically, the methodology is applicable because:

1. The captured gas is being flared, or
2. The captured gas may be used to produce energy (e.g., electricity/thermal energy), but no emission reductions will be claimed for displacing or avoiding energy from other sources.[1]
3. The farms have livestock populations managed under confined conditions and operate in a competitive market.
4. The livestock populations are comprised of swine animals, an applicable animal type.
5. The AWMS, including both the baseline scenario and the manure management systems introduced as part of the project activity, is in accordance with the regulatory framework in the country, excluding the discharge of manure into natural resources (e.g., rivers or estuaries).
6. The project activity introduces an AWMS practice and technology to reduce GHG emissions.
7. The project activity results in a reduction of GHG emissions due to the AWMS improvements.

[1] Although in this project no emission reductions are claimed for displacing or avoiding energy from other sources, all possible financial revenues and/or emission leakages will be taken into account in the analysis performed.

D.2.1 Option 1: Monitoring of the emissions in the project scenario and the baseline scenario:

AM0016 monitoring methodology is a broad based methodology that can be applied to various animal categories, waste management systems, and data types. As such, the methodology defines a superset of ID numbered parameters available for application at individual project activity scenarios. Individual projects will not require monitoring of the entire superset of parameters. The selection of such parameters is dependent on the result of the data characterization and emission factor determination test (Table **Error! Reference source not found.**). The following subset of parameters has been identified for use at the project activities:

D.2.1.1 Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID Number	Data Variable	Source of Data	Data Unit	Measured (m) Calculated (c), Estimated (e)	Recording Frequency	Proportion of Data to be monitored	How will data be archived?	Comment
1. Population month	Integer, Classification	Herd/breed counts per type	#, Type	m	Entrance – exit records of animals to the barn	100%	electronic	Animal counts by population classification and genetics. Classification data also includes mortality and days resident.
6. BA	Classification	Type of AWMS	Type	m	Entrance – exit records of animals to the barn	100%	electronic	AWMS type used to select appropriate parameters from IPCC lookup tables
9. TR	Integer, volume	Temperature	^{o}C, cm	m	Monthly	100%	electronic	Used to determine climate conditions for selection of appropriate parameters from IPCC lookup tables
12. CF	Volume	Biogas produced	M^3	m	Cumulative monthly production recorded monthly	100%	electronic	QC/QA check. This parameter enables verification of the anaerobic digestion process. Considered over several months, this parameter helps establish “typical” performance for an anaerobic digester.
13. CD	Percent	CO_2 concentration	%	m	Quarterly	100%	electronic	QC/QA check. This parameter monitors digester operation.

D.2.1.1 Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID Number	Data Variable	Source of Data	Data Unit	Measured (m) Calculated (c), Estimated (e)	Recording Frequency	Proportion of Data to be monitored	How will data be archived?	Comment
14. INT	N/A	Operational status	N/A	m	Weekly	100%	electronic	Operational status of all project equipment is checked. This parameter helps ensure proper digester operation.
15. DR	Classification	Referenced data from standard tables	Type	m	Entrance-exit records of animals to the barn	100%	electronic	Data from standard references and IPCC tables.

D.2.1.2 Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emission units of CO_2 equ.):

Equations 9, 10, 11, 13, 14, 15, and 16 from Approved Methodology AM0016 are used to determine project activity emissions.

Four options are available for the determination of the volatile solids (V_s) excretion rate used with equation 11. Two of the four originate from lookup tables, IPCC and country-specific. If lookup references were not available, then the V_s could have been determined via calculation based on feed nutrition content and animal weight, e.g., equations 1 and 2 in AM0016. IPCC default values for V_s. were selected for use at the project activity farms. Furthermore, country specific factors are not available.

Two options are available for the determination of methane conversion factors (MCF) used with equation 11. One originates from IPCC lookup tables and the other can be calculated using equation 8 in AM0016. IPCC default values were selected for use at the project activity farms.

Four options are available for the determination of the nitrogen excretion (N_{ex}) rate used with equations 15 and 16. Two of the four originate from lookup tables, IPCC and country-specific. If lookup references were not available, then the N_{ex} could have been determined via calculation based on feed nutrition content and animal weight, e.g., equations 3 and 4 in AM0016. IPCC default values were selected for use at the project activity farms. Furthermore, country specific factors are not available.

