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VERIFICATION AND CERTIFICATION REPORT

PROJECT TITLE

CHAO KHUN AGRO BIOGAS ENERGY PROJECT

(UNFCCC Registration Ref. No. 2138)
Verification Period:
1 April 2011 – 31 December 2012

Report No. : SQAS-CDM-ET07850004
Revision No.:02

Report No.:	Date of first issue:	Version :	Date of this revision :
SQAS-CDM-ET07850004	14 March 2013	02	10 July 2013
Project title :	Chao Khun Agro Biogas Energy Project		
DOE :	SIRIM QAS International Sdn. Bhd.		
Client :	Thai Biogas Energy Co. Ltd.		

Summary:

Thai Biogas Energy Co. Ltd. has appointed SIRIM QAS International Sdn. Bhd. to perform the second verification and certification of the emissions reduction reported for the 'Chao Khun Agro Biogas Energy Project' for the period from 1 April 2011 to 31 December 2012. The project activity was registered by the UNFCCC Executive Board on 9 March 2009. The verification was based on the validated project design document (PDD)[/2/] dated 19 February 2009 Version 04, applied methodology AM0022[/3/], the validation report[/4/], monitoring reports[/5/&/44/] and other supporting documents made available to the verification team by the PP..

The project activity is located at Chao Khun Agro Products Co. Ltd., 44 Moo 2, Songkorn, Kaengkoi, Saraburi, 18110, Thailand. The project developed by Thai Biogas Energy Company Ltd (TBEC) is an industrial anaerobic wastewater treatment which treats wastewater from the cassava processing factory. The project activity involves the installation of a Covered In-Ground Anaerobic Reactor (CIGAR) to treat the wastewater. The CIGAR has a treatment capacity of 41,000m^3 where organic material within the wastewater is digested and produces biogas. The generated biogas is captured in the digester and supplied to one unit of thermal boiler installed with a biogas burner at a rated capacity range from 1,400kW to 10,800kW thermal and with a steam generation capacity of 15mt/hr.. The biogas being utilized replaces the fossil fuel in the thermal energy generation while the surplus biogas is flared in an open flaring system. The project results in the reduction of GHG emissions by the avoidance of methane from being emitted into the atmosphere.

As a result of the verification, the SIRIM QAS Intl. verification team confirms that the project has achieved emissions reduction for the monitoring period as below:

Monitoring Period	1 April 2011 to 31 December 2012
Total Baseline Emissions (rounded down value)	113,227.00 tCO_2e
Total Project Emissions (rounded down value)	26,958.00 tCO_2e
Emissions Reduction (rounded down value)	86,269.00 tCO_2e

Subject : CDM Verification

Work carried out by :

Hafriazhar Mohd Mokhtar - Verification Team Leader

Syed Anuar Shah Syed Mansor - Verification Team Member

Technical Reviewer :
Isnazunita Ismail

Report approved by :
Parama Iswara Subramaniam

Abbreviations

CAR	Corrective Action Request
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CH_4	Methane
CIGAR	Covered In-Ground Anaerobic Reactor
CL	Clarification Request
DNA	Designated National Authority
DOE	Designated Operational Entity
EB	Executive Board
ER	Emission Reduction
FAR	Forward Action Request
FFB	Fresh Fruit Bunches
GHG	Greenhouse Gas(es)
IPCC	Intergovernmental Panel on Climate Change
MR	Monitoring Report
MP	Monitoring Plan
PDD	Project Design Document
PE	Project Emissions
PEA	Provincial Electricity Authority
PP	Project Participant
RE	Renewable Energy
SIRIM QAS Intl.	SIRIM QAS International Sdn. Bhd.
TBEC	Thai Biogas Energy Co. Ltd.
UNFCCC	United Nations Framework Convention for Climate Change
VVS	Validation and Verification Standard version 2.0

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1. INTRODUCTION

1.1 Objective

The objectives of this verification were:

- To verify that the actual monitoring system and procedures are in full compliance with the system and procedures described in the monitoring plan of registered PDD, version 04, dated 19 February 2009 as well as with the applicable methodology;
- To verify that the data reported were accurate, complete, consistent, transparent and free of material error or omission by checking the monitoring records and the emissions reduction calculation; and
- To verify and certify GHG emission reduction reported for 'Chao Khun Agro Biogas Energy Project' for the period from 1 April 2011 to 31 December 2012

1.2 Scope

The scope of the verification was the independent and objective review and ex-post determination of the monitored reductions in GHG emissions from 'Chao Khun Agro Biogas Energy Project'. The verification of this CDM project was based on the validated and registered project design document (PDD), validation report, monitoring reports, the approved request for deviation and supporting documents made available to the verification team. These documents were reviewed against the requirements of the Kyoto Protocol, the CDM Modalities and Procedures, related rules and guidance, and the Validation and Verification Standard (version 03.0)[/1/].

