




**Verification and certification report form for
CDM programme of activities
(Version 03.0)**

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION

Title and UNFCCC reference number of the programme of activities (PoA)	Title: Thailand Small Scale Livestock Waste Management Program UNFCCC ref: 8027	
Version number(s) of the PoA-DD(s) to which this report applies	14	
Version number of the verification and certification report	2.0Aa	
Completion date of the verification and certification report	26/01/2020	
Monitoring period number and duration of this monitoring period	3 rd Monitoring period. Duration: 01/01/2017 – 31/12/2018 (both days included)	
Number and version number of the monitoring report to which this report applies	Number of monitoring reports: 01 Version: 03 of 13/01/2020	
Coordinating/managing entity (CME)	Energy Research and Development Institute Nakhonping of Chiang Mai University (ERDI)	
Host Parties	Host Parties of the PoA	Is this a host Party to a CPA covered in this report? (yes/no)
	Thailand	Yes
Applied methodologies and standardized baselines	AMS-III.D, version 18 - Methane recovery in animal manure management systems	
Mandatory sectoral scopes	13	
Conditional sectoral scopes, if applicable	N/A	
Estimated amount of GHG emission reductions or GHG removals for this monitoring period in the included CPAs covered in this report	239,594 tCO ₂ e	
Certified amount of GHG emission reductions or GHG removals for this monitoring period for the included CPAs covered in this report	CPA 01: 13,476 tCO ₂ e CPA 02: 0 tCO ₂ e CPA 03: 39,470 tCO ₂ e	
Name and UNFCCC reference number of the DOE	RINA Services S.p.A. (RINA) E-0037	
Name, position and signature of the approver of the verification and certification report	Laura Severino Head of Certification Innovation & Sustainability Unit 	

SECTION A. Executive summary

>>Purpose and general description and location:

The PoA is developed by Energy Research and Development Institute – Nakornping of Chiang Mai University (ERDI) also the CME of the PoA aims to reduce greenhouse gas emissions from piggeries manure by converting anaerobic lagoons to flow closed anaerobic treatment digesters with biogas capture and power generation in Thailand. The treatment of livestock manure by way of anaerobic digester processes leads to the production of a biogas consisting of 60% methane (CH₄). The project will apply anaerobic digesters which will capture the biogas and use it to generate electricity for on farm consumption or sale to national grid.

The current monitoring period involves CPA 01, CPA 02 and CPA 03. The 'CPA 01' involves manure management in three swine farms (Chokchaikansukorn farm- 14°52'25.3"N and 102°10'20.9", Khana Hybrid Co., Ltd (Phanomsarakham Farm 1) -13°46'27.6"N and 101°24'37.4"E and Laemthong Hybrid Co., Ltd (Wang Noi Farm- 14°11'45.3"N and 100°39'28.7"E) to recover biogas, thereby reducing methane emissions and utilization of recovered biogas for electricity generation. Each of the farm installed digester of 3,750 m³ capacity which is equipped to gas generator to generate power and utilize the same for in-house consumption. CPA 02 involves manure management in Charoenphansamchuk Farm -14°75'14.03"N and 99°99'16.75 E to recover biogas, thereby reducing methane emissions and utilization of recovered biogas for electricity generation. Similarly, CPA 03 involves manure management in Veerachai Nongpong Pig Farm- 13°23'20" N and 99°42'4" E to recover biogas, thereby reducing methane emissions and utilization of recovered biogas for electricity generation and in-house consumption.

Verification scope:

The objective of the verification is to have an independent review ex post determination by a Designated Operational Entity (DOE) of the monitored reductions in GHG emissions that have occurred as a result of the registered CDM project activity during a defined monitoring period. Certification is the written assurance by the DOE that, during a specific time period, a proposed CDM project activity achieved the reductions in anthropogenic emissions by sources of GHGs as verified.

The verification scope is:

- to verify that actual monitoring systems and procedures are in compliance with the monitoring systems and procedures described in the monitoring plan;
- to evaluate the GHG emission reduction data and express a conclusion with a reasonable level of assurance about whether the reported GHG emission reduction data is free from material misstatement;
- to verify that reported GHG emission data is sufficiently supported by evidence.

Verification shall ensure that reported emission reductions are complete and accurate in accordance with applicable UNFCCC criteria for CDM in order to be certified.

Verification process:

Verification is conducted using RINA procedures in line with the requirements specified in the latest version of the CDM Validation and Verification Standard, relevant decisions of the CDM EB and applying standard auditing techniques. RINA assesses and determines that the implementation and operation of the project activity, and steps taken to report emission reductions comply with the CDM criteria and relevant guidance provided by the Board. The verification assessment involved a document review of relevant documentation and the on-site visit. Verification is not meant to provide any consultancy towards the project participants. However, stated requests for clarifications and/or corrective actions may have provided input for improvement of the monitoring.

Conclusion:

RINA Services S.p.A. (RINA), commissioned by The World Bank (The International Bank for Reconstruction and Development as Trustee of the Carbon Fund for Europe), has verified the greenhouse gas emission reductions reported for the CPA "Thailand Small Scale Livestock Waste Management Program CPA 01, CPA 02 and CPA 03" in Thailand, CDM Registration Reference N° 8027-0001, 8027-0002, 8027-0003 for the period 01/01/2017 to 31/12/2018 (both days included), with regard to the relevant requirements for CDM PoA/CPA activities. The verification shall ensure that reported emission reductions are complete and accurate in accordance with applicable CDM requirements in order to be certified.

The PoA was validated by DNV (validation report N° 2010-0125 issued on 12/10/2012) and it was registered on 09/11/2012 under the CDM registration reference N° 8027; the CPA 1 was validated by DNV (validation report N° 2010-0114 issued on 12/10/2012) and it was registered on 09/11/2012 under the CDM registration

reference N° 8027-P1-0001-CP1; CAP 02 was validated by DNV (validation report N° 2014-0019 issued on 27/11/2014) and it was registered on 28/11/2014 under the CDM registration reference N° 8027-P1-0002-CP1; CPA 3 was validated by DNV (validation report N° 2014-0107 issued on 28/11/2014) and it was registered on 28/11/2014 under the CDM registration reference N° 8027-P1-0003-CP1.

The GHG emission reductions were calculated on the basis of the approved methodology AMS-III.D, version 18, 'Methane recovery in animal manure management systems' of 29/09/2011 and the monitoring plan included in the registered CPA DD version 14 dated 18/08/2016 for CPA 01, CPA-DD version 09 of 18/08/2016 for CPA 02 and CPA-DD version 09 of 18/08/2016 for CPA 03.

In conclusion, it is RINA's opinion that the CPAs (CPA 01, CPA 02 and CPA 03) of the PoA 'Thailand Small Scale Livestock Waste Management Program', in "Thailand", as described in the Monitoring Report version 03 of 13/01/2020, meets all relevant requirements for CDM PoA/CPA activities and all relevant host Party criteria and correctly applies the baseline and monitoring methodology "AMS-III.D", "Methane recovery in animal manure management systems", version 18 of 29/09/2011. In our opinion the GHG emission reductions reported for the project in the monitoring report are fairly stated.

SECTION B. Verification team, technical reviewer and approver

B.1. Verification team members

No.	Role	Type of resource	Last name	First name	Affiliation (e.g. name of central or other office of DOE or outsourced entity)	Involvement in			
						Desk/document review	On-site inspection	Interview(s)	Verification findings
1.	Team Leader & Technical Expert (TA 13.2)	IR	Menon	Rekha	RINA India	√	√	√	√
2.	Verifier	IR	Buragohain	Champak	RINA India	√	√	√	√

B.2. Technical reviewer and approver of the verification and certification report

No.	Role	Type of resource	Last name	First name	Affiliation (e.g. name of central or other office of DOE or outsourced entity)
1.	Technical reviewer	IR	Liu	Hui Feng	RINA China
2.	Approver	IR	Severino	Laura	RINA HQ

SECTION C. Application of materiality in conducting the verification

C.1. Consideration of materiality in planning the verification

No.	Risk that could lead to material errors, omissions or misstatements	Assessment of the risk		Response to the risk in the verification plan and/or sampling plan
		Risk level	Justification	
1.	Human error in the quantification of emissions (which may be more likely to occur if personnel are unfamiliar with, or not well trained regarding, emissions processes or data)	Low	Being 3 rd verification, the project proponent is familiar with monitoring procedures and data reporting in line with the registered CPA DDs and previous verification and	During the site visit, the verification team will interview the staffs of the CDM team and check all records to confirm whether the monitoring plan have been well implemented. The team will

	recording).		certification reports. Hence, the risk level is low.	review the whole data set of the daily report, and crosschecked against relevant log book records.
2.	Undue reliance on a poorly designed information system, which may have few effective quality controls	Low	Being 3 rd verification, the project proponent has already established a well-organized monitoring team, monitoring plan, including data collection procedure and QA/QC procedure consistent with registered monitoring plan. Log books are maintained, monitoring equipments are calibrated at defined frequency. Hence, the risk level is low.	The verification team will check the relevant records to confirm whether the data collection procedure and QA/QC procedure have been well implemented. Depending on how data is generated, processed, and reported, place greater emphasis on verifying data captured and processed manually and/or in spreadsheets versus those that are generated from an automated system
3.	Manual adjustment of otherwise automatically recorded activity levels	Medium	The swine population is monitored based on daily purchase (births, internal transfer) and exit (ex: sale, death, internal transfer). The aggregated value is manually recorded in log books. Being 3 rd verification, the responsible people are aware of defined monitoring procedure. However, there is likelihood that while transferring the recorded data manually, there is mistake. Hence, the risk is medium.	The verification team will verify the birth record, purchase and sales record, transfer record to cross check the swine population reported in emission reduction worksheet.
		Medium	The weight of each category of swine monitored on sample basis randomly and recorded in log books. The sample identification and weight is manual process and therefore may lead to a medium risk.	The verification team will verify the sampling procedure, records of weight data, competency of personnel involved and calibration records of weighing scales.

C.2. Consideration of materiality in conducting the verification

>>In order to detect errors, omissions or misstatements in emission reductions or removals being claimed by project participants in the monitoring report, the materiality have been applied by RINA a per clause 10.1.2.3 of VVS, Version 02 /07/. The project is a small scale CDM PoA and a 5 percent materiality threshold is applied.

- In planning the verification, RINA is able to understand the environment in which the project activity operates, the sources of project emissions within the project boundary and the leakage, the monitoring activities, the equipment used to monitor or measure activity data, the origin and application of data used to calculate or measure the emissions, data flow, the internal quality control system, and the overall organization with respect to monitoring and reporting.
- A verification plan has been designed to minimize risks that a material discrepancy would not be detected. The CPAs involves five sites and 100% data is available for verification. The data which directly affect emission reduction calculations being "the population of swine, biogas generated and utilized, weight of swines and electricity consumption from grid are monitored and measured by calibrated meters, weigh scale and hence 100% verifiable. The data log sheets of all the parameters

used in ER calculations were verified 100%. The use of spreadsheets shows the adequate controls related to data updates, version tracking, traceability and security.

- (c) During the course of the verification, any individual or aggregate errors, omission or misstatement identified, which resulted in discrepancies have been considered material and requested to be corrected.

RINA confirms that the claimed emission reductions are free from material errors, omissions or misstatements, with a reasonable level of assurance, and proceeds with the verification as defined in the verification plan.

SECTION D. Means of verification

D.1. Desk/document review

>>The monitoring report, version 01 of 01/08/2019, version 02 of 25/09/2019 and version 03 of 13/01/2020 /**01**/, the emission reduction calculations provided in the form of a spreadsheet (POA8027 ERs CPA1_2017-2018_ver1.xls) version 01 of 01/08/2019, POA8027 ERs CPA2_ver1.1.xls of 01/08/2019 and POA8027 ERs CPA3_2017_2018_ver1.xls of 01/08/2019 and 'POA8027 ERs CPA1_2017-2018_ver2.2.xls' of 25/09/2019, 'POA8027 ERs CPA2_ver2.2.xls' of 25/09/2019 and 'POA8027 ERs CPA3_2017_2018_ver2.1.xls' of 25/09/2019 /**02**/ were assessed as part of the verification. In addition the registered PoA DD version 14 of 18/08/2016 /**03**/, registered CPA-DD for CPA 1 version 14 of 18/08/2016, CPA 2 version 09 of 18/08/2016, and CPA 3 version 09 of 18/08/2016 /**04**/, in particular the baseline estimations and the monitoring plan and the validation report /**05**/ for the project were reviewed.

The monitoring report version 01 of 01/08/2019 /**01**/ was made publicly available on the CDM UNFCCC website on 06/08/2019. Appendix 3 lists the documentation that was reviewed during the verification.

D.2. On-site inspection

Duration of on-site inspection: 10/09/2019				
No.	Activity performed on-site	Site location	Date	Team member
1.	<p>Assessment of the implementation and operation of the project activity as per the registered PoA framework and registered monitoring plan;</p> <p>Monitoring arrangements and location of monitoring equipments (flow meter, energy meter, weighing scale etc.).</p> <p>Interviews with relevant personnel to determine whether the operational and data collection procedures are implemented in accordance with the registered monitoring plan;</p> <p>Cross check between information provided in the monitoring report and data from plant records such as logbooks, inventories, purchase records, invoices, energy bills, calibration records or similar data sources;</p> <p>A review of calculations and assumptions made in determining the GHG data and emission reductions and QA/QC procedures</p>	Chok Chai Farm	10/09/2019	Champok Buragohain & Rekha Menon

Out of three farms under CPA 1, one farm (Khana Hybrid Co., Ltd.- Phanom farm) is not in operation since July 2016 and therefore not part of this verification. Physical visit to Wang Noi Farm under CPA 01 was avoided due to restrictions imposed pertaining to spread of flu disease¹. However, it is to be clarified here that Wang Noi farm was visited by this same DOE during 04/03/2015 to 06/03/2015 and therefore it is not the first verification for the DOE with regard to this CPA. Also, the CPA has achieved only 13,858 tCO₂e emission reductions as part of first verification and expected to achieve another 20,610 tCO₂e emission reductions during last verification (under issuance request). Therefore, the CPA has not achieved more than 300,000 tCO₂e of emission reductions since last verification when an on-site inspection was conducted. Accordingly, as per paragraph 321 of VVS for PoA, version 02 site visit exclusion for Wang Noi farm under the CPA 1 is justified. The verification team did check all original records, latest dated photographs of monitoring equipment's and arrangements, calibration records etc. to verify the monitoring data and monitoring arrangements are in place. Similarly, physical site visit to CPA 2 and CPA 3 is avoided due to restrictions imposed pertaining to spread of flu diseases as explained above. In addition, as per paragraph 321 of VVS for PoA, version 02 the site visit can be avoided for CPA 2 and CPA 3 for below reasons:

- 1) It is not the first verification for this DOE with regard to these CPAs
- 2) The last physical on-site inspection to both the CPAs were done on 21/01/2019 and on 22/01/2019 and therefore it is far less than three years since the last on-site inspection was conducted for the CPAs by the same DOE.
- 3) None of the CPAs has achieved more than 300,000 tCO₂e of GHG emission reductions since the last verification when on-site inspection was conducted.

¹ <https://www.scmp.com/news/asia/southeast-asia/article/3010987/were-red-alert-thailand-ramps-efforts-prevent-african/> , <https://www.economist.com/asia/2019/06/20/african-swine-fever-spreads-to-south-east-asia/> <https://www.insurancejournal.com/news/international/2019/05/20/526807.htm>

Therefore, site visit was not conducted by the DOE. The verification team did check all original records, latest dated photographs of monitoring equipment's and arrangements, calibration records etc. to verify the monitoring data and monitoring arrangements are in place.

D.3. Interviews

No.	Interviewee			Date	Subject	Team member
	Last name	First name	Affiliation			
1.	Siripat	Alongkorn	ERDI	06/09/2019, 09/09/2019- 10/09/2019	Project implementation and operation, Institutional arrangement and Technical aspects project activity. Information flows for generating, aggregating and reporting the monitoring parameters Cross-check of information in the monitoring report and data source Monitoring plan and monitoring parameters. Technical equipment, calibration and monitoring observation	Champak Buragohain & Rekha Menon
3.	Chua	Susana	Representative from 'The World Bank'	06/09/2019, 09/09/2019- 10/09/2019	Preparation of MR, emission reduction calculations, methodology applicability etc.	Champak Buragohain & Rekha Menon
4.	Chitcharaenthon	Ekkaphoom	Chock Chai farm	10/09/2019	Actual project implementation, monitoring and record keeping. QA/QC procedures.	Champak Buragohain & Rekha Menon

D.4. Sampling approach

>>No sampling approach has been considered for the PoA. However, for monitoring of 'Average animal weight of a defined livestock population at the project site' (W_{site}), random sampling approach has been adopted at each CPA level and at each farm within the CPA for each of the swine category. The sampling plan has been detailed in the MR. 90/10 confidence precision has been considered by project participant and accordingly sample number in each swine category is determined for monitoring W_{site} for each swine type.