- Equation 9, Baseline methane (CH_4) emissions in CO_2e:

$$CO_{2eq\ methane} = CH_{4\ annual} * GWP_{CH4}/1000$$

- Equation 10, Baseline methane (CH_4) annual emissions:

$$CH_{4\ annual} = \sum_{mj} EF_{month} * Population_{month} * MS\%j$$

- Equation 11, Animal group emission factor:

$$EF_{month} = V_s * n_m * B_0 * 0.67kg/m^3 * MCF_{month}$$

- Equation 13, Baseline nitrous oxide (N_2O) emissions in CO_2e:

$$CO_{2equiv\ N2O} = GWP_{N2O} * N_2O_{total\ annual}/1000$$

- Equation 14, Baseline nitrous oxide (N_2O) annual emissions:

$$N_2O_{total\ annual} = \sum_{mj} (N_2O_d + N_2O_i) * Population_{month} * MS\%j$$

- Equation 15, Direct nitrous oxide (N_2O) emissions:

$$N_2O_d = N_{ex\ month} * EF_3 * (1- F_{gasm}) * C_m$$

- Equation 16, Indirect nitrous oxide (N_2O) emissions:

$$N_2O_i = N_{ex\ month} * EF_4 * F_{gasm} * C_m$$

D.2.1.3 Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHG within the project boundary and how such data will be collected and archived.

ID number	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?	Comment
1. Population month	Integer, Classification	Herd/breed counts per type	#, Type	m	Entrance – exit records of animals to the barn	100%	electronic	Animal counts by population classification and genetics. Classification data also includes mortality and days resident.
6. BA	Classification	Type of AWMS	Type	m	Entrance – exit records of animals to the barn	100%	electronic	AWMS type used to select appropriate parameters from IPCC lookup tables
9. TR	Integer, volume	Temperature and rainfall	^oC, cm	m	Monthly	100%	electronic	Used to determine climate conditions for selection of appropriate parameters from IPCC lookup tables

D.2.1.4 Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emission units of CO_2 equ.):

Equations 9, 10, 11, 13, 14, 15, and 16 from Approved Methodology AM0016 are used to determine baseline emissions.

Four options are available for the determination of the volatile solids (V_s) excretion rate used with equation 11. Two of the four originate from lookup tables, IPCC and country-specific. If lookup references were not available, then the V_s could have been determined via calculation based on feed nutrition content and animal weight, e.g., equations 1 and 2 in AM0016. IPCC default values for V_s were selected for use at the project activity sites. Furthermore, country specific factors are not available.

Two options are available for the determination of methane conversion factors (MCF) used with equation 11. One originates from IPCC lookup tables and the other can be calculated using equation 8 in AM0016. IPCC default values were selected for use at the project activity sites.

Four options are available for the determination of the nitrogen excretion (N_{ex}) rate used with equations 15 and 16. Two of the four originate from lookup tables, IPCC and country-specific. If lookup references were not available, then the N_{ex} could have been determined via calculation based on feed nutrition content and animal weight, e.g., equations 3 and 4 in AM0016. IPCC default values were selected for use at the project activity sites. Furthermore, country specific factors are not available.

- Equation 9, Baseline methane (CH_4) emissions in CO_2e:

$$CO_{2eq\ methane} = CH_{4\ annual} * GWP_{CH4}/1000$$

- Equation 10, Baseline methane (CH_4) annual emissions:

$$CH_{4\ annual} = \sum_{mj} EF_{month} * Population_{month} * MS\%j$$

- Equation 11, Animal group emission factor:

$$EF_{month} = V_s * n_m * B_0 * 0.67kg/m^3 * MCF_{month}$$

- Equation 13, Baseline nitrous oxide (N_2O) emissions in CO_2e:

$$CO_{2equiv\ N2O} = GWP_{N2O} * N_2O_{total\ annual}/1000$$

- Equation 14, Baseline nitrous oxide (N_2O) annual emissions:

$$N_2O_{total\ annual} = \sum_{mj} (N_2O_d + N_2O_i) * Population_{month} * MS\%j$$