The verification is not meant to provide any consulting towards the client. However, stated request for clarifications and/or corrective actions may provide input for improvement of the project design.

1.3 Description of the Project Activity

Project Participants/Parties	:	Thai Biogas Energy Company Limited / Thailand Asian Development Bank as a trustee of the Asia Pacific Carbon Fund / Switzerland Kingdom of Spain / Spain Swedish Energy Agency / Switzerland
Title of project activity	:	Chao Khun Agro Biogas Energy Project
UNFCCC registration No	:	2138
Registered date	:	9 March 2009
Crediting period	:	9 March 2009 to 8 March 2019 (fixed)
Location of the project activity	:	Chao Khun Agro Products Co. Ltd., 44 Moo 2, Songkorn, Kaengkoi, Saraburi, 18110, Thailand
GPS coordinates	:	Latitude 14°35'59.28"N Longitude 101°00'41.30"E

The Chao Khun Agro Biogas Energy Project is a CDM project activity developed by the Thai Biogas Energy Company Ltd (TBEC) The project is located at a cassava processing factory owned by Chao Khun Agro Products Co. Ltd. at 44 Moo 2, Songkorn, Kaengkoi, Saraburi, 18110, Thailand.

The project is an industrial anaerobic wastewater treatment which treats wastewater from the cassava processing factory.

The project activity involves the installation of a Covered In-Ground Anaerobic Reactor (CIGAR) anaerobic digester plant equipped with biogas capture system. Biogas produced in the CIGAR is captured and used as fuel in one unit of thermal boiler which produced hot air. The hot air is used in the Chao Kun Agro Products factory to dry the wet starch cake to the final dry starch product, thereby displacing the fuel oil which was employed by the factory for the drying processes. Surplus biogas is flared in an open flare system

The project activity contributes to the GHG reduction in two ways. The first is by avoiding the methane release into the atmosphere and the second is by generating clean thermal energy that replaces the fossil fuel consumption in the steam boiler for wet starch cake drying process.

The project is a registered large scale CDM project that applies CDM methodology AM0022 – Avoided Wastewater and On-site Energy Use Emissions in the Industrial Sector version 04[3]. The project was registered by the CDM Executive Board on 9 March 2009 under the sectoral scope no. 13 (waste handling and disposal).

The project has been reducing GHG emissions since 16 December 2006 (prior to the project registration date). This was evident through the copy of the letter from PP to the project owner i.e. Notice of Official Commercial Operations Date[7] as part of the Build-Own-Transfer Agreement between PP and the project owner i.e. Chao Khun Agro Products Co. Ltd..

1.4 Verification team

The following verification team was assigned to carry out the verification of the project:

Verification team leader	:	Hafriazhar Mohd. Mokhtar
Verification team member	:	Syed Anuar Shah Syed Mansor

Hafriazhar Mohd Mokhtar is a Chemical Engineer by qualification. He has several years of working experience in palm oil milling including the operation of POME treatment plant, biomass boilers and diesel generators. He has been trained in CDM validation and verification processes, and has been qualified as a CDM lead auditor (SS TA 1.1, 1.2, 13.1 and 15.1) in accordance with SIRIM QAS Intl.'s qualification criteria. He is also a qualified Environmental Management System (ISO 14001) auditor.

Syed Anuar Shah Syed Mansor is a Chemical Engineer by qualification. He has extensive experience in the area of renewable energy, energy efficiency and wastewater treatment technology. He has been trained in the CDM validation and verification processes, and has been qualified as a CDM lead auditor in accordance with SIRIM QAS Intl.'s qualification criteria.

1.5 Technical Reviewer: Isnazunita Ismail

Isnazunita Ismail holds a Degree in Microbiology and Microbiol Technology and is currently pursuing a Master degree in the Environmental Biotechnology. She is at currently a senior researcher at Environmental Research and Technology Centre, SIRIM Berhad with 16 years of work experience in the area of wastewater treatment technology and the application of biogas.

2. METHODOLOGY

The SIRIM QAS Intl.'s verification process consisted of the following phases:

i) document review of the CDM registered PDD, the Monitoring Report and the emission reductions calculation spreadsheets submitted by the client;

ii) verification audit planning;

iii) on-site visit to the project activity which included interviews with the project owner and the client, review of various monitoring records and records of calibration of the monitoring equipment, and verification of measurement procedures;

iv) preparation of draft verification report (issuance of verification audit findings);

v) resolution of outstanding issues and the issuance of final verification report and opinion.