On annual basis, considering the total swine population under each swine category over the year, sample size to be determined considering 90/10 confidence precision.

The sample size for each swine category over the year is determined as explained in section E.3.4.3 of this report. The sample number varies based on the population size (average of the year) as transparently given in monitoring report section E.3 and also in emission reduction worksheet /02/. The sample number for each category in each farm is deemed to be adequate due to the following reasons. With margin of error to be

10%, confidence level at 90% and 50% response distribution the maximum sample size results to be 68 if the population size is more than 7,000 /11/. Therefore, the maximum sample size in PP's sample is 68 for some category of swines and it is less than 68 for some category of swines over the year due to population size. Therefore, selected sample by CME is representative of each type of swine population as outlined in MR and meets the desired confidence precision /11/ (Refer section E.3.4.3 of this report for details).

RINA considered to verify all sample record in each swine category at each farm covering the monitoring period during on-site visit and document review. The verification team did not find any discrepancy in reporting the sample results from the records of actual measurement. Therefore, desired confidence precision is achieved. For more details on the application of sampling plan, please refer to section E.3.4.3.

D.5. Clarification requests, corrective action requests and forward action requests raised

Areas of verification findings	No. of CL	No. of CAR	No. of FAR
General			
Compliance of the monitoring report with the monitoring report form			
Remaining forward action requests from validation and/or previous verifications			
CPAs considered for verification and covered in this report			
Programme of activities			
Compliance of the programme implementation with the registered PoA-DD	1		
Implementation and operation of the management system			
Post-registration changes			
• Corrections			
• Inclusion of a monitoring plan			
• Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents ²			
• Changes to the programme design			
• Addition of CPA inclusion template			
• Change of coordinating/managing entity			
• Changes specific to afforestation and reforestation activities			
Component project activities			
Compliance of the CPA implementation with the included CPA design document			
Post-registration changes			
• Temporary deviations from registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents			
• Corrections			
• Changes to the start date-of the crediting period			
• Inclusion of a monitoring plan			
• Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents			
• Changes to the project design			
• Changes specific to afforestation and reforestation activities			

² Other standards, methodologies, methodological tools and guidelines (to be) applied in accordance with the applied(selected) methodologies are collectively referred to as the other (applied) methodological regulatory documents).

Compliance of the registered monitoring plan with applied methodologies and standardized baselines			
Compliance of monitoring activities with the registered monitoring plan			
<ul style="list-style-type: none"> Data and parameters fixed ex ante or at renewal of crediting period 			
<ul style="list-style-type: none"> Data and parameters monitored 			
<ul style="list-style-type: none"> Implementation of sampling plan 			
Compliance with the calibration frequency requirements for measuring instruments		1	
Assessment of data and calculation of emission reductions or net removals			
<ul style="list-style-type: none"> Calculation of baseline GHG emissions or baseline net GHG removals by sinks 		1	
<ul style="list-style-type: none"> Calculation of project GHG emissions or actual net GHG removals by sinks 			
<ul style="list-style-type: none"> Calculation of leakage GHG emissions 			
<ul style="list-style-type: none"> Summary of calculation of GHG emission reductions or net GHG removals by sinks 			
<ul style="list-style-type: none"> Comparison of actual GHG emission reductions or net GHG removals by sinks with estimates in included CPA 			
<ul style="list-style-type: none"> Remarks on difference from estimated value in included CPA 			
Assessment of reported sustainable development co-benefits			
Global stakeholder consultation			
Others (please specify)			
Total	1	2	0

SECTION E. Verification findings

E.1. General

E.1.1. Compliance of the monitoring report with the monitoring report form

Means of verification	Comparing the monitoring report /01/ with the monitoring report form provided by CDM EB listed in UNFCCC website /12/.
Findings	NA
Conclusion	RINA confirms that the monitoring report used by the PP is compliance with the latest MR form available at UNFCCC website and is completed in accordance with the applicable instruction /12/.

E.1.2. Remaining forward action requests from validation and/or previous verifications

>>No FAR remaining from validation and or previous verification to be addressed during this verification.

E.1.3. CPAs considered for verification and covered in this report

Title and UNFCCC reference number of the CPA included in the PoA as of the end of this monitoring period	Is the CPA considered for this verification? (yes/no)	The date when the CPA was included	Version of the PoA-DD	Confirmation that a request for issuance including the CPA has been published for the previous monitoring period (Y/N)
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Thailand Small Scale Livestock Waste Management Program CPA 01	Yes	09/11/2012	Version 14 of 18/08/2016	Y
Thailand Small Scale Livestock Waste Management Program CPA 02	Yes	28/11/2014	Version 14 of 18/08/2016	Y
Thailand Small Scale Livestock Waste Management Program CPA 03	Yes	28/11/2014	Version 14 of 18/08/2016	Y

E.2. Programme of activities

E.2.1. Compliance of the programme implementation with the registered programme design document

Means of verification	<p>RINA has performed a site visit and document review to assess that all physical features (technology, project equipment, and monitoring and metering equipment) of the CPAs in the registered PoA-DD are in place and to verify the real implementation of the project against the description in its registered PoA-DD.</p> <p>The PoA involves, livestock manure management (in swine farms) and setting up anaerobic digester to recover biogas and utilize for power generation. This project plans to install anaerobic digestion technology designed by Energy Research and Development Institute (ERDI). The CPA 01 involves three swine farms namely Chokchaikansukorn Farm, Khana Hybrid Co., Ltd (Phanomsarakham Farm 1) and Laemthong Hybrid Co., Ltd (Wang Noi Farm). Each farm has installed anaerobic bio-digester of 3,750m³ and commissioned prior to the registration of the project activity under UNFCCC /09/. At Khana Hybrid Co., Ltd (Phanomsarakham Farm 1) the digester is equipped with two gas engine of capacity 150kW each, at Chokchaikansukorn Farm the digester is equipped with two gas engine of capacity 200kW each and at Laemthong Hybrid Co., Ltd (Wang Noi Farm) the digester is equipped with two gas engine of capacity 150 kW each. The commissioning of digester and gas engine at each farm under CPA 01 is verified from commissioning report of ERDI (technology supplier) /14/. CPA 02 involves one swine farm namely Charoenphansamchuk (CPS farm) with installed anaerobic bio-digester of capacity 6,250 m3 with two gas engine of capacity 328 kW commissioned on 09/11/2012 /17/. CPA 03 involves one swine farm namely Veerachai Nongpong with installed anaerobic bio-digester of capacity 10,000 m3 with one gas engine of capacity of 1200 kW (operating load 600 kW) commissioned on 05/03/2013 /18/.</p>
Findings	N/A
Conclusion	RINA confirms that the implementation and operation of the registered PoA and included CPA that is taken for this verification has been conducted in accordance with the description contained in the registered PoA-DD and CPA-DD.

E.2.2. Implementation and operation of the management system

Means of verification	<p>RINA conducted document review and on-site interview to assess implementation and operation of the management system which is consistent with the registered PoA-DD and CPA-DD. The followings were assessed and confirmed.</p> <ul style="list-style-type: none"> - The CME (ERDI) is under overall responsibility for operation and implementation of the programme. ERDI conducts regular audit and records review at each farm for consistency of implementing and monitoring arrangements. - A monitoring structure was established. ERDI (CME) and participating each farm working on the monitoring work of this PoA. - The data collection and management process is finally under the control of CME. Each farm sends raw data to CME and CME transfer the same for the calculation of the emission reduction.
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	During on-site inspection and document review, data management system was checked by the verification team. Raw data at each farm was cross checked against the compiled data presented in the ER sheet. Therefore, RINA is able to confirm that the data management system were properly designed and operated, and operation was well followed.
Findings	N/A
Conclusion	In conclusion, based on document review and interview, RINA confirms that the implementation and operation of the management system included in the CPA-DDs are consistent with the registered PoA-DD and CPA-DDs.

E.2.3. Post-registration changes

E.2.3.1. Corrections

>>N/A

E.2.3.2. Inclusion of a monitoring plan

>>N/A

E.2.3.3. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

>>N/A

E.2.3.4. Changes to the programme design

>>N/A

E.2.3.5. Addition of CPA inclusion template

>> N/A

E.2.3.6. Change of coordination/managing entity

>> N/A

E.2.3.7. Changes specific to afforestation and reforestation activities

>> N/A

E.3. Component project activities

E.3.1. Compliance of the CPA implementation with the included CPA design document

Means of verification	<p><i>Khana Hybrid Co., Ltd (Phanomsarakham Farm 1) under CPA 01 is not in operation since July 2016 and therefore not part of this verification.</i></p> <p>Charoenphansamchuk farm (CPA 2) could not monitor biogas flow to generator during the monitoring period which required for MDy calculation in line with the applied methodology and hence emission reductions for CPS farm for the monitoring period is not claimed.</p> <p>RINA visited Chockchai farm under CPA01 to access at all physical features (technology, project equipment, and monitoring and metering equipment) of the included CDM CPA in this monitoring period are in places and the coordinating/managing entity have operated the CPA as per the PoA-DD and</p>
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	<p>included CPA-DD. Site visit to Wang Noi farm under CPA 01, Charoenphansamchuk farm (under CPA 02) and Veerachai Nongpong farm (under CPA 03) was not done as explained in section D.2 above. However, the operation and implementation of each farms during the monitoring period was verified through document review of all original records, latest dated photographs of monitoring equipment's and arrangements, calibration records etc. to verify the monitoring data and monitoring arrangements are in place.</p> <p>The CPAs includes livestock manure management and setting up anaerobic digester to recover biogas and utilize for power generation in each participating farms. Each farm has installed anaerobic bio-digester and commissioned prior to the registration of the project activity under UNFCCC /09/. Also, each farm has installed gas engine equipped with digester to generate electricity and utilize at the respective farm. Chokchaikansukorn Farm digester is equipped with two gas engine of capacity 200kW each, although runs at a load of 150 kW /13/ and at Laemthong Hybrid Co., Ltd (Wang Noi Farm) the digester is equipped with two gas engine of capacity 150 kW each which runs at a load of 110 kW and 130 kW /13/. Charoenphansamchuk farm (under CPA 02) with installed anaerobic bio-digester of capacity 6,250 m3 has two gas engine of capacity 328 kW commissioned on 09/11/2012 /17/. Veerachai Nongpong farm (under CPA 03) with installed anaerobic bio-digester of capacity 10,000 m3 has one gas engine of capacity 1200 kW (operated at 600 kW) /18/. The commissioning of digester and gas engine at each farm is verified from commissioning report of ERDI (technology supplier) /14/, /17/, /18/. The biogas generation and its utilization (burning at gas engine and flaring) is monitored using dedicated flow meter so as to estimate the methane avoidance. Also the net electricity generation is monitored continuously. The generated power is used for internal consumption at farm. Biogas consumption in gas engines and at flaring are monitored continuously in separate mass flow meter in each farm except in Veerachai farm where flow meter to flaring is not yet installed. Other arrangements are in line with the registered CPA-DD.</p> <p>A new gas generator of 290 kW capacity was installed at CPS farm and in Veerachai farm a new 985 kW generator is installed. It was verified that the 290 kW generator at CPS farm was installed in May 2017 /20/ and the 985 kW generator at Veerachai farm was installed in January 2017 /21/.</p>
Findings	CL 01 was raised to clarify how the addition of new generators in CPS farm and Veerachai farm does not affect the additionality of the CPAs to which PP has clearly justified that the effective output even with operation of both the generators are not above the ex-ante defined output capacity (refer appendix 4 of this report) and hence CL is closed.
Conclusion	RINA confirms that the implementation and operation of the registered PoA and CPAs that are taken for this verification are in implementation as per the description contained in the registered PoA-DD and CPA-DD.

E.3.2. Post-registration changes

E.3.2.1. Temporary deviations from the registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents

>>N/A.

E.3.2.2. Corrections

>>N/A

E.3.2.3. Changes to the start-date of the crediting period

>> N/A

E.3.2.4. Inclusion of a monitoring plan

>> N/A

E.3.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents

>> N/A

E.3.2.6. Changes to the project design

>> N/A

E.3.2.7. Changes specific to afforestation and reforestation activities

>> N/A

E.3.3. Compliance of the registered monitoring plan with applied methodologies and standardized baselines

Means of verification	The registered monitoring plan is in compliance of AMS-III.D version 18 and applied 'tool to determine project emissions from flaring of gases containing methane' and all monitoring parameters ($N_{LT,y}$, $N_{da,y}$, $N_{p,y}$, W_{site} , BG_{burnt} , BG_{flare} , $EC_{PJ,y}$ and FFR) as per the registered monitoring plan found monitored during this monitoring period by each participating farm. The CME is responsible for compiling and keeping all records necessary for emission reduction of the project activity.
Findings	N/A
Conclusion	RINA confirms that the monitoring plan of the included CPA-DD is in compliance with the monitoring methodology including applicable tool(s) /01/, /03/, /04/, /09/.

E.3.4. Compliance of monitoring activities with the registered monitoring plan

E.3.4.1. Data and parameters fixed ex ante or at renewal of crediting period

Means of verification	DATA/PARAMETER Unit	Source of data	Reported value for the project period	Assessment/Observation
	Capacity / for each participating farm (kW)	Commissioning report of digester and biogas plant at each farm /14/, /17/, /18/	ChokchaiKansu Farm: 200kW*2 Khana Hybrid Farm: 150kW*2 Wang Noi Farm: 150kW*2 CPS Farm: 328 kW*2 Veerachai Farm: 1200 kW (operated at 600 kW) & 985 kW (stand-by)	The value is cross checked from name plant and commissioning reports and confirmed to be correct. However, the actual operating load is 150kW in ChokchaiKansu Farm, 110kW and 130 kW in Wang Noi Farm as confirmed during site visit and from operation reports from ERDI /13/. Also for CPS farm the operational load is 260 kW and for Veerachai farm it is operated at 600 kW. The details are consistent with validated CPA-DDs /04/, /09/. Khana Hybrid farm is not part of this verification.
	Fraction of manure being treated by the system ($MS\%_{BI,j}$)	Data based on registered CPA-DDs /04/ and validation	100%	The value is as per the registered CPA-DDs, which has been justified and validated by

		report /09/		validation DOE to follow the applied methodology and already approved by EB /04/, /09/.
	Global Warming Potential of Methane (GWP_{CH_4})	Data based on registered CPA-DDs /04/ and validation report /09/	21 tCO_2e/tCH_4 for first commitment period upto 31/12/2012 and 25 from 01/01/2013 onwards.	The value is as per the registered CPA-DDs, which has been justified and validated by validation DOE and as per EB guideline /04/, /09/, /15/.
	Density of methane at room temperature (20°C) and 1 atm pressure (D_{CH_4})	Data based on registered CPA-DDs /04/ and validation report /09/	0.00067 t/m^3	The value is as per the registered CPA-DDs, which has been justified and validated by validation DOE to follow the applied methodology and already approved by EB /04/, /09/.
	Annual methane conversion factor (MCF) for baseline animal waste management system "j" (MCF_j)	Data based on registered CPA-DDs /04/ and validation report /09/	80%	The value is as per the registered CPA-DDs, which has been justified and validated by validation DOE to follow the applied methodology and already approved by EB /04/, /09/.
	Maximum methane producing potential of the volatile solid generate for animal type "LT" ($B_{0,LT}$)	IPCC Guidelines for National Greenhouse Gas Inventories Annex 10A.2 Tables 10A-7 and 10A-8 /16/	Default as per Annex 10A.2 Tables 10A-7 and 10A-8 /16/	The value as reported in CPA-DD is default value of IPCC /16/ and consistent with methodology requirement /08/. Hence, accepted by the verification team.
	Model correction factor to account for model uncertainties (UF_b)	Data based on registered CPA-DDs /04/ and validation report /09/	0.94	The value is as per the registered CPA-DDs, which has been justified and validated by validation DOE to follow the applied methodology and already approved by EB /04/, /09/.
	Volatile solids for livestock "LT" entering the animal manure management system in year "y" ($VS_{LT,y}$)	IPCC Guidelines for National Greenhouse Gas Inventories Annex 10A.2 Tables 10A-7 and 10A-8 /16/	Default as per Annex 10A.2 Tables 10A-7 and 10A-8 /16/	The value as reported in CPA-DDs is default value of IPCC /16/ and consistent with methodology requirement /08/. Hence, accepted by the verification team.
	Flare Efficiency (FE)	Data based on registered CPA-DDs /04/ and validation report /09/	50%	The value is as per the registered CPA-DDs, which has been justified and validated by validation DOE to follow the applied methodology and tool and already

				approved by EB /04/, /09/
	Emission coefficient of the electricity distribution system (CEF _{grid})	Data based on registered CPA-DDs /04/ and validation report /09/	0.5661 tCO ₂ /MWh	The value is as per the registered CPA-DDs, which has been justified and validated by validation DOE to follow the applied methodology and already approved by EB /04/, /09/
	Methane content in biogas in the year "y" on a dry basis (mass fraction) (W _{CH₄,y})	Data based on registered CPA-DDs /04/ and validation report /09/	60%	The value is as per the registered CPA-DDs, which has been justified and validated by validation DOE to follow the applied methodology and already approved by EB /04/, /09/
Findings	N/A			
Conclusion	RINA confirms that all the ex-ante parameters have been correctly mentioned and justified in section E.1 of the MR and applied in the ER calculation. The information of data and parameters fixed ex-ante provided in the monitoring report is compliance with the revised PoA-DD and revised CPA-DDs /01/, /03/, /04/.			