- Equation 15, Direct nitrous oxide (N_2O) emissions:

$$N_2O_d = N_{ex\ month} * EF_3 * (1- F_{gasm}) * C_m$$

- Equation 16, Indirect nitrous oxide (N_2O) emissions:

$$N_2O_i = N_{ex\ month} * EF_4 * F_{gasm} * C_m$$

D.2.2 Option2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E):

D.2.2.1 Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.2.2 Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emission units of CO_2 equ.):

D.2.3 Treatment of leakage in the monitoring plan:

D.2.3.1 If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity:

ID number	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
16. EP_y	Electricity	Power	kWh	M or c	Monthly	100%	electronic	Electricity used for project equipment. If calculated, assume that all relevant electrical equipment operates at full rated capacity, plus 10% to account for distribution losses, for 8760 hours per annum.
19. EP_p	Electricity	Power	kWh	m	Monthly	100%	electronic	Electricity produced through co generation of the captured methane

D.2.3.2	Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emission units of CO_2 equ.):

Equations 17 to 23 from Approved Methodology AM0016 are used to determine project activity leakage.

Equation 17 will be used to determine electrical leakage on a continual basis.

The project developer used equations 18 through 23 in a one-time analysis to confirm that the change in AWMS (project activity) did not adversely affect GHG emissions due to land application, runoff and ammonia volatilization. The results of the analysis show that there is no change in GHG emissions in these areas by the incorporation of an anaerobic digester.

- Equation 17, Project activity electricity emissions in CO_2e:

$$EE_y = (EP_{y\text{-}project} - EP_{p\text{-}project} - EP_{y\text{-}baseline}) * EC_y / 1000$$

- Equation 18, Land leakage:

$$Land\ Leakage = Project\ activity\ land\ emissions - Baseline\ land\ emissions$$

- Equation 19, Direct nitrous oxide (N_2O) emissions from land application:

$$N_2O_{land} = N_{ex} * N * (1\text{-}F_{gasm}) * EF_1 * C_m$$

- Equation 20, Indirect nitrous oxide (N_2O) emissions from runoff:

$$N_2O_{runoff} = N_{ex} * N * (1\text{-}F_{gasm}) * F_{leach} * EF_5 * C_m$$

- Equation 21, Indirect nitrous oxide (N_2O) emissions from ammonia volatilization:

$$N_2O_i = N_{ex} * N * EF_4 * F_{gasm} * C_m$$

- Equation 22, Total nitrous oxide (N_2O) emissions:

$$N_2O_{total} = (N_2O_{land} + N_2O_i + N_2O_{runoff}) / 1000$$

- Equation 23, Total nitrous oxide (N_2O) emissions in CO_2 equivalent:

$$N_2O_{CO2\text{-}equiv} = GWP_{N2O} * N_2O_{total}$$

- And, the following equation was used to sum the land application and electricity leakage:

$$L_o = EE_y + N_2O_{CO2\text{-}equiv}$$

D.2.4 Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

Equations 24 and 26 from Approved Methodology AM0016 are used to determine project activity emission reductions:

- Equation 24, Total emissions in metric tonnes CO_2e:

$$Total\ Emissions_{mt} = CO_{2eq\ methane} + CO_{2equiv\ N2O}$$

- Equation 26, Net emission reductions:

$$ER_{net} = BE - PE - L_o$$

D.3 Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored.

Data *(Indicate table and ID number, e.g., D.2-1, D.2-2)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
D.2.1.1-1	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.1.3-1	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.1.1-6	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.1.3-6	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.1.1-9	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.1.3-9	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.1.1-12	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.1.1-13	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.1.1-14	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.3.1-16	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.3.1-19	Low	Work instructions for the collection of this data point are available in O&M Manual

AgCert's monitoring and reporting plan has been developed under the organization's pending ISO 9001 and ISO 14001 Quality and Environmental Management System. Additionally, AgCert has been privileged to be afforded the opportunity to comment on draft ISO 14064, Guidelines for measuring, reporting, and verifying entity project-level GHG emissions and has applied the main concepts to its QC and QA procedures. AgCert is working towards ISO 9001/14001 certification.