Duration of Verification

The verification of the project was carried out between January 2013 and April 2013, with details as follows:

Off site preparation / document review and planning: 14 to 15 January 2013

On-site verification: 28 to 29 January 2013

Preparation of draft report: February 2013

Preparation of final report: June 2013

The project assessment was based on the methodology developed in the VVS version 03.0 In order to ensure transparency, a verification protocol was customized for the project, according to the VVS. The protocol shows, in a transparent manner, requirements, means of verification and the results. The verification protocol serves the following purpose;

- it organizes, provides details and clarifies the requirements of a verification of a CDM project is expected to meet;
- it ensures a transparent verification process where the verifier will document how a particular requirement has been proved, and the results of the verification.

The completed protocol is enclosed in Annex 1 to this report.

2.1 Review of Documentation

The following documentation were reviewed and verified:

- Registered PDD[/2/], version 04 dated 19 February 2009
- Validation Report[/4/] by DNV, report no. 2005-1475 rev. no. 02 dated 20 February 2009
- Monitoring Report[/5/] version 01, dated 3 January 2013
- ER Spreadsheet[/6/] version 01, dated 3 January 2013

- Monitoring Report[43] version 02 dated 15 March 2013
- ER Spreadsheet[44] version 02 dated 20 March 2013

A complete list of all documents reviewed is as listed in part 5 (References) of this report.

2.2 Site Visits

The SIRIM QAS Intl.'s verification team conducted an on-site audit at the project site in Chao Khun Agro Products Co. Ltd., 44 Moo 2, Songkorn, Kaengkoi, Saraburi, 18110, Thailand on 28 and 29 January 2013. The on-site audit consisted of a visit to the project site to verify the project implementation, the location of the monitoring equipment and the review of documents available at project site. The verification team had also conducted a review of documents and the monitored data. Interviews with relevant personnel were also carried out to confirm the method of recording the GHG data.

The verification of data in the monitoring report included the raw data from the respective checklists, results of analysis and the plant design diagram.

The personnel interviewed and the coverage of interviews is summarized below.

Coverage	Source of information/Persons interviewed
• GHG reporting and calculation • Information in the monitoring report • Assessment of project boundary • Qualification and training • Roles and responsibilities • GHG raw data compilation • Reporting and reviewing of GHG data • CDM Monitoring and reporting	Sittisak Sugsaisakon, CDM Manager, TBEC Pasu Sirisareewan, CDM Officer, TBEC Niwat Phongsai, Plant Manager, TBEC Pradit Aneksri, Shift Leader, Chao Khun Site Isarang Onsila, Shift Leader, Chao Khun Site Pornthip Promsunam, Lab Technician, Chao Khun Site Krisorn Pangsayta, Maintenance Technician
• Review of physical components • Plant operation	Niwat Phongsai, Plant Manager, TBEC Pradit Aneksri, Shift Leader, Chao Khun Site
• Biogas plant operation • Collection of measurements • Data logging and reporting • Maintenance of monitoring equipment • Calibration of equipment	Sittisak Sugsaisakon, CDM Manager, TBEC Pasu Sirisareewan, CDM Officer, TBEC

2.3 Assessment

Means of verification used were:

- desk review, involving
  - a review of the data and information presented to verify their completeness;
  - a review of the monitoring plan and monitoring methodology;
  - an evaluation of data management and the quality assurance and quality control system;

- on-site assessment, involving
  - an assessment of the implementation and operation of the CDM project activity as per the registered PDD;
  - a review of information flows for the monitoring parameters;
  - interviews with relevant personnel to confirm that the operational and data collection procedures are implemented in accordance with the monitoring plan in the PDD;
  - a cross-check between information provided in the monitoring report and data from other sources;
  - a check of the monitoring equipment including calibration performance and observations of monitoring practices;
  - a review of calculations and assumptions made in determining the GHG data and emission reductions;
  - an identification of quality control and quality assurance procedures in place to prevent or identify and correct any errors or omissions in the reported monitoring parameters.

Details of all findings are recorded in the verification protocol in Annex 1 of this report.

2.4 Reporting of Findings

Findings identified during the verification may be classified into Corrective Action Request (CAR), Clarification Request (CL) and/or Forward Action Request (FAR).

A CAR is raised if one of the following occurs:

- non-conformities with the monitoring plan or methodology are found in monitoring and reporting, or if the evidence provided to prove conformity is insufficient; or
- mistakes have been made in applying assumptions, data or calculations of emission reductions that will impair the estimate of emission reductions; or
- issues identified in a FAR during validation to be verified during verification have not been resolved by the project participants.

A CL is raised if information is insufficient or not clear enough to determine whether the applicable CDM requirements have been met.

For CAR and CL, the client is required to take necessary corrective actions and provide evidence of the implementation. All CARs and CLs shall be resolved prior to submitting a request for issuance.