E.3.4.2. Data and parameters monitored

Means of verification	Data/Parameter	Assessment																																							
	Data Unit	N _{LT,y} ; number																																							
	Description	Number of animals produced annually of type <i>LT</i> for the year <i>y</i> .																																							
	Source of data to be used	Farm record																																							
	Value of monitored parameter for the monitoring period	<p>Total number of animals produced annually of type <i>LT</i> (N_{LT,y}) includes 'N_{da,y}' (Number of days animal is alive in the farm in the year <i>y</i>) in monthly farm records. The farm record includes daily purchase (births, internal transfer) and exit (ex: sale, death, internal transfer). Therefore, N_{LT,y} record implicitly consider N_{da,y}. Farm wise, N_{LT,y} recorded value is provided below:</p> <p>CPA 01: Laemthong Hybrid (Wang Noi):</p> <table><tr><td>Category</td><td>2017</td><td>2018</td><td>Period Total</td></tr><tr><td>Nursery</td><td>13,476</td><td>13,589</td><td>27,065</td></tr><tr><td>Fattening 1</td><td>-</td><td>-</td><td></td></tr><tr><td>Fattening 2</td><td>7,808</td><td>8,163</td><td>15,971</td></tr></table> <p>Chokchaikansukorn:</p> <table><tr><td>Category</td><td>2017</td><td>2018</td><td>Period Total</td></tr><tr><td>Nursery</td><td>2,664</td><td>2,703</td><td>5,367</td></tr><tr><td>Fattening 1</td><td>-</td><td>-</td><td>-</td></tr><tr><td>Fattening 2</td><td>10,228</td><td>9,790</td><td>20,018</td></tr><tr><td>Breed Male</td><td>42</td><td>37</td><td>79</td></tr><tr><td>Breed</td><td>1 444</td><td>1 412</td><td>2 856</td></tr></table>	Category	2017	2018	Period Total	Nursery	13,476	13,589	27,065	Fattening 1	-	-		Fattening 2	7,808	8,163	15,971	Category	2017	2018	Period Total	Nursery	2,664	2,703	5,367	Fattening 1	-	-	-	Fattening 2	10,228	9,790	20,018	Breed Male	42	37	79	Breed	1 444	1 412
Category	2017	2018	Period Total																																						
Nursery	13,476	13,589	27,065																																						
Fattening 1	-	-																																							
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Nursery	2,664	2,703	5,367																																						
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Breed Male	42	37	79																																						
Breed	1 444	1 412	2 856																																						

		Female			
		CPA 02:			
		CPS farm:			
		Category	2017	2018	Period Total
		Nursery	9,682	9,299	18,981
		Fattening 2	11,346	15,095	26,441
		Breed Male	60	64	124
		Breed Female	123	128	251
		CPA 03			
		Veerachai Farm			
		Category	2017	2018	Period Total
		Nursery	31,916	43,664	75,580
		Fattening 1	-	-	-
		Fattening 2	51,982	59,268	111,250
		Breed Male	49	50	99
		Breed Female	10,563	11,019	21,582
		RINA cross-checked the monthly values used in the emission reduction calculation /02/ against the monthly records /22-26/ and found the reported values to be correct. RINA cross-checked the number of livestock with indirect information like animal purchase and sales /27/.			
	Monitoring equipment	N/A			
	Accuracy of the monitoring equipment	N/A			
	Measuring/Reading/Recording frequency	Recorded monthly and aggregated annually. This is as per registered monitoring plan.			
	Calculation method (if applicable)	N/A			
	Data/Parameter	Assessment			
	Data Unit	N _{p,y} ; number			
	Description	Number of animals produced annually of type LT for the year y.			
	Source of data to be used	Farm record			
	Value of monitored parameter for the monitoring period	N _{p,y} is incorporated in monthly farm records for arriving total number of animals produced annually of type LT (N _{LT,y}). The farm record includes daily purchase (births, internal transfer) and exit (ex: sale, death, internal transfer). Therefore, N _{LT,y} record implicitly consider N _{da,y} . Farm wise, N _{LT,y} recorded value is provided below: CPA 01: Laemthong Hybrid (Wang Noi):			
		Category	2017	2018	Period Total
		Nursery	13,476	13,589	27,065
		Fattening 1	-	-	
		Fattening 2	7,808	8,163	15,971
		Chokchaikansukorn:			
		Category	2017	2018	Period Total

Nursery	2,664	2,703	5,367
Fattening 1	-	-	-
Fattening 2	10,228	9,790	20,018
Breed Male	42	37	79
Breed Female	1,444	1,412	2,856

CPA 02:

CPS farm:

Category	2017	2018	Period Total
Nursery	9,682	9,299	18,981
Fattening 2	11,346	15,095	26,441
Breed Male	60	64	124
Breed Female	123	128	251

CPA 03

Veerachai Farm

Category	2017	2018	Period Total
Nursery	31,916	43,664	75,580
Fattening 1	-	-	-
Fattening 2	51,982	59,268	111,250
Breed Male	49	50	99
Breed Female	10,563	11,019	21,582

RINA cross-checked the monthly values used in the emission reduction calculation /02/ against the monthly records /22-26/ and found the reported values to be correct. RINA cross-checked the number of livestock with indirect information like animal purchase and sales /27/.

Monitoring equipment

N/A

Accuracy of the monitoring equipment

N/A

Measuring/Reading/Recording frequency

Recorded monthly and aggregated annually. This is as per registered monitoring plan.

Calculation method (if applicable)

N/A

Data/Parameter	Assessment		
Data Unit	W _{site} ; Kg		
Description	Average animal weight of a defined livestock population at the project site (in kg)		
Source of data to be used	Farm records of animal weight in each category in the farm annually.		
Value of monitored parameter for the monitoring period	Year 2017		
	CPA 01:		
	Type of animal	Wang Noi	Chochaikansukorn
	Breeding (male)	-	251.68
	Breeding (female)	-	186.00
Fattening 1			

Fattening 2	96.5	100.99
Nursery	11.0	20.28

CPA 02 (CPS farm)

Type of animal	Weight (kg)
Breeding (male)	247.3
Breeding (female)	189.5
Fattening 1	115.2
Fattening 2	
Nursery	17.7

CPA 03 (Veerachai farm):

Type of animal	Weight (kg)
Breeding (male)	248.2
Breeding (female)	190.9
Fattening 1	-
Fattening 2	115.4
Nursery	20.0

Year 2018:

CPA 01:

Type of animal	Wang Noi	Chochaikansukorn
Breeding (male)	-	257.12
Breeding (female)	-	189.75
Fattening 2	98.4	104.51
Nursery	10.9	19.45

CPA 02 (CPS farm)

Type of animal	Weight (kg)
Breeding (male)	243.8
Breeding (female)	187.9
Fattening 2	113.0
Nursery	17.6

CPA 03 (Veerachia Farm)

Type of animal	Weigh (kg)
Breeding (male)	248.7
Breeding (female)	191.1
Fattening 2	114.3
Nursery	18.5

Average value of all samples in the year is considered for emission reduction calculation. Weight records of all samples for each category of swine taken on different dates of the year were checked and average value is considered in emission reduction calculation /22-26/. The sampling approach is described in section D.4 and section E.3.4.3 of this report.

Monitoring equipment

Type : Weighing scale

Farm	Make	Sl. No.
Wang Noi (CPA 01)	WI-P	2013016
Chokchai	Commandor	0000719

		(CPA 01)	HP-05	
		CPS farm (CPA 02)	Mettler Toledo Kingbird	0042546AJ
		Veerachai Farm (CPA 03)	Mettler Toledo Kingbird	B301674114
		Accuracy class: $\pm 5\%$		
Accuracy of the monitoring equipment	The uncertainty measurement of $\pm 5\%$ is as per equipment specifications /28-31/.			
Measuring/Reading/Recording frequency	Recorded annually for sample of swines in each category. Measuring and recording frequency is as per registered CPA-DD.			
Calculation method (if applicable)	Not applicable. However, calibration of weighing scales do not cover the entire monitoring period for VCS and Veerachai farm. Calibration gap noted from 01/01/2017 to 19/12/2017 for CPS farm and from 01/01/2017 to 25/12/2017 for Veerachai farm. Therefore PP has applied maximum error factor of the instrument (5%) for the duration of the monitoring period (as resulted error found within permissible limit) as per 'Appendix: Calibration' of VVS for PoA, version 02 /07/. Corrected conservative values are reported in MR and emission reduction worksheet. On different dates within the monitoring period, each farm take random swine samples from each swine category and measure the weight. Records are kept /22-26/. Required number of samples are used for emission reduction calculation. Original weighing records were verified during site visit at each farm.			

Data/Parameter	Assessment																				
Data Unit	$BG_{burnt,y}; Nm^3$																				
Description	Biogas volume in year y																				
Source of data to be used	Monitored value as per flow meter used for BG_{elec} and BG_{flare} .																				
Value of monitored parameter for the monitoring period	<table border="1"> <tr> <th>Farm</th><th>2017</th><th>2018</th><th>Period Total</th></tr> <tr> <td>Wang Noi (CPA 01)</td><td>300,186</td><td>339,642</td><td>639,828</td></tr> <tr> <td>Chokchai (CPA 01)</td><td>383,846</td><td>351,045</td><td>734,891</td></tr> <tr> <td>CPS farm (CPA 02)</td><td>0</td><td>0</td><td>0</td></tr> <tr> <td>Veerachai Farm (CPA 03)</td><td>2,076,851</td><td>1,894,438</td><td>3,971,290</td></tr> </table>	Farm	2017	2018	Period Total	Wang Noi (CPA 01)	300,186	339,642	639,828	Chokchai (CPA 01)	383,846	351,045	734,891	CPS farm (CPA 02)	0	0	0	Veerachai Farm (CPA 03)	2,076,851	1,894,438	3,971,290
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CPS farm (CPA 02)	0	0	0																		
Veerachai Farm (CPA 03)	2,076,851	1,894,438	3,971,290																		
Monitoring equipment	Since, $BG_{burnt,y}$ is the summation value of $BG_{elec,y}$ and $BG_{flare,y}$. Monitoring equipment details of $BG_{elec,y}$ and $BG_{flare,y}$ are given in respective parameters.																				
Accuracy of the monitoring equipment	Refer for parameter $BG_{elec,y}$ and $BG_{flare,y}$.																				
Measuring/Reading/Recording frequency	Refer for parameter $BG_{elec,y}$ and $BG_{flare,y}$.																				
Calculation method (if applicable)	$BG_{burnt,y}$ is the summation value of $BG_{elec,y}$ and $BG_{flare,y}$.																				

Data/Parameter	Assessment																					
Data Unit	BG _{elec,y} , Nm ³																					
Description	Amount of biogas captured and used as fuel for the generator																					
Source of data to be used	Monitored value as per flow meter																					
Value of monitored parameter for the monitoring period	<table border="1"> <thead> <tr> <th>Farm</th><th>2017</th><th>2018</th><th>Period Total</th></tr> </thead> <tbody> <tr> <td>Wang Noi (CPA 01)</td><td>300,186</td><td>339,642</td><td>639,828</td></tr> <tr> <td>Chokchai (CPA 01)</td><td>383,846</td><td>351,045</td><td>734,891</td></tr> <tr> <td>CPS farm (CPA 02)</td><td>0</td><td>0</td><td>0</td></tr> <tr> <td>Veerachai Farm (CPA 03)</td><td>2,076,851</td><td>1,894,438</td><td>3,971,290</td></tr> </tbody> </table> <p>The reported values are cross checked from log book records at each farm and found to be correct /22-26/. The total biogas used in generator was also cross checked from totalized value in the flow meter and found to be correct. The measurement, monitoring recording and QA/QC procedure is as per registered CPA-DD. Further, the emission reduction is claimed as per equation 9 of applied methodology; therefore a conservative approach has been followed. For CPS farm no recording of flow of biogas to the generator was done for the entire monitoring period and hence, zero value is considered for this period. This is conservative as per paragraph 228 (b) of CDM project standard for PoA version 02.</p>	Farm	2017	2018	Period Total	Wang Noi (CPA 01)	300,186	339,642	639,828	Chokchai (CPA 01)	383,846	351,045	734,891	CPS farm (CPA 02)	0	0	0	Veerachai Farm (CPA 03)	2,076,851	1,894,438	3,971,290	
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Monitoring equipment	<p>Endress-Hauser Proline t-mass 65, Thermal mass flowmeter (CPA 01 & CPA 02).</p> <table border="1"> <thead> <tr> <th>Farm</th><th>Serial Number</th><th>Installation Date</th></tr> </thead> <tbody> <tr> <td>Wang Noi (CPA 01)</td><td>F5147D02000</td><td>30/10/2012</td></tr> <tr> <td>Chokchai (CPA01)</td><td>EC0A3E02000</td><td>28/10/2012</td></tr> <tr> <td>CPS farm (CPA 02)</td><td>D3048502000</td><td>06/05/2015</td></tr> </tbody> </table> <p>FCI. FLUID COMPONENTS INTERNATIONAL LLC flow meter in Veerachai Farm (CPA 03)</p> <table border="1"> <thead> <tr> <th>Engine</th><th>Serial No.</th><th>Installation date</th></tr> </thead> <tbody> <tr> <td>1200 kW</td><td>493548</td><td>01/07/2015</td></tr> <tr> <td>985 kW</td><td>493549</td><td>January 2017</td></tr> </tbody> </table>	Farm	Serial Number	Installation Date	Wang Noi (CPA 01)	F5147D02000	30/10/2012	Chokchai (CPA01)	EC0A3E02000	28/10/2012	CPS farm (CPA 02)	D3048502000	06/05/2015	Engine	Serial No.	Installation date	1200 kW	493548	01/07/2015	985 kW	493549	January 2017
Farm	Serial Number	Installation Date																				
Wang Noi (CPA 01)	F5147D02000	30/10/2012																				
Chokchai (CPA01)	EC0A3E02000	28/10/2012																				
CPS farm (CPA 02)	D3048502000	06/05/2015																				
Engine	Serial No.	Installation date																				
1200 kW	493548	01/07/2015																				
985 kW	493549	January 2017																				
Accuracy of the monitoring equipment	<p>±1.5 % of reading for 100 % to 10 % of range (at reference conditions)- Endress-Hauser flowmeter ±0.15 % of full scale for 10 % to 1 % of range (at reference conditions)- Endress-Hauser flowmeter ± 2% reading ± 0.5% full scale (FCI flow meter)</p>																					
Measuring/Reading/Recording frequency	Monitored continuously and aggregated monthly and reported annually. This is as per registered monitoring plan /04/ .																					
Calculation method (if applicable)	N/A																					