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects generated by the project activity:

The following table outlines overall CDM related responsibilities.

D.4. CDM Process (Overall Responsibility: Director, Climate Change Programs)					
Step	**Duration**	**Activity**	**Comments**	**Responsible Office**	**Co responsibility**
1	120 - 180 Days	Farm Aggregation	Sign LOI Form A (Initial Producer Data) Env Permits/Op License Legal Entity Docs	Aggregation	Producer
2		Contract Execution	Sign Contract	Aggregation	Producer AgCert Itn'l Executive Staff Quality
3		Farm Assessment	Assess Farm - Form B Collect production data (3 yr)	Assessment	Producer
4		Data Entry	Enter data into SMS	Data Entry (Host Country)	
5		Data quality check	Check data for accuracy	Quality	Project Co-ordinator
6		PDD Assignment	Assign Farm System/Site to PDD	Host Country Manager	Project Coordinator
7		Stakeholder's Meeting	Send Invitations Prepare & conduct meeting Take Minutes/Photos	Aggregation	AgCert Int'l
8		Prepare PDD	Using data	Technical Documentation	Host Country Project co-ordinator
9		Confirm PDD	Check accuracy of PDD	Project Co-ordinator / QA	Host nation staff
10		Submit PDD to DOE & to DNA for LOA	PDD not submitted to DNAs that require validation reports at this time (See step 12)	Regulatory	Host Country Manager
11		Validation Audit	On-site Visit Pre Screening 30-Day Pubilc Review Formal Report	DOE	Regulatory Host Country Project co-ordinator Site Assessment
12		Submit PDD to DNA (that require validation report) for LOA	6-8 week process	Regulatory	Host Country Manager
13		Submit Project Activty Package for Registration	Collect and submit LOAs, Validation Report, Public Comments, etc.	Regulatory / DOE	Host Country Project co-ordinator Technical Documentation
14		Eight Week Public Review	Formal Pre-registration Requirement	UNFCCC / DOE	Regulatory
15		Project Registered	Automatic after 8-wk period if no comments received	UNFCCC / DOE	Business Development
16	90 - 120 Days	Start Project Activity Constuction	May begin earlier but at AgCert's risk if project not registered.	Host Nation Construction Manager	AgCert Int'l Construction Manager Producer
17		Conduct Project Activity Transfer	Construction Complete System Quality Checks Configuration Management Documentation Producer Training	Host Nation Construction Manager Host Nation O&M Manager Host Nation Quality Supervisor	AgCert Int'l Construction Manager AgCert Int'l O&M Manger AgCert Int'l Quality Manager
18	10 Years	Monitoring (Site Activities)	Collect data Document systems checks Conduct Monitoring Plan and O&M Activities	Host Nation Monitoring Manager	AgCert Int'l Quality Manager
19		Prepare Monitoring Report	Prepare Periodic Montioring Report for Verification Audit	AgCert Int'l Monitoring Manger	Host Country Project co-ordinator IT
20		Schedule and Conduct Periodic Verification Audit(s)		DOE	Regulatory Host Country Project co-ordinator
21		Certify Emission Reductions		DOE	Regulatory Host Country Project co-ordinator
22		Transfer CERs	Send distribution instructions	Business Development Sales	DOE/EB

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 O&M Manual has been developed to provide guidance (work instructions) to individuals that collect and/or process data. An AgCert employed “circuit rider” will perform audits of farm operations personnel on a periodic basis to ensure proper data collection and handling.

AgCert has designed and implemented a unique set of data management tools to efficiently capture and report data throughout the project lifecycle. On-site assessment (collecting Geo-referenced, time/date stamped data), supplier production data exchange, task tracking, and post-implementation auditing tools have been developed to ensure accurate, consistent, and complete

data gathering and project implementation. Sophisticated tools have also been created to estimate/monitor the creation of high quality, permanent, ERs using IPCC formulae.

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

D.5 Name of person/entity determining the monitoring methodology:

AgCert determined the monitoring methodology for use at these project activities. AgCert is the project developer and participant.