A FAR should be issued, where:

- the actual project monitoring and reporting requires attention and /or adjustment for the next verification period, or
- an adjustment of the MP is recommended.

In the context of FARs, risks have been identified, which may endanger the delivery of high quality CERs in the future, i.e. by deviations from standard procedures as defined by the monitoring plan. As a consequence, such aspects should receive a special focus during the next consecutive verification. A FAR may originate from lack of data sustaining claimed emission reductions.

3 VERIFICATION FINDINGS

During this second periodic verification, two (2) CARs and eight (8) CLs were raised after the on-site audit. Details of the findings are provided in Table 2 of Annex 1 of this report.

3.1 Remaining Issues, CARs, FARs from Previous Validation or Verification

There were no remaining issues from the previous verification. All issues raised during the previous verification of this project had been satisfactorily closed out prior to submission for request for issuance..

3.2 Project Implementation

According to the PDD, the project activity will employ the CIGAR technology, which comprises a uniquely designed lagoon process with mixers, baffles and a thick HDPE cover. It was observed during the site visit that one lagoon (denoted as CIGAR in Figure 2 in the Monitoring Report) covered with HDPE membrane had been in operation with one unit of open flare installed. One unit of steam boiler with a capacity of 15MT/hr of steam production was mounted with a biogas burner that covers a firing range from 1,400kW up to 10,800kW maximum. In terms of the monitoring system, the relevant sampling and measuring points for parameters such as COD untreated and COD treated, POME flow rate, biogas flow rate and CH_4 concentration were also noted and found to be correct.

During this monitoring period, there was no desludging activity carried out. All the required project equipment and monitoring system had been installed in accordance with the PDD[/2/] and the monitoring requirement as specified in the monitoring plan had also been implemented accordingly.

3.3 Completeness of Monitoring

The monitoring was confirmed to be in accordance with the monitoring plan contained in the registered PDD[/2/], the approved methodology applied by the CDM project activity and the methodology AM0022 Version 04[/3/]. Following are the parameters which were required to be monitored:

- Total wastewater flows entering system boundary (WW_{input}),
- Total wastewater flows leaving treatment system (WW_{output}),
- Total wastewater organic material concentration entering the project boundary (COD_{input}),
- Total wastewater organic material concentration leaving the treatment facility (COD_{output}),
- Total volume of biogas sent to facility heaters (V_{heat}),
- Total biogas sent to flare (V_{flare} also $FV_{FG,h}$),
- Amount of chemical oxidizing agents entering system boundary ($C_{SO4}{}^{2-}{}_{in}$),
- Amount of chemical oxidizing agents out of the digester ($C_{SO4}{}^{2-}{}_{out}$),
- Total flow of wastewater directly to the current water treatment system, and bypassing the new wastewater treatment facility ($WW_{bypassing}$),
- Loss of biogas from pipeline (Biogas loss from pipeline),

- Biogas calorific value (NCV_{biogas}),
- Project emissions from flaring of the residual gas stream (PE_{flare}),
- Fossil fuel volume equivalent to generate the same amount of heat generated from the biogas collected in the anaerobic treatment facility (F)
- Biogas methane concentration (C_{CH4} also $FV_{CH4,y}$)
- Heating system combustion efficiency (f_{heat})
- Organic material removed from wastewater facility ($M_{removed}$)

All parameters stated in the registered monitoring plan were monitored and reported appropriately. The monitoring report had included each parameter required by the monitoring plan. The monitoring methodology and sustaining records were sufficient to enable the verification of the emissions reduction. The verification of each parameter was as follows:

Data/parameter:	WW_{input}
Data unit:	m^3
Description:	Total wastewater flows entering system boundary
Source of data used:	Measured using continuous flow meter
Means of verification :	The total wastewater flows entering system boundary is measured continuously using an ABB electromagnetic flow meter located at the incoming pipe to the CIGAR and reading recorded daily The flow meter is connected to the SCADA system which has been programmed to enable the viewing of totalized volume reading and is able to produce a daily cumulative volume record through the Production Midnight Report/8/ generated every 24 hours Data from the SCADA system through this Production Midnight Report/8/ was transferred manually into the calculation working spread sheet daily by either the Shift Leader or Process Operator No data transfer error was found. However, it was noted that there were a few days throughout the monitoring period where the volume of wastewater was recorded as zero and no Production Midnight Report was available for these days. CL 3 was raised on this issue. Details of the findings and the resolutions are as in Table 2 of Annex 1 of this report.