Data/Parameter	Assessment																				
Data Unit	BG _{flare,y} ; Nm ³																				
Description	Amount of biogas sent to flare																				
Source of data to be used	Monitored value as per flow meter																				
Value of monitored parameter for the monitoring period	<table border="1"> <thead> <tr> <th>Farm</th><th>2017</th><th>2018</th><th>Period Total</th></tr> </thead> <tbody> <tr> <td>Wang Noi (CPA 01)</td><td>0</td><td>0</td><td>0</td></tr> <tr> <td>Chokchai (CPA 01)</td><td>0</td><td>0</td><td>0</td></tr> <tr> <td>CPS farm (CPA 02)</td><td>0</td><td>0</td><td>0</td></tr> <tr> <td>Veerachai farm (CPA 03)</td><td>0</td><td>0</td><td>0</td></tr> </tbody> </table> <p>No flaring in any of the participating farms as seen from records during site visit and document review. For Veerachai farm flow meter is not installed for flaring was not installed until the end of the monitoring period and no emission reductions are accordingly claimed. Therefore reported value is put as zero. This is conservative approach only.</p>	Farm	2017	2018	Period Total	Wang Noi (CPA 01)	0	0	0	Chokchai (CPA 01)	0	0	0	CPS farm (CPA 02)	0	0	0	Veerachai farm (CPA 03)	0	0	0
Farm	2017	2018	Period Total																		
Wang Noi (CPA 01)	0	0	0																		
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Farm	Serial Number	Installation Date																			
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CPS farm (CPA 02)	L20CFE02000	24/02/2016																			
Veerachai (CPA 03)	No flow meter installed.																				
Accuracy of the monitoring equipment	<p>±1.5 % of reading for 100 % to 10 % of range (at reference conditions)</p> <p>±0.15 % of full scale for 10 % to 1 % of range (at reference conditions).</p>																				
Measuring/Reading/Recording frequency	Monitored continuously and aggregated monthly and reported annually. This is as per registered monitoring plan /04/.																				
Calculation method (if applicable)	N/A																				

Data/Parameter	Assessment														
Data Unit	Flare operation; Hours														
Description	Flare operation in hour 'h'														
Source of data to be used	As per farm records														
Value of monitored parameter for the monitoring period	<p>Total operational hours during the monitoring period:</p> <p>Year 2017:</p> <table border="1"> <thead> <tr> <th>Farm</th><th>Hours</th></tr> </thead> <tbody> <tr> <td>Wang Noi (CPA 01)</td><td>0</td></tr> <tr> <td>Chokchai (CPA 01)</td><td>0</td></tr> <tr> <td>CPS farm (CPA 02)</td><td>0</td></tr> <tr> <td>Veerachai Farm (CPA 03)</td><td>0</td></tr> </tbody> </table> <p>Year 2018</p> <table border="1"> <thead> <tr> <th>Farm</th><th>Hours</th></tr> </thead> <tbody> <tr> <td>Wang Noi (CPA 01)</td><td>0</td></tr> </tbody> </table>	Farm	Hours	Wang Noi (CPA 01)	0	Chokchai (CPA 01)	0	CPS farm (CPA 02)	0	Veerachai Farm (CPA 03)	0	Farm	Hours	Wang Noi (CPA 01)	0
Farm	Hours														
Wang Noi (CPA 01)	0														
Chokchai (CPA 01)	0														
CPS farm (CPA 02)	0														
Veerachai Farm (CPA 03)	0														
Farm	Hours														
Wang Noi (CPA 01)	0														

		Chokchai (CPA 01)	0			
		CPS farm (CPA 02)	0			
		Veerachai Farm (CPA 03)	0			
Monitoring equipment	A thermocouple type K, Model TH-10 with SUS316L from IES ELECTRIC Co., Ltd., is used to measure temperature.					
		Farm	Serial Number			
		Wang Noi (CPA 01)	TH102459			
		Chokchai (CPA 01)	TH101256			
		CPS farm (CPA 02)	TH105214			
		Veerachai Farm (CPA 03)	TH106574			
Accuracy of the monitoring equipment	The accuracy of k type thermocouple is $\pm 2.2\text{C}\%$ or $\pm .75\%$ /35/.					
Measuring/Reading/Recording frequency	The temperature and flaring time will be automatically recorded continuously. Daily flare operational hours recorded in each farm and monthly summarized value is presented in ER sheet /02/. The raw input log sheet containing flare operation hours checked for each farm /22/. If flare is detected for more than 20 minutes the same is reported in emission reduction worksheet. Monitoring is as per registered monitoring plan /04/.					
Calculation method (if applicable)	N/A					
Data/Parameter		Assessment				
Data Unit		EC _{PJ,y} kWh				
Description		Quantity of electricity consumed by the project from the grid				
Source of data to be used		Conservative estimate using maximum rating and continuous use of equipment				
Value of monitored parameter for the monitoring period		Value is estimated considering source of GHG emissions operated at full capacity for the entire monitoring period for all farms and presented in MWh in below:				
			2017	2018	Period total	
		Wang Noi (CPA 01)	146.73	146.73	293.46	
		Chokchai (CPA 01)	126.14	126.14	252.29	
		CPS farm (CPA 02)	196.22	196.22	392.44	
		Veerachai farm (CPA 03)	353.9	353.9	707.81	
Monitoring equipment	In consistent with registered CPA-DDs, 'if monitoring of electricity consumed by the project cannot be isolated from the overall farm electricity consumption, EC _{PJ,y} will be derived from applying the assumption that electrical appliances are continuously utilized' PP could not independently monitor electricity consumed by the each farm from grid under each CPA and therefore in consistent with Appendix 2 of CDM project standard for PoA, version 02 /06/, managing entity					

		estimated these parameters assuming that the source of the GHG emissions operated at maximum capacity for the full period. The connected load of each farm under the CPAs were verified from commissioning report of the projects and during site visit /14/,/17/, /18/. Since, the parameter is for project GHG emissions related to the consumption of electricity, the estimate included an addition of 10% to account for transmission and distribution losses as per CDM project standard for PoA, version 02 paragraph 228 (b)-(ii) /06/.
	Accuracy of the monitoring equipment	N/A
	Measuring/Reading/Recording frequency	N/A
	Calculation method (if applicable)	The installed equipments for consuming grid electricity were considered operated at full capacity and for entire period (8760 hours every year) and included an addition of 10% to account for transmission and distribution losses. This is in line with paragraph 228 b (ii) of CDM project standard for PoA , version 02 /06/.

Data/Parameter	Assessment
Data Unit	EG _{y;auxiliary} ; kWh
Description	Renewable electricity generated by the project activity, consumed by auxiliary equipment
Source of data to be used	Farm record on the utilization of electrical appliances under the project activity, using renewable energy
Value of monitored parameter for the monitoring period	Value is considered zero for this monitoring period as entire electricity generated from produced bio-gas is used for in house consumption and there is no off-farm sale as verified during site visit. Therefore this is considered zero on conservative side.
Monitoring equipment	Not applicable since this zero value is considered for this parameter
Accuracy of the monitoring equipment	N/A
Measuring/Reading/Recording frequency	N/A
Calculation method (if applicable)	N/A

Data/Parameter	Assessment
Data Unit	NCV _{i,y} ; GJ/m ³
Description	Net calorific value of fuel type / in year y
Source of data to be used	Values from the fuel supplier will be used
Value of monitored parameter for the monitoring period	Value is considered zero for this monitoring period as no fossil fuel found consumed in any of the participating farms during the monitoring period as verified during site visit. Grid electricity consumption (refer parameter 'EC _{PJy} ' above) has been taken for project emission calculation. There is no diesel generator installed and used for the

	project activities under the CPAs.
Monitoring equipment	Not applicable since this zero value is considered for this parameter
Accuracy of the monitoring equipment	Not applicable since this zero value is considered for this parameter
Measuring/Reading/Recording frequency	Not applicable since this zero value is considered for this parameter
Calculation method (if applicable)	N/A

Data/Parameter	Assessment
Data Unit	EF _{CO2,I,y} ; tCO ₂ /GJ
Description	CO ₂ emission factor of fuel type I in year y
Source of data to be used	Values from the fuel supplier will be used or IPCC default values
Value of monitored parameter for the monitoring period	Value is considered zero for this monitoring period as no fossil fuel found consumed in any of the participating farms during the monitoring period as verified during site visit.
Monitoring equipment	Not applicable since this zero value is considered for this parameter
Accuracy of the monitoring equipment	Not applicable since this zero value is considered for this parameter
Measuring/Reading/Recording frequency	Not applicable since this zero value is considered for this parameter
Calculation method (if applicable)	N/A

Data/Parameter	Assessment
Data Unit	MS%
Description	Fraction on manure handled in system I in the project activity in year y
Source of data to be used	Farm Record
Value of monitored parameter for the monitoring period	100%. All manure at each farm was found handled in the treatment system which is cross checked from farm records duly signed by farm manager on daily basis /32/.
Monitoring equipment	Manure is collected daily or every other day by hose flushing all material through a series of collection channels, operating by gravity. Since, no manure was diverted during the monitoring period there was no weighing scale involved for the same.
Accuracy of the monitoring equipment	N/A
Measuring/Reading/Recording frequency	N/A
Calculation method (if applicable)	N/A

Data/Parameter	Assessment
Data Unit	nd _y ; Days
Description	Number of days that the animal manure

	management system was operational																		
Source of data to be used	Farm Record																		
Value of monitored parameter for the monitoring period	<table border="1"> <tr> <th>Farms</th><th colspan="2">Number of operational days</th></tr> <tr> <td></td><th>Year 2017</th><th>Year 2018</th></tr> <tr> <td>Wang Noi- CPA 1</td><td>365</td><td>365</td></tr> <tr> <td>Chockchai- CPA 1</td><td>365</td><td>365</td></tr> <tr> <td>CPS- CPA 2</td><td>365</td><td>365</td></tr> <tr> <td>Veerachai- CPA 3</td><td>365</td><td>365</td></tr> </table> <p>Operational days are incorporated in the emission reduction worksheet. Log book records of operation of manure management system at each farm was checked during site visit /22-26/.</p>	Farms	Number of operational days			Year 2017	Year 2018	Wang Noi- CPA 1	365	365	Chockchai- CPA 1	365	365	CPS- CPA 2	365	365	Veerachai- CPA 3	365	365
Farms	Number of operational days																		
	Year 2017	Year 2018																	
Wang Noi- CPA 1	365	365																	
Chockchai- CPA 1	365	365																	
CPS- CPA 2	365	365																	
Veerachai- CPA 3	365	365																	
Monitoring equipment	Log book records /22-26/.																		
Accuracy of the monitoring equipment	N/A																		
Measuring/Reading/Recording frequency	Daily as verified from log book records /22-26/.																		
Calculation method (if applicable)	N/A																		

Data/Parameter	Assessment
Data Unit	Proper soil application (not resulting in methane emissions) of the residual waste; %
Description	Ratio of final sludge treated aerobically over total sludge treated
Source of data to be used	Farm Record
Value of monitored parameter for the monitoring period	100% of the sludge generated found treated aerobically as seen during site visit.
Monitoring equipment	Log book records.
Accuracy of the monitoring equipment	N/A
Measuring/Reading/Recording frequency	Daily and reported monthly as verified from log book records /22-26/.
Calculation method (if applicable)	N/A

Data/Parameter	Assessment
Data Unit	Onsite inspections for each individual farm included in the project boundary
Description	Onsite inspections of the project boundary
Source of data to be used	Farm Record
Value of monitored parameter for the monitoring period	N/A. Farm records for operational condition of all equipments, system, calibration status etc. are recorded at each farm /22-26/.
Monitoring equipment	Farm record.
Accuracy of the monitoring equipment	N/A
Measuring/Reading/Recording frequency	Annual recording.

Calculation method (if applicable)	N/A
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Data/Parameter	Assessment
Data Unit	Genetic source of the production operations livestock
Description	Genetic source of the production operations livestock
Source of data to be used	Farm Record
Value of monitored parameter for the monitoring period	<p>The genetic source of swines for all the Farms (CPA 1, CPA 2 and CPA 3) are from Western Europe and North America /45/. Accordingly considered VS_{LT} and Bo_{LT} default values from IPCC applicable for Western Europe and North America are used /16/.</p> <p>Based on the genetic source, IPCC default value of Bo_{LT} from Western Europe origin is taken conservatively for all swine categories. Similarly IPCC default value of VS_{LT} for market swine of North America origin is taken conservatively. And for breeding swines Western Europe origin is taken conservatively.</p> <p>This is consistent with the applied methodology /08/.</p>
Monitoring equipment	Farm record.
Accuracy of the monitoring equipment	N/A
Measuring/Reading/Recording frequency	Annual recording.
Calculation method (if applicable)	N/A

Data/Parameter	Assessment
Data Unit	FFR
Description	Formulated Feed Rations
Source of data to be used	Farm Record
Value of monitored parameter for the monitoring period	<p>During the site visit it has been seen that formulated feed rations are being controlled according to internal operational procedures manual at each farms /31/. RINA also checked the formulae of food composition for each farm /27/.</p>
Monitoring equipment	Farm record.
Accuracy of the monitoring equipment	N/A
Measuring/Reading/Recording frequency	Annual recording.
Calculation method (if applicable)	N/A

Data/Parameter	Assessment
Data Unit	TDL _{j,y}
Description	Average technical transmission and distribution losses for providing electricity to source <i>j</i> in year <i>y</i>
Source of data to be used	Ministry of Energy. Use recent, accurate and

		reliable data available in Thailand	
	Value of monitored parameter for the monitoring period	6.10% as per Thailand Energy Statistics (Preliminary) 2013", published by DEDE, Ministry of Energy /32/. However, on a conservative side PP has applied 10% for this parameter to account project emission as per paragraph 228 (b)-ii of CDM project standard for PoA /06/.	
	Monitoring equipment	N/A	
	Accuracy of the monitoring equipment	N/A	
	Measuring/Reading/Recording frequency	Annual as per registered monitoring plan /04/.	
	Calculation method (if applicable)	N/A	
Findings	CAR 01 was raised as there was inconsistency in reporting the values in emission reduction sheet from records which PP corrected in the revised documents and hence CAR is closed.		
Conclusion	RINA is able to confirm that the monitoring has been implemented in compliance with the registered monitoring plan and as per provision of project standard.		

E.3.4.3. Implementation of sampling plan

Means of verification	<p>Sampling plan is followed for monitoring of 'Average animal weight of a defined livestock population at the project site' (W_{site}) at each farm at CPA level. Random sampling approach has been adopted at each farm within the CPA for each of the swine category. 90/10 confidence precision has been considered by project participant and accordingly sample number in each swine category is determined for monitoring W_{site} for each swine type annually. Considering total number of swines in each category in each farm, sample size is determined as per the formula considered in the registered CPA-DDs.</p> $n \geq \frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p(1-p)}{e^2 N} \right)}$ <p>Where:</p> <p>n Sample size</p> <p>z z-score (the number of standard deviations a given proportion is away from the mean) of confidence level of 90% (1.645)</p> <p>p Response distribution (50% used for normal distribution)</p> <p>e Relative precision (or margin of error)</p> <p>N Total number of heads (same as N_{LT})</p> <p>Accordingly each year number of sample size is determined and weigh record of each sample is recorded on a paper form and signed by the farm personnel who perform the weighing.</p> <p>It is noted that the parameter for which sample size is to be determined is a mean-value parameter and using a formula for mean-value parameter (referring equation 18 of guideline: sampling and surveys for CDM project activities and programme of activities' version 4 /48/) the sample size results near to zero for many swine categories. Hence, as explained in section B.1 of the MR, the proportion value formula used for sample size calculation is considered more conservative.</p> <p>The sample size of each swine category in each farm is deemed to be adequate due to the following reasons. With margin of error to be 10%, confidence level at 90% and 50% response distribution the maximum sample size results to be 68 with more than 7,000 population /11/. Therefore, the maximum sample size in PP's sample is 68 for some category of swines and it is less than 68 for some category of swines over the year due to population size. Therefore, selected sample by CME is representative of each type of swine population as outlined in MR and meets the desired confidence precision /11/. The</p>
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verification team referring sampling guideline /48/, cross checked for each swine category in each year to confirm that actual precision is within 10% as given below:

Farm	Wang Noi (2017)			
Category		Nursery		Fattening 2
Population		13,476		7,808
Actual sample size		68		68
Sample Mean		11		96.5
Standard deviation		2.3		4.2
t-value for the confidence (90 or 95%) with (n-1) degree of freedom		1.985		1.985
Confidence interval	2.85	1.75	5.21	3.19
Reliability (Precision)	%	5.0		1.0

Farm		Wang Noi (2018)		
Category		Nursery		Fattening 2
Population		13,589		8,163
Actual sample size		68		68
Sample Mean		10.9		98.4
Standard deviation		1.7		12.3
t-value for the confidence (90 or 95%) with (n-1) degree of freedom		1.985		1.985
Confidence interval	2.11	1.29	15.25	9.35
Reliability (Precision)	%	3.7		3.0

Farm		Chokchai (2017)						
Category		Nursery		Fattening 2		Breed Male		Breed Female
Population		2,659		10,216		42		1443
Actual sample size		66		68		26		65
Sample Mean		20.28		100.99		251.68		186
Standard deviation		2.58		12.33		4.13		4.07
t-value for the confidence (90 or 95%) with (n-1) degree of freedom		1.985		1.985		1.985		1.985
Confidence interval	3.2	1.96	15.29	9.37	5.12	3.14	5.05	3.09
Reliability (Precision)	%	3.1		2.9		0.4		0.5

Farm		Chokchai (2018)						
Category		Nursery		Fattening 2		Breed Male		Breed Female
Population		2699		9,785		40		1515

Actual sample size		66		68		26		65
Sample Mean		19.4		104.5		257.1		189.7
Standard deviation		2.6		3.8		4.3		4.1
t-value for the confidence (90 or 95%) with (n-1) degree of freedom		1.985		1.985		1.985		1.985
Confidence interval	3.2	1.97	4.71	2.89	5.29	3.31	5.09	3.11
Reliability (Precision)	%	3.2		0.9		0.4		0.5

Farm		CPS (2017)						
Category		Nursery		Fattening 2		Breed Male		Breed Female
Population		9,682		11,346		60		123
Actual sample size		68		68		32		44
Sample Mean		17.7		115.2		247.3		189.5
Standard deviation		2.5		3.9		5.1		4.0
t-value for the confidence (90 or 95%) with (n-1) degree of freedom		1.985		1.985		1.985		1.985
Confidence interval	3.10	1.90	4.84	2.96	6.32	3.88	4.96	3.04
Reliability (Precision)	%	3.4		0.8		0.5		0.5

Farm		CPS (2018)						
Category		Nursery		Fattening 2		Breed Male		Breed Female
Population		9,299		15,095		64		128
Actual sample size		68		68		33		45
Sample Mean		17.7		113		243.8		187.9
Standard deviation		2.4		4.5		5		4.0
t-value for the confidence (90 or 95%) with (n-1) degree of freedom		1.985		1.985		1.985		1.985
Confidence interval	2.98	1.82	5.58	3.42	6.20	3.80	4.95	3.05
Reliability (Precision)	%	3.3		1.0		0.5		0.5

Farm		Veerachai (2017)						
Category		Nursery		Fattening 2		Breed Male		Breed Female
Population		31,916		51,982		49		10,563
Actual sample size		68		68		29		68
Sample Mean		20		115.4		248.2		190.9

	Standard deviation		2.7		4.8		5.0		5.4
	t-value for the confidence (90 or 95%) with (n-1) degree of freedom		1.985		1.985		1.985		1.985
	Confidence interval	3.3	2.05	5.95	3.65	6.18	3.82	6.70	4.10
	Reliability (Precision)	%	3.2		1.0		0.5		0.7
	Farm								
	Veerachai (2018)								
	Category		Nursery		Fattening 2		Breed Male		Breed Female
	Population		43,664		59,268		50		11,019
	Actual sample size		68		68		29		68
	Sample Mean		18.5		114.3		248.7		191.1
	Standard deviation		3.2		4.3		4.4		4.2
	t-value for the confidence (90 or 95%) with (n-1) degree of freedom		1.985		1.985		1.985		1.985
	Confidence interval	3.97	2.43	5.33	3.27	5.45	3.35	5.21	3.19
	Reliability (Precision)	%	4.2		0.9		0.4		0.5
	<p>RINA considered to verify all sample records in each swine category from each farm for all the years covering the monitoring period during on-site visit and document review. The verification team did not find any discrepancy between CME's reported values with actual records.</p> <p>Hence, RINA confirms that the sampling size and the method of onsite verification was in line with the requirements of the sampling standard /10/.</p>								
	Findings	N/A							
	Conclusion	RINA confirms that the random sampling plan adopted by CME for the monitoring parameter representative of the entire population for the monitoring period.							

E.3.5. Compliance with the calibration frequency requirements for measuring instruments

Means of verification	Data/Parameter	Assessment		
	Data Unit	W _{site} ; Kg		
	Description	Average animal weight of a defined livestock population at the project site (in kg)		
	Monitoring equipment	Type : Weighing scale		
		Farm	Make	Sl. No.
		Wang Noi (CPA 01)	WI-P	2013016
		Chokchai (CPA 01)	Commandor HP-05	0000719
		CPS farm (CPA 02)	Mettler Toledo Kingbird	0042546AJ
		Veerachai Farm (CPA 03)	Mettler Toledo Kingbird	B301674114
	Calibration frequency/interval	As per registered monitoring plan the scale is calibrated according to the national standards and recalibrated at appropriate intervals according to manufacturer specifications, but at least once in three years /04/. PP calibrated weighing scales of all farms within defined frequency except CPS and Veerachai farm. Therefore,		
	Is the calibration interval in line with the monitoring plan of the PDD?			

		for CPS and Veerachai farm CME applied maximum error factor of the scales over the measured value as per paragraph 352 of VVS, version 02 /07/.																				
	Does the calibration cover the monitoring period? Has the calibration frequency been respected?	<p>The monitoring period is 01/01/2017 to 31/12/2018. Calibration details are given below:</p> <table border="1"> <thead> <tr> <th>Farm</th> <th>Serial Number</th> <th>Calibration Date</th> <th>Expiration Date</th> </tr> </thead> <tbody> <tr> <td>Wang Noi</td> <td>2013016</td> <td>22/03/2016</td> <td>21/03/2019 (in 3 years)</td> </tr> <tr> <td>Chokchai</td> <td>0000719</td> <td>25/03/2016</td> <td>24/03/2019 (in 3 years)</td> </tr> <tr> <td>CPS</td> <td>0042546AJ</td> <td>19/12/2017</td> <td>18/12/2020 (in 3 years)</td> </tr> <tr> <td>Veerachai</td> <td>B301674114</td> <td>20/12/2017</td> <td>19/12/2020 (in 3 years)</td> </tr> </tbody> </table> <p>For CPS farm from January 2017 to December 2017 maximum error factor (5%) over the measured value (as resulted error was within the permissible limit) was applied for all category of swines in CPS farm as calibration of the weighing scale was done after the end of the monitoring period.</p> <p>For Veerachai farm maximum error factor (5%) over the measured value (as resulted error was within the permissible limit) was applied for all category of swines from January 2017 to December 2017.</p> <p>The delay calibration adjustment is as per paragraph 352 of VVS, version 02 /07/.</p>	Farm	Serial Number	Calibration Date	Expiration Date	Wang Noi	2013016	22/03/2016	21/03/2019 (in 3 years)	Chokchai	0000719	25/03/2016	24/03/2019 (in 3 years)	CPS	0042546AJ	19/12/2017	18/12/2020 (in 3 years)	Veerachai	B301674114	20/12/2017	19/12/2020 (in 3 years)
	Farm	Serial Number	Calibration Date	Expiration Date																		
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CPS	0042546AJ	19/12/2017	18/12/2020 (in 3 years)																			
Veerachai	B301674114	20/12/2017	19/12/2020 (in 3 years)																			
Calibration certificates	<table border="1"> <thead> <tr> <th>Weighing scale</th> <th>Calibration details</th> </tr> </thead> <tbody> <tr> <td>2013016</td> <td>By Thai Calibration Services Co. Ltd. calibrated on 22/03/2016 /28/</td> </tr> <tr> <td>0000719</td> <td>By Thai Calibration Services Co. Ltd. calibrated on 25/03/2016 /28/</td> </tr> <tr> <td>0042546AJ</td> <td>By Thai Calibration Services Co. Ltd. calibrated on 19/12/2017 /30/</td> </tr> <tr> <td>B301674114</td> <td>By Thai Calibration Services Co. Ltd. calibrated on 20/12/2017 /31/</td> </tr> </tbody> </table>	Weighing scale	Calibration details	2013016	By Thai Calibration Services Co. Ltd. calibrated on 22/03/2016 /28/	0000719	By Thai Calibration Services Co. Ltd. calibrated on 25/03/2016 /28/	0042546AJ	By Thai Calibration Services Co. Ltd. calibrated on 19/12/2017 /30/	B301674114	By Thai Calibration Services Co. Ltd. calibrated on 20/12/2017 /31/											
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0042546AJ	By Thai Calibration Services Co. Ltd. calibrated on 19/12/2017 /30/																					
B301674114	By Thai Calibration Services Co. Ltd. calibrated on 20/12/2017 /31/																					
Does the calibration of meters have been done by an accredited person or institution?	Thai Calibration Services Co. Ltd. and Northern Weights and Measures Centre (Chiang Mai) are accredited Laboratories According to ISO/IEC 17025 /33/.																					
Data/Parameter	Assessment																					
Data Unit	BG _{elec,y} ; Nm ³																					
Description	Amount of biogas captured and used as fuel for the generator																					

	Monitoring equipment	Endress-Hauser Proline t-mass 65, Thermal mass flowmeter.																																			
		<table border="1"> <tr> <th>Farm</th> <th>Serial Number</th> <th>Installation Date</th> </tr> <tr> <td>Wang Noi (CPA 01)</td> <td>F5147D02000</td> <td>30/10/2012</td> </tr> <tr> <td>Chokchai (CPA01)</td> <td>EC0A3E02000</td> <td>28/10/2012</td> </tr> <tr> <td>CPS farm (CPA 02)</td> <td>D3048502000</td> <td>06/05/2015</td> </tr> </table>	Farm	Serial Number	Installation Date	Wang Noi (CPA 01)	F5147D02000	30/10/2012	Chokchai (CPA01)	EC0A3E02000	28/10/2012	CPS farm (CPA 02)	D3048502000	06/05/2015																							
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	CPS farm (CPA 02)	D3048502000	06/05/2015																																		
		FCI. FLUID COMPONENTS INTERNATIONAL LLC flow meter in Veerachai Farm (CPA 03)																																			
		<table border="1"> <tr> <th>Engine</th> <th>Serial No.</th> <th>Installation date</th> </tr> <tr> <td>1200 kW</td> <td>493548</td> <td>01/07/2015</td> </tr> <tr> <td>985 kW</td> <td>493549</td> <td>January 2017</td> </tr> </table>	Engine	Serial No.	Installation date	1200 kW	493548	01/07/2015	985 kW	493549	January 2017																										
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	1200 kW	493548	01/07/2015																																		
985 kW	493549	January 2017																																			
Calibration frequency/interval	As per registered monitoring plan the scale is calibrated according to manufacturer specifications /04/. As per manufacturer instruction calibration to be every two to three years /34/, /35/. PP has considered 2 years calibration frequency.																																				
Is the calibration interval in line with the monitoring plan of the PDD?																																					
Does the calibration cover the monitoring period?	The monitoring period is 01/01/2017 to 31/12/2018. Calibration details are given below:																																				
Has the calibration frequency been respected?	<table border="1"> <tr> <th>Farm</th> <th>Serial Number</th> <th>Calibration Date</th> <th>Expiration Date</th> </tr> <tr> <td rowspan="2">Wang Noi</td> <td rowspan="2">F5147D02000</td> <td>10/08/2015</td> <td>09/08/2017</td> </tr> <tr> <td>25/08/2017</td> <td>24/08/2019</td> </tr> <tr> <td rowspan="3">Chokchai</td> <td rowspan="3">EC0A3E02000</td> <td>11/08/2015</td> <td>10/08/2017</td> </tr> <tr> <td>17/11/2016</td> <td>16/11/2018</td> </tr> <tr> <td>26/08/2019</td> <td>25/08/2021</td> </tr> <tr> <td>CPS</td> <td>D3048502000</td> <td>06/05/2015</td> <td>05/05/2017</td> </tr> <tr> <td></td> <td></td> <td>28/08/2017</td> <td>27/08/2019</td> </tr> <tr> <td rowspan="2">Veerachai</td> <td rowspan="2">493548</td> <td>01/07/2015</td> <td>30/06/2017</td> </tr> <tr> <td>19/08/2019</td> <td>18/08/2021</td> </tr> <tr> <td></td> <td>493549</td> <td>01/2017</td> <td>31/12/2019</td> </tr> </table>	Farm	Serial Number	Calibration Date	Expiration Date	Wang Noi	F5147D02000	10/08/2015	09/08/2017	25/08/2017	24/08/2019	Chokchai	EC0A3E02000	11/08/2015	10/08/2017	17/11/2016	16/11/2018	26/08/2019	25/08/2021	CPS	D3048502000	06/05/2015	05/05/2017			28/08/2017	27/08/2019	Veerachai	493548	01/07/2015	30/06/2017	19/08/2019	18/08/2021		493549	01/2017	31/12/2019
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		19/08/2019	18/08/2021																																		
	493549	01/2017	31/12/2019																																		
	There has been delay in calibration in Wang Noi farm from 10/08/2017 to 24/08/2017 and to cover the calibration delay, CME has applied the maximum error of the instrument (as resulted calibration error is within permissible limit) over the measured value as per paragraph 352 of VVS, version 02 /07/. Similarly for Chokchai farm calibration delay observed from 17/11/2018 to 25/08/2019 and to cover the calibration delay, CME has applied the maximum error of the instrument (as resulted calibration error is within permissible limit) over the measured value as per paragraph 352 of VVS, version 02 /07/. For Veerachi farm calibration delay of flow meter connected to 1200 kW found from July 2017 to end of the monitoring period which is adjusted with maximum error of the equipment per paragraph 352 of VVS, version 02. The error factor accounting over the measured values in raw measured data was cross checked by verification team and found correctly applied.																																				

Calibration certificates	By Endress-Hauser /36-39/ and by FCI /46/ and commissioning report of new gas engine for new flow meter 493549 /21/
Does the calibration of meters have to be done by an accredited person or institution?	Endress-Hauser and FCI, the manufacturer of the instruments and hence credible for calibration of the equipment.

Data/Parameter	Assessment																				
Data Unit	BG _{flare,y} ; Nm ³																				
Description	Amount of biogas sent to flare																				
Monitoring equipment	Endress-Hauser Proline t-mass 65, Thermal mass flowmeter. <table border="1"> <tr> <th>Farm</th><th>Serial Number</th><th>Installation Date</th></tr> <tr> <td>Wang Noi (CPA 01)</td><td>F5147C02000</td><td>30/10/2012</td></tr> <tr> <td>Chokchai (CPA 01)</td><td>D3048402000</td><td>10/10/2014</td></tr> <tr> <td>CPS farm (CPA 02)</td><td>L20CFE02000</td><td>24/02/2016</td></tr> <tr> <td>Veerachai (CPA 03)</td><td colspan="2">No flow meter installed.</td></tr> </table>	Farm	Serial Number	Installation Date	Wang Noi (CPA 01)	F5147C02000	30/10/2012	Chokchai (CPA 01)	D3048402000	10/10/2014	CPS farm (CPA 02)	L20CFE02000	24/02/2016	Veerachai (CPA 03)	No flow meter installed.						
Farm	Serial Number	Installation Date																			
Wang Noi (CPA 01)	F5147C02000	30/10/2012																			
Chokchai (CPA 01)	D3048402000	10/10/2014																			
CPS farm (CPA 02)	L20CFE02000	24/02/2016																			
Veerachai (CPA 03)	No flow meter installed.																				
Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PDD?	As per registered monitoring plan the scale is calibrated according to manufacturer specifications /04/. As per manufacturer instruction calibration to be every two to three years /34/. PP has considered 2 years calibration frequency.																				
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	The monitoring period is 01/01/2017 to 31/12/2018. Calibration details are given below: <table border="1"> <tr> <th>Farm</th><th>Serial Number</th><th>Calibration Date</th><th>Expiration Date</th></tr> <tr> <td rowspan="2">Wang Noi</td><td rowspan="2">F5147C02000</td><td>10/08/2015</td><td>09/08/2017</td></tr> <tr> <td>10/08/2017</td><td>09/08/2019</td></tr> <tr> <td rowspan="2">Chokchai</td><td rowspan="2">D3048402000</td><td>22/10/2014</td><td>21/10/2016</td></tr> <tr> <td>02/12/2016</td><td>01/12/2018</td></tr> <tr> <td>CPS farm</td><td>L20CFE02000</td><td>24/02/2016</td><td>23/02/2018</td></tr> </table> <p>There was no flaring in CPA 01 and CPA 02 during the monitoring period. In Veerachai farm there is no flow meter installed for monitoring flow to flaring until the end of the monitoring period. This is conservative approach. As there was no flaring, therefore any delay in calibration does not have any impact in the ER calculation.</p>	Farm	Serial Number	Calibration Date	Expiration Date	Wang Noi	F5147C02000	10/08/2015	09/08/2017	10/08/2017	09/08/2019	Chokchai	D3048402000	22/10/2014	21/10/2016	02/12/2016	01/12/2018	CPS farm	L20CFE02000	24/02/2016	23/02/2018
Farm	Serial Number	Calibration Date	Expiration Date																		
Wang Noi	F5147C02000	10/08/2015	09/08/2017																		
		10/08/2017	09/08/2019																		
Chokchai	D3048402000	22/10/2014	21/10/2016																		
		02/12/2016	01/12/2018																		
CPS farm	L20CFE02000	24/02/2016	23/02/2018																		
Calibration certificates	By Endress-Hauser /40-43/.																				
Does the calibration of meters have to be done by an accredited person or institution?	Endress-Hauser is the manufacturer of the instrument and hence credible for calibration of the equipment.																				