Data/parameter:	WW_{output}
Data unit:	m^3
Description:	Total wastewater flows leaving treatment system
Source of data used:	Measured using continuous flow meter
Means of verification :	The wastewater flows leaving treatment system is measured continuously using ABB electromagnetic flow meter with a cumulative flow meter located at the pipe leaving the CIGAR. It was noted that during this monitoring period, two units of the following meters were used: : • ABB ProcessMaster s/n: 3K672012180486 • ABB COPA-XE DE43F s/n: 000422483/X002 (converter); s/n: 019442 (detector) The flow meters were connected to the SCADA system which was programmed to enable the viewing of totalized volume reading and

	able to produce a daily cumulative volume record through the Production Midnight Report[8] generated every 24 hours Data from the SCADA system through this Production Midnight Report[8] was transferred manually into the calculation working spread sheet daily by either the Shift Leader or Process Operator No data transfer error was found. However, it was noted that there were a few days throughout the monitoring period where the volume of wastewater was recorded as zero and no Production Midnight Report was available for these days. CL 3 was raised on this issue. Details of the findings and resolutions are as in Table 2 of Annex 1 of this report.

Data/parameter:	COD_{input}
Data unit:	kg_{COD}/m^3
Description:	Total wastewater organic material concentration entering the project boundary
Source of data used:	Internal laboratory records of daily wastewater analysis
Means of verification :	In accordance with the monitoring plan of the registered PDD, this parameter is to be analysed onsite at the facility's laboratory daily and weekly samples are sent to an accredited analytical laboratory for cross- checking with on-site data to assure accuracy. During on-site verification, it was confirmed that daily samples of wastewater entering the project boundary were taken at the inlet pipe entering to CIGAR. The sampling point was checked and it can be confirmed that the sampling point is the correct point as it is just before entering the CIGAR. The sampling and analysis of the daily COD entering to the CIGAR was carried out at the in-house laboratory by the Senior Lab Technician using the COD analyser (HACH DR-2800 Spectrophotometer s/n: 1156884). In house laboratory test method was established i.e. the "Procedure for COD concentration data collection"[9]. The procedure includes the method of samples preparation and operation of the equipment. The method was in accordance with the HACH method. The results of the COD analysis are recorded in the daily "Wastewater analysis report"[10]. As for external analysis, the samples of the wastewater were sent on a weekly basis to a third party accredited laboratory, SCI Plant Services Company Limited. Both the internal and external analysed results were compared, and it was confirmed that there was not much variance between the results, hence, only internal results were reported and transferred into the calculation spreadsheet. No data transfer error was found. However, it was noted that there were a few days throughout the monitoring period where the volume of wastewater was recorded as zero and no COD analysis results were available. CL 3 was raised on this issue. Details of the findings and resolutions are as in Table 2 of Annex 1 of this report.

Data/parameter:	COD_{output}
Data unit:	kg_{COD}/m^3
Description:	Total wastewater organic material concentration leaving the treatment facility
Source of data used:	Internal laboratory records of daily wastewater analysis
Means of verification :	In accordance with the monitoring plan of the registered PDD, this parameter is to be analysed onsite at the facility's laboratory daily and weekly samples are sent to an accredited analytical laboratory for cross- checking with on-site data to assure accuracy. During on-site verification, it was confirmed that daily samples of the wastewater leaving the CIGAR were taken at the outlet pipe of CIGAR. The sampling point was checked and it can be confirmed that the sampling point is the correct points as it is just after exiting the CIGAR. The sampling and analysis of the daily COD of effluent exiting from the CIGAR was carried out at the in-house laboratory by the Senior Lab Technician using the COD analyser (HACH DR-2800 Spectrophotometer s/n: 1156884) In house laboratory test method was established i.e. the "Procedure for COD concentration data collection"/9/. The procedure includes the method of samples preparation and operation of the equipment. The method was in accordance with the HACH method. The results of the COD analysis are recorded in the daily "Wastewater analysis report"/10/. As for external analysis, the samples of the wastewater were sent on a weekly basis to a third party accredited laboratory, SCI Plant Services Company Limited. Both the internal and external analysed results were compared, and it was confirmed that there was not much variance between the results, hence, only internal results were reported and transferred into the calculation spreadsheet. No data transfer error was found. However, it was noted that there were a few days throughout the monitoring period where the volume of wastewater was recorded as zero and no COD analysis results were available. CL 3 was raised on this issue. Details of the findings and resolutions are as in Table 2 of Annex 1 of this report.

Data/parameter:	V_{heat}
Data unit:	Nm^3
Description:	Total volume of biogas sent to facility heaters
Source of data used:	Measured using continuous flow meter
Means of verification :	The total volume of biogas sent to facility heaters is measured in normalized volume using thermal mass flow meter installed on the dedicated biogas pipeline prior to the facility heater During this monitoring period, three units of ABB thermal mass flow meter were used to measure biogas flow into heater (boiler) i.e.: • ABB Sensyflow FMT500 IG s/n: 241163131 X001

	• ABB Sensyflow IG-EX s/n: 27751279 • ABB Sensyflow s/n: 27751278 The flow meters were connected to the SCADA system which was programmed to enable the viewing of totalized volume reading and able to produce a daily cumulative volume record through the Production Midnight Report/8/ generated every 24 hours Data from the SCADA system through this Production Midnight Report/8/ was transferred manually into the calculation working spread sheet daily by either the Shift Leader or Process Operator. No data transfer error was found. In the first version of the MR, the ABB Sensyflow s/n: 27751278 had not been included. CAR 1 was raised on the matter and details of the findings are provided in Table 2 of Annex 1 of this report.

Data/parameter:	V_{flare} (also $FV_{FG,h}$)
Data unit:	Nm^3
Description:	Total biogas sent to flare
Source of data used:	Measured using continuous flow meter
Means of verification :	The total volume of biogas sent to flare is measured in normalized volume using thermal mass flow meter installed on the dedicated pipeline prior to the flare. During this monitoring period, two units of ABB thermal mass flow meter were used to measure biogas flow to flare i.e.: • ABB Sensyflow FMT500 IG s/n: 241151957 Y001 (converter); s/n: 241151957 X001 (sensor) • ABB Sensyflow IG-EX s/n: 26750814 The flow meters were connected to the SCADA system which was programmed to enable the viewing of totalizer volume reading and able to produce a daily cumulative volume record through the Production Midnight Report/8/ generated every 24 hours Data from the SCADA system through this Production Midnight Report/8/ was transferred manually into the calculation working spread sheet daily by either the Shift Leader or Process Operator. No data transfer error was found.

Data/parameter:	$C_{SO4^{2-}in}$
Data unit:	$tonnes/m^3$
Description:	Amount of chemical oxidizing agents entering system boundary
Source of data used:	Internal laboratory records of wastewater analysis
Means of verification :	In accordance with the monitoring plan, this parameter to be analysed weekly. Daily samples of wastewater entering system boundary were taken at the inlet pipe entering to CIGAR and mixed to get a composite sample on a weekly basis. The composite sample was analysed at the in-house laboratory using the HACH DR-2800 Spectrophotometer s/n: 1156884 on a weekly basis.

	In house laboratory test method was established i.e. the "Procedure for C_{SO4}^{2-} concentration data collection"/11/. The procedure includes the method of samples preparation and operation of the equipment. The method was in accordance with the HACH method. The results of the C_{SO4}^{2-} analysis are recorded in the daily "Wastewater analysis report"/10/. No data transfer error was found. However, it was noted that there were a few days throughout the monitoring period where the volume of wastewater was recorded as zero and no C_{SO4}^{2-} analysis results were available. CL 3 was raised on this issue. Details of the findings and resolutions are as in Table 2 of Annex 1 of this report.

Data/parameter:	$C_{SO4}^{2-}{}_{out}$
Data unit:	kg/m^3
Description:	Average concentration of chemical oxidative substance (sulphate) in the effluent from the digester in year y
Source of data used:	Internal laboratory records of wastewater analysis
Means of verification :	In accordance with the monitoring plan, this parameter to be analysed weekly. Daily samples of the wastewater exiting the CIGAR were taken at the outlet pipe of CIGAR and mixed to get a composite sample on a weekly basis. The composite sample was analysed at the in-house laboratory using the HACH DR-2800 Spectrophotometer s/n: 1156884 on a weekly basis. In house laboratory test method was established i.e. the "Procedure for C_{SO4}^{2-} concentration data collection"/11/. The procedure includes the method of samples preparation and operation of the equipment. The method was in accordance with the HACH method. The results of the C_{SO4}^{2-} analysis are recorded in the daily "Wastewater analysis report"/10/. No data transfer error was found. However, it was noted that there were a few days throughout the monitoring period where the volume of wastewater was recorded as zero and no C_{SO4}^{2-} analysis results were available. CL 3 was raised on this issue. Details of the findings and resolutions are as in Table 2 of Annex 1 of this report.

Data/parameter:	$WW_{bypassing}$
Data unit:	m^3
Description:	Total flow of wastewater directly to the current water treatment system, and bypassing the new wastewater treatment facility
Source of data used:	Measured using continuous flow meter
Means of verification :	A flow meter had been installed to measure any wastewater flows directly to the current water treatment system and bypassing the new wastewater treatment facility.

	During this monitoring period, three units of ABB electromagnetic flow meter were used i.e.: • ABB ProcessMaster s/n: 3K67201450101 • ABB ProcessMaster s/n: 6711071069 • ABB DE41F s/n: 000420831/Y004 (converter); s/n: 000282153/X001 (detector) The flow meters were connected to the SCADA system which was programmed to enable the viewing of totalizer volume reading and able to produce a daily cumulative volume record through the Production Midnight Report/8/ generated every 24 hours Data from the SCADA system through this Production Midnight Report/8/ is transferred manually into the calculation working spread sheet daily by the Shift Leader and Process Operator Based on the records of daily operation including the Production Midnight Report/8/, it was confirmed that there was no any bypassing of wastewater occurred during the whole monitoring period CL 4 was raised for non-reporting of the operational period of all the installed flow meters for this parameter. Details of the findings and the resolutions are as in Table 2 of Annex 1 of this report.