Data/Parameter	Assessment
Data Unit	Flare operation; Hours

	Description	Flare operation in hour 'h'	
	Monitoring equipment	A thermocouple type K, Model TH-10 with SUS316L from IES ELECTRIC Co., Ltd., is used to measure temperature.	
		Farm	Serial Number
		Wang Noi (CPA 01)	TH102459
		Chokchai (CPA 01)	TH101256
		CPS farm (CPA 02)	TH105214
		Veerachai Farm (CPA 03)	TH106574
	Calibration frequency/interval Is the calibration interval in line with the monitoring plan of the PDD?	As per registered monitoring plan the equipment to be calibrated according to manufacturer specifications /04/. As per manufacturer recommendation calibration not required for the thermocouple /44/. Hence, PP has not calibrated the same as there was no error found with the thermocouple during the monitoring period.	
Does the calibration cover the monitoring period? Has the calibration frequency been respected?	N/A		
Calibration certificates	N/A		
Does the calibration of meters have been done by an accredited person or institution?	N/A		
Findings	CAR 02 was raised to clarify how the delay in calibration frequency adjusted in emission reduction calculation to which PP has explained and applied appropriate error factor as per paragraph 352 of VVS, version 02 and hence CAR is closed.		
Conclusion	RINA confirms that all applicable monitoring and measuring equipment have been calibrated by accredited agencies as per defined frequency of registered monitoring plan in consistent with applied methodology and appropriately maintained.		

E.3.6. Assessment of data and calculation of emission reductions or net removals

E.3.6.1. Calculation of baseline GHG emissions or baseline net GHG removals by sinks

Means of verification	<p>According to the applied methodology "AMS-III.D", "Methane recovery in animal manure management systems", version 18 /08/, and the registered CPA-DD /04/ the Baseline emissions (BE_y) is calculated as below:</p> $BE_y = GWP_{CH_4} * D_{CH_4} * UF_b * \sum_{j,LT} MCF_j * B_{O,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{BI,j}$ <p>Where,</p> <p>BE_y is the Baseline emissions in year "y" (tCO_{2e})</p> <p>GWP_{CH₄} is the global warming potential for methane fixed ex-ante to apply 21 for the period upto 31/12/2012 and 25 from 01/01/2013 /15/.</p> <p>D_{CH₄} is the density of methane fixed ex-ante to be 0.00067 t/m³ as per applied methodology /08/.</p> <p>UF_b is the model correction factor to account for model uncertainties is fixed ex-ante to be 0.94 as per the applied methodology /08/.</p> <p>MCF_j is the annual methane conversion factor (MCF) for the baseline animal waste management is fixed ex-ante to be 80% as per the registered CPA-DD /04/.</p> <p>B_{O,LT} is the maximum methane producing potential of the volatile solid generated for animal type "LT" (m³ CH₄/kg dm) which is also fixed ex-ante to be considered as per</p>
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	<p>IPCC default values /16/ in the registered CPA-DD and revised CPA-DD /04/. Swines are origin of Western Europe and Northern America and therefore, default values from IPCC for these regions are used conservatively /16/.</p> <p>$VS_{LT,y}$ is the volatile solids for livestock “LT” entering the animal manure management system in year (on a dry matter weight basis, kg dm/animal/year) is calculated as below:</p> $VS_{LT,y} = \left(\frac{W_{site}}{W_{default}} \right) * VS_{default} * nd_y$ <p>W_{site} (Average animal weight of a defined livestock population at the site (kg)) is monitored for each swine category following simple random sampling approach and records of each sample were verified during site visit /22-26/. $W_{default}$ (Default average animal weight of a defined population) is fixed ex-ante from IPCC default values /04/, /16/.</p> <p>$VS_{default}$ is also fixed ex-ante to be considered as per IPCC default values /16/ in the registered CPA-DD and revised CPA-DD /04/. Swines are origin of Western Europe and Northern America and therefore, default values from IPCC for these regions are used conservatively /16/.</p> <p>Nd_y is the number of days in year “y” where the animal manure management system is operational which is monitored daily and confirmed that during the monitoring period the manure management system at each farm was completely operational as per details given in the emission reduction worksheet /22-26/.</p> <p>MS% is the fraction of manure handled in baseline animal manure management system which is monitored and found that during the monitoring period 100% of the manure is handled in the manure management systems as confirmed from site visit and documents review /32/.</p> <p>$N_{LT,y}$ is annual average number of animals of type “LT” in year “y” (numbers) which is to be calculated as per below formula:</p> $N_{LT,y} = N_{da,y} * \left(\frac{N_{p,y}}{365} \right)$ <p>Where,</p> <p>$N_{da,y}$ is Number of days animal is alive in the farm in the year y (numbers) and $N_{p,y}$ is the Number of animals produced annually of type LT for the year y (numbers).</p> <p>$N_{da,y}$ and $N_{p,y}$ is incorporated in monthly farm records for arriving total number of animals produced annually of type LT ($N_{LT,y}$). The farm record includes daily purchase (births, internal transfer) and exit (ex: sale, death, internal transfer). Therefore, $N_{LT,y}$ record implicitly consider $N_{da,y}$ and $N_{p,y}$. Farm wise, $N_{LT,y}$ recorded value was cross checked from records /22-26/.</p> <p>Thus, the baseline emission during the monitoring period from each farm are realized as below:</p> <table><tr><th>Farm</th><th>01/01/2017 – 31/12/2017</th><th>01/01/2018 – 31/12/2018</th><th>Total (tCO₂e)</th></tr><tr><td>Wang Noi (CPA 1)</td><td>9,431.50</td><td>10,629.00</td><td>20,060</td></tr><tr><td>Chokchai (CPA 1)</td><td>13,619.86</td><td>13,518.00</td><td>27,138</td></tr><tr><td>CPS farm (CPA 2)</td><td>15,877.00</td><td>23,347.00</td><td>39,223</td></tr><tr><td>Veerachai (CPA 3)</td><td>82,426.00</td><td>97,857.00</td><td>180,283</td></tr></table>	Farm	01/01/2017 – 31/12/2017	01/01/2018 – 31/12/2018	Total (tCO ₂ e)	Wang Noi (CPA 1)	9,431.50	10,629.00	20,060	Chokchai (CPA 1)	13,619.86	13,518.00	27,138	CPS farm (CPA 2)	15,877.00	23,347.00	39,223	Veerachai (CPA 3)	82,426.00	97,857.00	180,283
Farm	01/01/2017 – 31/12/2017	01/01/2018 – 31/12/2018	Total (tCO ₂ e)																		
Wang Noi (CPA 1)	9,431.50	10,629.00	20,060																		
Chokchai (CPA 1)	13,619.86	13,518.00	27,138																		
CPS farm (CPA 2)	15,877.00	23,347.00	39,223																		
Veerachai (CPA 3)	82,426.00	97,857.00	180,283																		
Findings	N/A																				
Conclusion	RINA confirms that baseline emissions have been appropriately calculated and are consistent with site visit observations, the applied methodology, revised CPA-DD and registered monitoring plan /01/, /02/, /03/, /04/, /05/, /09/.																				

E.3.6.2. Calculation of project GHG emissions or actual net GHG removals by sinks

Means of verification	<p>Project emission as per the applied methodology and registered CPA-DD is as below:</p> $PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y} + PE_{transp,y} + PE_{storage,y}$ <p>Where,</p> <p>PE_y is the Project emissions in year “y” (tCO₂e)</p>
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$PE_{PL,y}$ is the Emissions due to physical leakage of biogas in year “y” (tCO_{2e}) which is calculated as below:

$$PE_{PL,y} = 0.10 * GWP_{CH_4} * D_{CH_4} * \sum_{i,LT} B_{o,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{i,y}$$

Where,

GWP_{CH_4} is the global warming potential for methane fixed ex-ante to apply 21 for the period upto 31/12/2012 and 25 from 01/01/2013 /10/.

D_{CH_4} is the density of methane fixed ex-ante to be 0.00067t/m³ as per applied methodology /08/.

$B_{o,LT}$ is the maximum methane producing potential of the volatile solid generated for animal type “LT” (m³ CH₄/kg dm) which is also fixed ex-ante to be considered as per IPCC default values /16/ in the registered CPA-DD and revised CPA-DD /04/. Swines are origin of Western Europe and Northern America and therefore, default values from IPCC for these regions are used conservatively /16/.

$VS_{LT,y}$ is the volatile solids for livestock “LT” entering the animal manure management system in year (on a dry matter weight basis, kg dm/animal/year) is calculated as below:

$$VS_{LT,y} = \left(\frac{W_{site}}{W_{default}} \right) * VS_{default} * nd_y$$

W_{site} (Average animal weight of a defined livestock population at the site (kg)) is monitored for each swine category following simple random sampling approach and records of each sample were verified during site visit /22-26/.

$W_{default}$ (Default average animal weight of a defined population) is fixed ex-ante from IPCC default values /04/, /16/.

$VS_{default}$ is also fixed ex-ante to be considered as per IPCC default values /16/ in the registered CPA-DD and revised CPA-DD /04/. Swines are origin of Western Europe and Northern America and therefore, default values from IPCC for these regions are used conservatively /16/.

Nd_y is the number of days in year “y” where the animal manure management system is operational which is monitored daily and confirmed that during the monitoring period the manure management system at each farm was completely operational as per details given in the emission reduction worksheet /22-26/.

$MS\%$ is the fraction of manure handled in baseline animal manure management system which is monitored and found that during the monitoring period 100% of the manure is handled in the manure management systems as confirmed from site visit and documents review /32/.

$N_{LT,y}$ is annual average number of animals of type “LT” in year “y” (numbers) which is to be calculated as per below formula:

$$N_{LT,y} = N_{da,y} * \left(\frac{N_{p,y}}{365} \right)$$

Where,

$N_{da,y}$ is Number of days animal is alive in the farm in the year y (numbers) and $N_{p,y}$ is the Number of animals produced annually of type LT for the year y (numbers).

$N_{da,y}$ and $N_{p,y}$ is incorporated in monthly farm records for arriving total number of animals produced annually of type LT ($N_{LT,y}$). The farm record includes daily purchase (births, internal transfer) and exit (ex: sale, death, internal transfer). Therefore, $N_{LT,y}$ record implicitly consider $N_{da,y}$ and $N_{p,y}$. Farm wise, $N_{LT,y}$ recorded value was cross checked from records /22-26/.

Thus, the project emission from due to physical leakage of biogas ($PE_{PL,y}$) has been correctly calculated and for each farm is realized as below:

Farm	01/01/2017 – 31/12/2017	01/01/2018 – 31/12/2018	Total (tCO _{2e})
Wang Noi (CPA 1)	1,254	1,413	2,667

Chokchai (CPA 1)	1,811	1,798	3,609
CPS farm (CPA 2)	2,111	3,105	5,216
Veerachai (CPA 3)	10,725	12,760	23,485

$PE_{flare,y}$ (project emissions from flaring of biogas stream) is calculated following 'Tool to determine project emissions from flaring gases containing Methane' as below:

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h} * (1 - \eta_{flow,h}) * \frac{GWP_{CH_4}}{1000}$$

Where,

GWP_{CH_4} is the global warming potential for methane fixed ex-ante to apply 21 for the period upto 31/12/2012 and 25 from 01/01/2013 /15/.

$\eta_{flow,h}$ is the flare efficiency in hour 'h' which is fixed ex-ante to be 50% default for open flaring as per registered CPA-DD /04/. The flaring system in each farm found to be open and hence accepted.

$TM_{RG,h}$ is the mass flow rate of methane in the residual gas in the hour h (kg/h) calculated as below:

$$TM_{RG,h} = FV_{RG,h} * f_{V_{CH_4,RG,h}} * \rho_{CH_4,n}$$

Where,

$FV_{RG,h}$ is the volumetric flow rate of the residual gas in dry basis at normal (Nm^3/h) conditions in hour h . Flow of residual gas for flaring (BG_{flare}) and operational hours of flare is monitored continuously; thereby, flow rate is calculated and summarized on monthly basis in the ER sheet /02/. The records of flow of biogas for flaring and operational hours of flare we cross checked for each farm and found no flaring was there in these farms. In Veerachai farm there is no flow meter installed for monitoring flow to flaring and therefore, no emission reductions are accounted for flaring in Veerachai farm.

$FV_{CH_4,RH,h}$ is the volumetric fraction of methane in the residual gas on dry basis in hour h ; which is fixed ex-ante to be 60% /04/.

$\rho_{CH_4,n}$ is the density of methane which is fixed ex-ante to be $0.716kg/m^3$ as per the applied methodology /08/.

Since there was no flaring during the monitoring period, emission from flaring (PE_{flare}) is zero.

PE_{power} is the Project emissions from the use of fossil fuel or electricity for the operation of the installed facilities. However, since there was no fossil fuel consumption reported during the monitoring period PE_{power} is calculated for the electricity consumption from electricity ($PE_{EC,y}$).

$$PE_{EC,y} = \sum_j EC_{PJ,j,y} \times EF_{EL,j,y} \times (1 + TDL_{j,y})$$

Where,

$EC_{PJ,j,y}$ is the Quantity of electricity consumed by the project electricity consumption source j in the year y (MWh/yr). Grid is source of electricity consumption in all three farms during the monitoring period. However, the CME was unable to produce monitored data for this parameter and no emission reductions claimed for this monitoring parameter and in line with paragraph 228 (b)-(ii) of CDM project standard for PoA, the managing entity estimated assuming that the source of the GHG emissions operated at maximum capacity for the full period. Since, the parameter is for project GHG emissions related to the consumption of electricity, the estimate included an addition of 10% to account for transmission and distribution losses. The installed equipments for consuming grid electricity were verified during site visit and therefore the estimation is correct. The installed equipments for consuming grid electricity were considered operated at full capacity and for entire period (8760 hours every year) and included an addition of 10% to account for transmission and distribution losses /02/.

$EF_{EL,j,y}$ is the emission factor for electricity generation for source j in year y (tCO_2/MWh) fixed ex-ante to be 0.5661 and $TDL_{j,y}$ is the technical transmission and distribution losses

	considered 10% as per paragraph 228 (b)-(ii) of CDM project standard for PoA /06/.		
	Accordingly, $PE_{power} = PE_{EC,y}$ is calculated for all the farms as below:		
	Farm	01/01/2017 – 31/12/2017	01/01/2018 – 31/12/2018
	Wang Noi (CPA 1)	91	91
	Chokchai (CPA 1)	78.55	78.55
	CPS farm (CPA 2)	122.18	122.18
	Veerachai (CPA 3)	220.38	220.38
			Total (tCO _{2e}) (round up value)
			183
			157
			245
			441
	<p>$PE_{transp,y}$ is the Emissions from incremental transportation in the year “y” (tCO_{2e}) is zero for this monitoring period as there was transportation involved for the manure management system and $PE_{storage,y}$ is the Emissions from storage of manure (tCO_{2e}) is also accounted zero since manure as generated is directly flowed to the manure management system.</p> <p>Therefore, total project emission from the project activity ($PE_{y-expost}$) during the monitoring period has been correctly calculated for each farm as below:</p>		
	Farm	01/01/2017 – 31/12/2017	01/01/2018 – 31/12/2018
	Wang Noi (CPA 1)	1,345	1,504
	Chokchai (CPA 1)	1,890	1,877
	CPS farm (CPA 2)	2,233	3,227
	Veerachai (CPA 3)	10,945	12,980
			Total (tCO _{2e}) roundup value
			2,850
			3,766
			5,460
			23,926
Findings	N/A		
Conclusion	RINA confirms that project emissions for the monitoring period is consistent with site visit observations, the applied methodology, registered CPA-DD and registered monitoring plan /01/, /02/, /03/, /04/, /05/, /09/.		

E.3.6.3. Calculation of leakage GHG emissions

Means of verification	As per the applied methodology and registered CPA-DD, no leakage emissions are to be accounted.
Findings	N/A
Conclusion	RINA confirms that zero leakage emissions for the monitoring period is consistent with site visit observations, the applied methodology, registered CPA-DD and registered monitoring plan /01/, /02/, /03/, /04/, /05/, /09/.