Data/parameter:	Biogas loss from pipeline
Data unit:	%
Description:	Loss of biogas from pipeline
Source of data used:	Pressure test report by external laboratory
Means of verification :	According to the monitoring plan, the integrity of biogas pipeline for losses of biogas methane is to be tested annually through pressurizing the system and establishing pressure drops through leakage. The tests for this parameter were conducted on 22 August 2011 and 17 August 2012 by an external laboratory i.e. SIWA Testing Inspection & Consulting Co. Ltd. From the test reports/12//13/ conducted each year, it was confirmed that there no pressure drops were detected. CL 5 was raised requesting PP to provide the integrity test reports. Details of the findings and resolutions are as in Table 2 of Annex 1 of this report.

Data/parameter:	NCV_{biogas}
Data unit:	J/Nm^3
Description:	Biogas calorific value
Source of data used:	NCV test report by external laboratory
Means of verification :	According to the monitoring plan, for this parameter, samples are to be taken annually and sent to an external laboratory. The biogas calorific value tests were conducted by PTT Chemical Public Company Limited on 25 July 2011 and 14 August 2012

	The analysis by PTT Chemical Public Company Limited was conducted based on ASTM D 1945-03 method. PP has provided the copy of the biogas calorific value test reports/14//15/. Based on the reports, it was confirmed that the reported value was consistent with the raw data and no transfer error found. CL 6 was raised on the appropriateness to use the value from the 2010 test in the calculation since this monitoring period started from April 2011. Details of the findings and the resolutions are as in Table 2 of Annex 1 of this report.

Data/parameter:	PE_{flare}
Data unit:	tCO_2
Description:	Project emissions from flaring of the residual gas stream
Source of data used:	Calculation as per "Tool to determine project emissions from flaring gases containing methane"/16/
Means of verification :	The project emission from flaring of the residual gas stream is determined through calculation. The calculation was carried out in accordance with the "Tool to determine project emissions from flaring gases containing methane"/16/ . During verification, CL 7 was raised for PP to provide the specification of the flare and all its related equipment installed in the project activity. Details of the findings and resolutions are as in Table 2 of Annex 1 of this report.

Data/parameter:	F
Data unit:	dm^3
Description:	Fossil fuel volume equivalent to generate the same amount of heat generated from the biogas collected in the anaerobic treatment facility
Source of data used:	Calculation based on the energy balance of biogas and fossil fuel
Means of verification :	In accordance with the monitoring plan, this parameter is to be calculated from the monitored V_{heat} multiplied by monitored NCV_{biogas} and divided by fixed parameter $NCV_{fuel\ oil.}$ In actual practice, the calculation was based on the monitored V_{heat} multiplied with the monitored NCV_{biogas} and divided by the pre-determined (*ex-ante*) fixed parameter of $NCV_{fuel.}$ The calculation is correctly applied in the spreadsheet.

Data/parameter:	C_{CH4} also $FV_{CH4,y}$
Data unit:	%
Description:	Biogas methane concentration
Source of data used:	Measured using continuous gas analyser
Means of verification :	The fraction of methane in the biogas is measured continuously using the infrared spectrometer gas analyser. The analyser ANRI CAM-3L s/n: LFB-028 was installed at the common biogas pipeline outlet from CIGAR prior to distribution to boiler and flare pipelines. The gas analyser is connected to the SCADA system which is

	programmed to enable the viewing of measured methane content reading and is able to produce a daily average record through the Production Midnight Report[/8/] generated every 24 hours Data from the SCADA system through this Production Midnight Report[/8/] is transferred manually into the calculation working spread sheet daily by the Shift Leader and Process Operator No data transfer error was found. However, it was noted that there were a few days throughout the monitoring period where the volume of wastewater was recorded as zero and no C_{CH4} value was recorded. CL 3 was raised on this issue. Details of the findings and resolutions are provided in Table 2 of Annex 1 of this report.

Data/parameter:	f_{heat}
Data unit:	%
Description:	Heating system combustion efficiency
Source of data used:	Test report
Means of verification :	In accordance with the monitoring plan, this parameter is to be measured annually. During this monitoring period, the combustion efficiency of the two boilers was measured by Thai Burner Industrial Heat Co. Ltd. on 1 June 2011 and 29 May 2012. PP has provided the copy of service report[/17//18/] and test sheet for the tests which were conducted by Thai Burner Industrial Heat Co. Ltd. in 2011 & 2012. The reported combustion efficiency was derived from the average of these multiple results of fuel feeding which was found to be correct.