E.3.6.4. Summary of calculation of GHG emission reductions or net GHG removals by sinks

Means of verification

As per applied methodology and registered CPA-DDs, the emission reduction achieved in any year are the lowest value of the following:

$$ER_{y,ex-post} = \min\{(BE_{y,ex-post} - PE_{y,ex-post}), (MD_y - PE_{power,y,ex-post})\}$$

$BE_{y,ex-post}$ and $PE_{y,ex-post}$ is achieved during the monitoring period for each farm as described in section E.3.6.1 and E.3.6.2 are given below:

Farm	$BE_{y,ex-post}$	$PE_{y,ex-post}$	Net removal (tCO _{2e})
Wang Noi (CPA 1)	20,060	2,850	17,210
Chokchai (CPA 1)	27,138	3,766	23,371
CPS farm (CPA 2)	39,223	5,460	33,763
Veerachai (CPA 3)	180,283	23,926	156,357

MD_y is calculated as below:

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

$BG_{burnt,y}$ is the Biogas flared or combusted in year y (Nm³) which is summation of monitored value of combustion biogas ($BG_{elec,y}$) and monitored value of flaring biogas ($BG_{flare,y}$). Therefore, $BG_{burnt,y}$ in each farm during the monitoring period is as below:

Farm	2017	2018	Period Total (Nm ³)
Wang Noi (CPA 01)	300,186	339,642	639,828
Chokchai (CPA 01)	383,846	351,045	734,891
CPS farm (CPA 02)	0	0	0
Veerachai Farm (CPA 03)	2,076,851	1,894,438	3,971,290

D_{CH_4} is the density of methane fixed ex-ante to be 0.00067 t/m³ as per applied methodology /08/.

GWP_{CH_4} is the global warming potential for methane fixed ex-ante to apply 25 from 01/01/2013 onwards /15/.

FE is the flare efficiency fixed ex-ante to be 50% for open flare /03/. Combustion efficiency is taken as 100%.

Therefore, MD_y for each farm for the monitoring period is calculated as below:

Farm	MD _y (tCO ₂ e)
Wang Noi (CPA 01)	6,430
Chokchai (CPA 01)	7,386
Veerachai Farm (CPA 03)	39,911

In case of CPS farm, biogas flow to gas generator was not recorded for the entire monitoring period and therefore, BG_{burnt} for CPS farm is taken a zero value as per paragraph 228 (b) of CDM project standard for PoA version 2 /06/. Therefore, MD_y for CPS farm (CPA 2) is zero for the monitoring period.

PE_{Power,y,ex-post} for each farm is given below as described in E.3.6.2 above:

Farm	PE _{Power,y,ex-post} (tCO ₂ e)
Wang Noi (CPA 01)	183
Chokchai (CPA 01)	157
CPS farm (CPA 02)	245
Veerachai Farm (CPA 03)	441

Therefore, MD_y – PE_{Power,y,ex-post} achieved during the monitoring period for each farm are:

Farm	MD _y – PE _{Power,y,ex-post} (tCO ₂ e)
Wang Noi (CPA 01)	6,248
Chokchai (CPA 01)	7,229
CPS farm (CPA 02)	0 (negative value is not considered as realized CER and therefore '0' value is taken)
Veerachai Farm (CPA 03)	39,470

Hence,

$$ER_{y,ex-post} = \min\{(BE_{y,ex-post} - PE_{y,ex-post}), (MD_y - PE_{power,y,ex-post})\}$$

Farm	ER _{y,ex-post} (tCO ₂ e)
Wang Noi (CPA 01)	6,248
Chokchai (CPA 01)	7,229
CPS farm (CPA 02)	0
Veerachai Farm (CPA 03)	39,470

Findings	N/A
Conclusion	The data presented in the monitoring report /01/ were assessed by reviewing in detail project documentation, collection of monitored data, observation of established monitoring and reporting practices and assessment of the reliability of

	monitoring equipment. Sufficient evidence was presented and verified by RINA for the reported emission reductions as listed above.
--	--

Title and UNFCCC reference number of the CPA	Baseline emissions or baseline net GHG removals by sinks (tCO _{2e})	Project emissions or actual net GHG removals by sinks (tCO _{2e})	Leakage (tCO _{2e})	GHG emission reductions or net GHG removals by sinks (tCO _{2e})		
				Amount achieved before 1 January 2013	Amount achieved from 1 January 2013	Amount achieved in the entire monitoring period
Thailand Small Scale Livestock Waste Management Program CPA 01 (8027-P1-0001-CP1)	13,816	340	0	0	13,476	13,476
Thailand Small Scale Livestock Waste Management Program CPA 02 (8027-P1-0002-CP1)	0	245	0	0	0	0
Thailand Small Scale Livestock Waste Management Program CPA 03 (8027-P1-0003-CP1)	39,911	441	0	0	39,470	39,470
Total	53,727	1,026	0	0	52,946	52,946

E.3.6.5. Comparison of actual GHG emission reductions or net GHG removals by sinks with estimates in included CPA

Means of verification	The emission reductions from the project for the monitoring period as reported in the monitoring report revision 3 of 13/01/2020 /01/ is equivalent to 52,946 tCO _{2e} . The reported emission reductions estimated as per registered CPA-DD works out to be 239,594 tCO _{2e} for the period /02/.
Findings	N/A
Conclusion	The emission reduction calculations provided in the spreadsheet /02/ have been verified to be correct and in line with the registered CPA-DD /03/.

Title and UNFCCC reference number of the CPA	Actual values achieved by the CPAs during this monitoring period	Value estimated in ex ante calculation in the included CPA-DD(s)
Thailand Small Scale Livestock Waste Management Program CPA 01 (8027-P1-0001-CP1)	13,476	111,542
Thailand Small Scale Livestock Waste Management Program CPA 02 (8027-P1-0002-CP1)	0	49,602
Thailand Small Scale Livestock Waste Management Program CPA 03 (8027-P1-0003-CP1)	39,470	78,450
Total	52,946	239,594 tCO ₂

E.3.6.6. Remarks on difference from estimated value in included CPA

Means of verification	N/A
Findings	N/A
Conclusion	N/A

E.3.7. Assessment of reported sustainable development co-benefits

Means of verification	N/A
Findings	N/A
Conclusion	N/A

E.3.8. Global stakeholder consultation

Means of verification	N/A
Findings	N/A
Conclusion	N/A

SECTION F. Internal quality control

>>The draft final verification report before being submitted to UNFCCC is subjected to an independent internal technical review to confirm that all verification activities had been completed according to the pertinent RINA instructions.

The technical review shall be performed by a technical reviewer(s) qualified in accordance with RINA's qualification scheme for CDM validation and verification.

SECTION G. Verification opinion

>>RINA Service Spa (RINA) has performed verification of the emission reductions reported for the CPAs "Thailand Small Scale Livestock Waste Management Program CPA 01 (8027-P1-0001-CP1)", "Thailand Small Scale Livestock Waste Management Program CPA 02 (8027-P1-0002-CP1)" and "Thailand Small Scale Livestock Waste Management Program CPA 03 (8027-P1-0003-CP1)" in Thailand, CDM Registration Reference N° 8027, for the period 01/01/2017 – 31/12/2018, with regard to the relevant requirements for CDM activities included in the PoA "Thailand Small Scale Livestock Waste Management Program".

The project participants/CME of the CPA 1, CPA 2 and CPA 3 "are responsible for:

- the preparation of greenhouses gas emissions data and the reported greenhouse gas emission reductions from the project on the basis set out in the monitoring plan contained in the registered project design document version 14 of 18/08/2016
- the development and maintenance of records and reporting procedures in accordance with that plan, including the calculation and determination of greenhouse gas emission reductions of the project

It is the responsibility of RINA to express an independent verification opinion about the project's conformity with the requirements of paragraph 62 of the CDM modalities and procedures and on the reported greenhouse gas emission reductions from the project.

Based on documented evidence and corroborated by an on-site assessment RINA can confirm that:

- the CPA has been implemented and operated as per the CPA 01 DD version 14 of 18/08/2016, CPA 02 DD version 09 of 18/08/2016, CPA 03 DD version 09 of 18/08/2019 and PoA-DD version 14 of 18/08/2016;

- the monitoring report and other supporting documents provided are complete and verifiable and in accordance with the applicable CDM requirements;
- the monitoring is in place as per the applied baseline and monitoring methodology;
- the monitoring complies with the monitoring plan in the CPA DDs and PoA-DD version 14 of 18/08/2016;
- the monitoring plan in the CPA DDs and PoA-DD version 14 of 18/08/2016 is as per the applied baseline and monitoring methodology.

SECTION H. Certification statement

>> It is RINA's opinion that the GHG emission reduction stated in the monitoring report version 03 of 13/01/2020 for the CPAs "Thailand Small Scale Livestock Waste Management Program CPA 01 (8027-P1-0001-CP1)", "Thailand Small Scale Livestock Waste Management Program CPA 02 (8027-P1-0002-CP1)" and "Thailand Small Scale Livestock Waste Management Program CPA 03 (8027-P1-0003-CP1)" in Thailand for the period 01/01/2017 to 31/12/2018 are fairly stated. The GHG emission reductions were calculated correctly on the basis of the approved monitoring methodology "AMS-III.D", "Methane recovery in animal manure management systems", version 18 of 29/09/2011 and the monitoring plan contained in the registered.

Hence RINA is able to certify that the emission reductions from the project during the monitoring period 01/01/2017 to 31/12/2018 amount to 52,946 tCO_{2e}.

Appendix 1. Abbreviations

Abbreviations	Full texts
BE	Baseline Emissions
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CDM-PCP	Clean Development Mechanism Project Cycle Procedure
CDM-PS	Clean Development Mechanism Project Standard
CDM-VVS	Clean Development Mechanism Validation and Verification Standard
CDM M&P	Modalities and Procedures CDM
CER(s)	Certified Emission Reduction(s)
CH ₄	Methane
CL	Clarification Request
CME	Coordinating and Managing Entity
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
CP	Certification Program
CPA	Component Project Activity
CPA-DD	Component Project Activity Design Document
DD	Design Document
DNA	Designated National Authority
DOE	Designated Operational Entity
EB	Executive Board
EIA	Environmental Impact Assessment
ER	Emission Reductions
ERDI	Energy Research and Development Institute- Nakornping of Chiang Mai University
FAR	Forward Action Request
GHG(s)	Greenhouse gas(es)
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
LoA	Letter of Approval
MoV	Means of Verification
MP	Monitoring Plan
MR	Monitoring Report
NGO	Non-governmental Organization
ODA	Official Development Assistance
PDD	Project Design Document
PE	Project Emission
PoA	Programme of Activities
PoA-DD	CMD Programme of Activities Design Document
PP(s)	Project Participant(s)
Ref.	Document Reference
RINA	RINA Services Spa
SS(s)	Sectoral Scope(s)

TA(s)	Technical Area(s)
UNFCCC	United Nations Framework Convention on Climate Change

Appendix 2. Competence of team members and technical reviewers



CERTIFICATO DI QUALIFICA QUALIFICATION CERTIFICATE

Si attesta che il sig./sig.ra:
We declare that Mr/Mrs/Ms:

Rekha MENON

è qualificato come¹:
is qualified as:

CDM-TEC, -VAL, -VER, -TL
ITRP, REG-EXP²

per le seguenti aree tecniche:
for the following technical areas:

1.2, 2.1, 13.1, 13.2, 14.1

AREE TECNICHE TECHNICAL AREAS	DESCRIZIONE DELL'AREA TECNICA TECHNICAL AREA DESCRIPTION	SCOPO SETTORIALE SECTORAL SCOPE
1.2	Renewables	1
2.1	Electricity Distribution	2
13.1	Solid Waste and wastewater	13
13.2	Manure	13
14.1	Afforestation and reforestation	14

in accordo alle istruzioni dell'unità Sostenibilità & Cambiamenti Climatici.
in accordance with the instructions of the Sustainability & Climate Change Unit.

REVISIONE REVISION	DATA DATE	MOTIVAZIONI PER LA REVISIONE REASON FOR THE REVISION
0	06-03-2008	-
11	31-03-2017	Update qualification as ITRP
12	23-07-2018	Update qualification as REG-EXP

Il Resp. CCPLS
Head of CCPLS

¹ Legend:

VAL: Validator
VER: Verifier
TEC: Technical Expert
TL: Team Leader
FIN-EXP: Financial Expert
DET: Determiner

CDM: Clean Development Mechanism
VCS: Verified Carbon Standard
GS: Gold Standard
SCS: Social Carbon Standard
JI: Joint Implementation

² India, Indonesia, Malaysia, Myanmar, Vietnam, Cambodia, Laos, Sri Lanka, Nepal, China, Philippines, Thailand, Iran, Congo

RINA Services S.p.A. è accreditato da UNFCCC, quale Entità Operativa Designata (DOE), per condurre la Validazione e la Verifica di Progetti CDM, da VCSA per condurre la Validazione e la Verifica di Progetti VCS, da GS Foundation, per condurre la Validazione e la Verifica di Progetti GS, da Ecologica Institute per condurre la Validazione e la Verifica di rapporti SCS

RINA Services S.p.A. is accredited by the UNFCCC, as Designated Operational Entity (DOE), to carry out Validation and Verification of CDM Projects, by the VCSA, to carry out Validation and Verification of VCS Projects, by the GS Foundation, to carry out Validation and Verification of GS Projects and by the Ecologica Institute, to carry out Validation and Verification of SCS Reports

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**CERTIFICATO DI QUALIFICA
QUALIFICATION CERTIFICATE**

Si attesta che il sig./sig.ra:
We declare that Mr/Ms/Ms:

Champak BURAGOHAIN

è qualificato come¹:
is qualified as:

CDM -TEC, -VAL, -VER, -TL
ITRP, REG-EXP²

per le seguenti aree tecniche:
for the following technical areas:

1.1, 1.2, 2.1, 13.1, 13.2

AREE TECNICHE TECHNICAL AREAS	DESCRIZIONE DELL'AREA TECNICA TECHNICAL AREA DESCRIPTION	SCOPO SETTORIALE SECTORAL SCOPE
1.1	Thermal energy generation	1
1.2	Renewables	1
2.1	Electricity distribution	2
13.1	Solid waste and wastewater	13
13.2	Manure	13

In accordo alle istruzioni dell'unità Certificazione, Innovazione e sostenibilità.
In accordance with the instructions of the Head of Certification Innovation & Sustainability Unit

REVISIONE REVISION	DATA DATE	MOTIVAZIONI PER LA REVISIONE REASON FOR THE REVISION
0	19-01-2011	-
13	10-10-2019	Update qualification as TEC in TA 1.1

Il Resp. CEINS
Head of CEINS

¹ Legend:

VAL: Validator
VER: Verifier
TEC: Technical Expert
TL: Team Leader
REG-EXP: Financial Expert
DET: Determiner

CDM: Clean Development Mechanism
VCS: Verified Carbon Standard
GS: Gold Standard
SCS: SocialCarbon Standard
JI: Joint Implementation

² India, Nepal, Sri Lanka, Thailand, Indonesia, Vietnam.

RNA Services S.p.A. è accreditato da UNFCCC, quale Entità Operativa Designata (DOE), per condurre la Validazione e la Verifica di Progetti CDM, da VCSA per condurre la Validazione e la Verifica di Progetti VCS, da GS Foundation, per condurre la Validazione e la Verifica di Progetti GS, da Ecologica Institute per condurre la Validazione e la Verifica di rapporti SCS.

RNA Services S.p.A. is accredited by the UNFCCC, as Designated Operational Entity (DOE), to carry out Validation and Verification of CDM Projects, by the VCSA, to carry out Validation and Verification of VCS Projects, by the GS Foundation, to carry out Validation and Verification of GS Projects and by the Ecologica Institute, to carry out Validation and Verification of SCS Reports.

GHG_QUAL_CERT_EN_07_18

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**CERTIFICATO DI QUALIFICA
QUALIFICATION CERTIFICATE**

Si attesta che il sig./sig.ra:

Hui Feng LIU

We declare that Mr/Mrs/Ms:

è qualificato come¹:
is qualified as:

CDM -TEC, -VAL, -VER, -TL
ITRP, REG-EXP²

per le seguenti aree tecniche:
for the following technical areas:

1.1, 1.2, 8.1, 9.2, 13.1

AREE TECNICHE TECHNICAL AREAS	DESCRIZIONE DELL'AREA TECNICA TECHNICAL AREA DESCRIPTION	SCOPO SETTORIALE SECTORAL SCOPE
1.1	Thermal energy generation	1
1.2	Renewables	1
8.1	Mining and mineral processes	8
9.2	Iron, steel and ferro-alloy production	9
13.1	Solid waste and wastewater	13

in accordo alle istruzioni dell'unità Sostenibilità & Cambiamenti Climatici.
in accordance with the instructions of the Sustainability & Climate Change Unit.

REVISIONE REVISION	DATA DATE	MOTIVAZIONI PER LA REVISIONE REASON FOR THE REVISION
0	10/09/2010	-
11	31/03/2017	Updating qualification as ITRP
12	30/07/2018	Updating qualification as REG-EXP

Il Resp. CCPLS
Head of CCPLS

¹ Legend:

VAL: Validator
VER: Verifier
TEC: Technical Expert
TL: Team Leader
FIN-EXP: Financial Expert
DET: Determiner

CDM: Clean Development Mechanism
VCS: Verified Carbon Standard
GS: Gold Standard
SCS: SocialCarbon Standard
JI: Joint Implementation

² China

RINA Services S.p.A. è accreditato da UNFCCC, quale Entità Operativa Designata (DOE), per condurre la Validazione e la Verifica di Progetti CDM, da VCSA per condurre la Validazione e la Verifica di Progetti VCS, da GS Foundation, per condurre la Validazione e la Verifica di Progetti GS, da Ecologica Institute per condurre la Validazione e la Verifica di rapporti SCS.

RINA Services S.p.A. is accredited by the UNFCCC, as Designated Operational Entity (DOE), to carry out Validation and Verification of CDM Projects, by the VCSA, to carry out Validation and Verification of VCS Projects, by the GS Foundation, to carry out Validation and Verification of GS Projects and by the Ecologica Institute, to carry out Validation and Verification of SCS Reports.

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Appendix 3. Documents reviewed or referenced

No.	Author	Title	References to the document	Provider
1	The World Bank	Monitoring report for project activity “Thailand Small Scale Livestock Waste Management Program CPA 01” :Thailand Small Scale Livestock Waste Management Program CPA 02” and “Thailand Small Scale Livestock Waste Management Program CPA 03” in Thailand	Version 01 of 01/08/2019, version 02 of 25/09/2019 and version 03 of 13/01/2020	CME
2	The World Bank	Emission reduction worksheets	Version 01 of 01/08/2019 and version 02 of 25/09/2019	CME
3	The World Bank	PoA-DD for project activity “Thailand Small Scale Livestock Waste Management Program”	Version 14 of 18/08/2016	CME
4	The World Bank	CPA-DD for project activity “Thailand Small Scale Livestock Waste Management Program CPA 01” “Thailand Small Scale Livestock Waste Management Program CPA 02” “Thailand Small Scale Livestock Waste Management Program CPA 03” in Thailand	CPA 1 version 14 of 18/08/2016, CPA 2 version 09 of 18/08/2016 and CPA 3 09 of 18/08/2016	CME
5	CDM Board Executive	CDM Project Cycle Procedure for PoA	version 02 of 29/11/2018	Others
6	CDM Board Executive	CDM Project Standard for PoA	version 02 of 29/11/2018	Others
7	CDM Board Executive	CDM Validation and Verification Standard for PoA	version 02 of 29/11/2018	Others
8	CDM Board Executive	Baseline and monitoring methodology “AMS-III.D”, “Methane recovery in animal manure management systems”	version 18 of 29/09/2011	Others
9	DNV	PoA Validation report (report N° 2010-0125) CPA validation report (report N° 2010-0114) CPA validation report (report N° 2014-0019) CPA validation report (report N° 2014-0107)	version 01 issued on 12/10/2012 version 01 issued on 12/10/2012 Version 01 issued on 27/11/2014 Version 01 issued on 28/11/2014	Others
10	CDM Board Executive	Standard ‘sampling and surveys for CDM project activities and programmes of activities’	version 07.0 dated 04/05/2017	Others
11	Raosoftware	Sample size calculator	http://www.raosoftware.com/sample_size.html	Others
12	CDM Board Executive	Monitoring Report Form for CDM programme of activities (CDM-PoA-MR-FORM) and ‘Instructions for filling out the monitoring report form for CDM programme of activities’	version 03.0 of 31/05/2019	Others

13	RINA	Verification and certification report for the CDM Programme of activities 'Thailand Small Scale Livestock Waste Management Program' PoA-8027 covering monitoring period 01/01/2015 to 31/12/2016		Others
14	ERDI	Commissioning report of digester and biogas plant at each farm under CPA 01	Commissioning report dated September 2010, November 2010 and July 2011	CME
15	CDM Executive Board	Standard for the application of the global warming potentials to clean development mechanism project activities and programme of activities for the second commitment period of the Kyoto Protocol	version 1, Annex 3 of EB 69 dated 13/09/2012	Others
16	IPCC	Emissions from livestock and manure management, IPCC 2006	IPCC Guidelines for National Greenhouse Gas Inventories Annex 10A.2 Tables 10A-7 and 10A-8	Others
17	ERDI	Commissioning report of digester and biogas plant at Charoenphansamchuk farm under CPA 02	Commissioning report	CME
18	ERDI	Commissioning report of digester and biogas plant at Veerachai Nongpong farm under CPA 03	Commissioning report	CME
19	Khana Farm	Records of farm operation and company statement on closure of farm due to renovation activities	Company record	CME
20	CPS Farm	Commissioning record of new gas generator capacity 290 kW	Commissioning record	CME
21	Veerachi Farm	Commissioning report of new gas generator capacity 985 kW	Commissioning report	CME
22	Chokchaikansukorn farm	Log book records of for swine population, biogas collected (burnt in generator and flare), flare operation hours, swine weight for each category, non-operational hours of manure management system, sludge records for the period of 01/01/2017 to 31/12/2018	Log book records	CME
23	Laemthong Hybrid Co., Ltd (Wang Noi Farm)	Log book records of for swine population, biogas collected (burnt in generator and flare), flare operation hours, swine weight for each category, non-operational hours of manure management system, sludge records for the period of 01/01/2017 to 31/12/2018	Log book records	CME
24	Charoenphansamchuk Farm (CPS farm)	Log book records of for swine population, biogas collected (burnt in generator and flare), flare operation hours, swine weight for each category, non-operational hours of manure management system, sludge records for the period of	Log book records	CME

		01/01/2015 to 31/12/2016		
25	Veerachai Farm	Log book records of for swine population, biogas collected (burnt in generator and flare), flare operation hours, swine weight for each category, non-operational hours of manure management system, sludge records for the period of 01/01/2017 to 31/12/2018	Log book records	CME
26	Chokchaikansukorn Farm, Wang Noi Farm, CPS farm and Veerachi farm	Sample of invoices of animal purchase and animal sales, invoices of purchase of food and formulae of food composition for the period January 2017 to December 2018	Sales/purchase records	CME
28	Thai Calibration Services Co. Ltd.	Calibration certificate of Weighing scale (sl.no. 0000719 and for sl.no. 2013016) calibrated on 25/03/2016 and on 22/03/2016 respectively.	Calibration certificate	CME
29	Northern Weights and Measures Centre (Chiang Mai)	Calibration certificate of Weighing scale (sl.no. IK2131237N4785) calibrated on 11/02/2016	Calibration certificate	Others
30	Thai Calibration Services Co. Ltd.	Calibration certificate of Weighing scale (sl.no. 0042546AJ) calibrated on 19/12/2017	Calibration certificate	CME
31	Thai Calibration Services Co. Ltd.	Calibration certificate of Weighing scale (sl.no. B301674114) calibrated on 20/12/2017	Calibration certificate	CME
32	Chokchaikansukorn Farm, Wang Noi Farm, CPS farm and Veerachi farm	Log book records of manure utilization in digester system during the period of 01/01/2017 to 31/12/2018	Log book records	CME
31	ERDI & participating farms	Operational manual for swine farming at each farms	Operational manual	CME
32	DEDE, Ministry of Energy	Thailand Energy Statistics (Preliminary) 2013	http://www.dede.go.th/download/stat58/statistics2556r_p.pdf	Others
33	Thai Industrial Standard	List of Accredited Laboratories According to ISO/IEC 17025	http://app.tisi.go.th/lab/calibrate/cilas_e.html	Others
34	Endress-Hauser	Operating Instructions-Proline t-mass 65 (thermal mass flow meter)	BA00111D/06/EN/13.14	Others
35	FCI	Installation, operation and maintenance manual (ST100 series thermal mass flow meter)	Doc. No. 06EN003400	Others
36	Endress-Hauser	Calibration certificate of flow meter F5147D02000 calibrated on 10/08/2015 and on 25/08/2017	Calibration certificates	CME
37	Endress-Hauser	Calibration certificate of flow meter EC0A3E02000 calibrated on 11/08/2015, on 17/11/2016 and on 26/08/2019	Calibration certificates	CME
38	Endress-Hauser	Calibration certificate of flow meter F6006402000 calibrated on 11/04/2014 and on 10/08/2015	Calibration certificates	CME

39	Endress-Hauser	Calibration certificate of flow meter D3048502000 calibrated on 28/08/2017	Calibration certificate	CME
40	Endress-Hauser	Calibration certificate of flow meter F5147C02000 calibrated on 09/04/2014 and on 10/08/2015	Certificate No. 4409090659-2/5	CME
41	Endress-Hauser	Calibration certificate of flow meter D3048402000 calibrated on 22/10/2014 and on 02/12/2016	Certificate No. 4409092503-01	CME
42	Endress-Hauser	Calibration certificate of flow meter F6006302000 calibrated on 11/04/2014 and on 13/08/2015	Certificate No. 4409090659-5/5	CME
43	Endress-Hauser	Calibration certificate of flow meter L20CFE02000 calibrated on 24/02/2016	P.O. No. 3026514193	CME
44	IES Electric Co. Ltd.	Letter for calibration requirement and technical specification of thermocouple type K, Model TH-10	Letter dated 28/12/2015	CME
45	Certified veterinary doctor	Letter confirming genetic source of swines in Khana Hybrid Co., Ltd., Chokchaikansukorn Farm, Wang Noi Farm, CPS farm and Veerachi farm	Letter dated 28/03/2019	CME
46	FCI International LLC	Calibration certificate of flow meter with serial number 493548 calibrated on 01/07/2015 and on 19/08/2019	Calibration Certificate	CME
47	TIP Industry Services Co. Ltd.	Calibration certificate of energy meter (1512454A) calibrated on 05/07/2019	Calibration Certificate	CME
48	UNFCCC	Guideline: sampling and surveys for CDM project activities and programme of activities'	Version 04	Others

Appendix 4. Clarification requests, corrective action requests and forward action requests

Table 1. Remaining FARs from validation and/or previous verification

FAR ID	NA	Section no.		Date:
Description of FAR				
NA				
CME response				Date: DD/MM/YYYY
Documentation provided by the CME				
DOE assessment				Date: DD/MM/YYYY

Table 2. CLs from this verification

CL ID	01	Section no.	E.3.1	Date: 11/09/2019
Description of CL				
<i>It has been noted that a new gas generator of 290 kW capacity was installed at CPS farm and in Veerachai farm a new 985 kW generator is installed during the monitoring period. CME is requested to clarify how the addition of new generators in both the CPAs will affect the design of the CPAs and justify the additionality of each CPA.</i>				
CME response				Date: 25/09/2019
<i>The new gas generator for CPS (290 kW) was installed since the old generator broke down in April 28, 2017. It is operating below the design capacity (129 kW in 2017, 147 kW in 2018) in the CPA-DD, thus the addition of the new generator does not impact the design of the CPA and its additionality. For the Veerachai farm, the addition of the 985 kW generator as a stand-by generator does not affect the design of the CPA since the operating capacity of the generators are 477 MW in 2017 and 558 MW in 2018, still below 600 kW. Thus, for the Veerachai farm the additionality is still valid.</i>				
Documentation provided by the CME				
<i>ER spreadsheet for CPA-02 v2, VCF 2017-2018 comparision</i>				
DOE assessment				Date: 14/10/2019
<i>Since with the new generator the actual operating load is below the ex-ante established 260 kW load for each generator, the additionality is not impacted for CPS farm. For Veerachai farm as well the actual operating load both the year is below 600 kW fixed ex-ante during registration of the CPA-DD. Hence, PP's justification is accepted and CL is closed.</i>				

Table 3. CARs from this verification

CAR ID	01	Section no.	E.3.4.2	Date: 11/09/2019
Description of CAR				
<i>Below inconsistencies are requested to address:</i>				
<ol style="list-style-type: none"> <i>The reported swine data for the month of July 2017 in Veerachai farm is not consistent with raw input data</i> <i>The reported value of total biogas flow to gas genset is not consistent with raw data sheet for Veerachai farm for all the months.</i> <i>The reported swine population (month-wise) for fattening category is wrong in case of Chokchai farm in emission reduction worksheet when cross checked with raw log book records.</i> 				
CME response				Date: 25/09/2019

1. The swine data for the month of July 2017 in Veerachai is now consistent with raw data. ER calculation is revised.	
2. The reported value of total biogas flow to gas genset were inconsistent from Jan-July 2017 and Oct 2017 reported summary of biogas flow and is now consistent with raw data sheet for Veerachai farm. Other total biogas flow are different from raw data since there were applied discounts for meter 1. The total biogas flow for all months of 2018 are consistent with the raw data sheet, totals are different from raw data since there were applied discounts for meter 1 flowmeter due to delayed calibration. (please see cell N32-43). The discounting is also mentioned in response to CAR 02#4 below.	
3. There was an error in transferring the raw data to the summarized table for the swine population for fatteners of Chokchai farm. The reported swine population (month-wise) for fattening category of Chokchai farm is now corrected in the emission reduction worksheet to be consistent with raw log book records.	
Documentation provided by the CME	
1 & 2. ER spreadsheet for CPA-03 v2	
2. VCF 2017-2018 comparison	
3. ER spreadsheet for CPA-02 v2, Chokchai pig 2017, Chokchai pig 2018.(raw data)	
DOE assessment	Date: 14/10/2019
Corrections are made in in consistent with actual records. Hence, response is accepted and CAR is closed.	

CAR ID	02	Section no.	E.3.5	Date: 11/09/2019
Description of CAR				
1. The calibration of weighing scale for CPS farm and Veerachai farm does not cover the entire monitoring period. However, no error adjustment is done over the measured value.				
2. Calibration details of Chok Chai farm included in MR does not cover the monitoring period.				
3. In case of CPS farm the calibration of energy meter is done after the end date of monitoring period. Measured date is not adjusted applying error factor.				
4. For calibration of flow meters to measure biogas to gas genset in Veerachai the does not cover the entire monitoring period. However, data reported are not adjusted with error factor.				
CME response				Date: 25/09/2019
1. The ER calculation is revised for the error adjustment for the weighing scale.				
2. Calibration details of Chok Chai farm included in MR were typographical errors and are corrected to cover the monitoring period.				
3. The calibration for the energy meter for CPS is still valid for the monitoring period but since the factory calibration is not available, the energy meter was calibrated in 05/07/2019. The ER spreadsheet is revised for the error adjustment for the entire monitoring period. MR is also revised to reflect the changes.				
4. The data reported was adjusted with the error factor for biogas meter 1. The ER calculation provided earlier for Veerachai had applied discount from 01/07/2017-31/12/2018 (please see cell N26-43) for meter 1 of biogas flowmeter.				
Documentation provided by the CME				
1. ER spreadsheet for CPA-02 v2, ER spreadsheet for CPA-03 v2				
2. MR version 2				
3. ER spreadsheet for CPA-02 v2				
DOE assessment				Date: 14/10/2019
For delayed calibration PP has adjusted the measured values applying maximum error which is consistent with the requirements of VVS version 02. Calibration records are consistent and hence CAR is closed.				

Table 4. FARs from this verification

FAR ID	xx	Section No.		Date: DD/MM/YYYY
Description of FAR				
CME response				Date: DD/MM/YYYY
Documentation provided by the CME				
DOE assessment				Date: DD/MM/YYYY

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Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
03.0	31 May 2019	Revision to: <ul style="list-style-type: none">• Ensure consistency with version 02.0 of the “CDM validation and verification standard for programmes of activities” (CDM-EB93-A08-STAN);• Make structural and editorial improvements.
02.0	29 December 2017	Revision to align with the requirements of the “CDM validation and verification standard for programme of activities” (version 01.0).
01.0	5 June 2015	Initial publication.
Decision Class: Regulatory Document Type: Form Business Function: Issuance Keywords: programme of activities, verifying and certifying		