Data/parameter:	$M_{removed}$
Data unit:	tCOD
Description:	Organic material removed from wastewater facility
Source of data used:	Calculation based on data source of COD_{in} and COD_{out}
Means of verification :	The organic material removed from wastewater facility is determined through calculation. The calculation was carried out by multiplying the wastewater input volume with its COD value deducted by the multiplication of wastewater output volume and its COD value. The calculation done in the spreadsheet was found accurate without any error.

3.4 Accuracy of Emission Reduction Calculations

In the calculation of the emission reductions, the following data input were used;

i) data recorded from the meters either installed or measured using portable measuring equipment;
ii) default/fixed values determined during the validation period;
iii) data provided by third party laboratory report; and

iv) data obtained from calculation.

A complete set of data for the specified monitoring period was made available during the site audit. PP has provided all raw data records copy of the following:

i) Production Midnight Reports Chao Khun Agro Biogas Energy Project (1 April 2011 to 31 December 2012) /8/
- Total wastewater flows entering system boundary
- Total wastewater flows leaving treatment system
- Total volume of biogas sent to facility heaters
- Total biogas sent to flare
- Total flow of wastewater directly to the current water treatment system and bypassing the new wastewater treatment facility
- Biogas methane concentration

ii) Daily wastewater analysis report /10/
- Total wastewater organic material concentration entering the project boundary
- Total wastewater organic material concentration leaving the treatment facility
- Amount of chemical oxidizing agents entering system boundary
- Amount of chemical oxidizing agents out of the digester

iii) Third party lab analysis/measurements record /12//13//14//15//17//18//46/
- Loss of biogas from pipeline
- Biogas calorific value
- Heating system combustion efficiency
- COD analysis

iv) Daily operation record
- Project emissions from flaring of the residual gas stream
- Fossil fuel volume equivalent to generate the same amount of heat generated from the biogas collected in the anaerobic treatment facility
- Organic material removed from wastewater facility

Summary of parameters is as follows:

Measured data by on-line meter:

Parameter	Equipment/Method	Unit	Remarks
WW_{input}	Electromagnetic flow meter	m^3	Refer CAR 2 and CL 3
WW_{output}	Electromagnetic flow meter	m^3	Refer CL 3
V_{heat}	Thermal mass flow meter	Nm^3	Refer CAR 1
V_{flare} also $FV_{FG,h}$	Thermal mass flow meter	Nm^3	No issue
$WW_{bypassing}$	Electromagnetic flow meter	m^3	Refer CL 4
C_{CH4} also $FV_{CH4,y}$	Gas analyser (near infrared spectrometry)	%	Refer CL 3

Lab analysis data:

Parameter	Equipment/Method	Unit	Remarks
COD_{input}	Internal lab analysis to determine COD (using spectrophotometer)	kg_{COD}/m^3	Refer CL 3
COD_{output}	Internal lab analysis to determine COD (using spectrophotometer)	kg_{COD}/m^3	Refer CL 3
$C_{SO4^{2-}in}$	Internal lab analysis to determine $C_{SO4^{2-}in}$	tonnes/m^3	Refer CL 3
$C_{SO4^{2-}out}$	Internal lab analysis to determine $C_{SO4^{2-}out}$	tonnes/m^3	Refer CL 3

Third party data analysis report

Parameter	Equipment/Method	Unit	Remarks
Biogas loss from pipeline	Pressure test by external laboratory	%	Refer CL 5
NCV_{biogas}	NCV test by external laboratory	J/Nm^3	Refer CL 6
f_{heat}	Combustion efficiency test by external laboratory	%	No issue

Calculated data:

Parameter	Equipment/Method	Unit	Remarks
PE_{flare}	Calculation	tCO_2	Refer CL 7
F	Calculation	dm^3	No issue
$M_{removed}$	Calculation	tCOD	No issue

For the default/fixed values, the values determined during the validation were used. These values were fixed for the entire crediting period of the project. Following are the default values that were used in the calculation of the emission reductions:

Parameter	Value	Unit	Remarks
EF_{CH4}	0.21	kgCH4/kg COD	AM0022 ver.04 IPCC values
GWP_{CH4}	21	-	AM0022 ver.04
$M_{lagoon\_aerobic}$	254	kg COD/ha/day	AM0022 ver.04
R_{lagoon}	96	%	PDD value
$R_{deposition}$	1.78	%	PDD value
$NCV_{fuel,oil}$	39.996×10^{-6}	TJ/dm^3	IPCC 2006 and density from Engineer's Edge
$EF_{fuel\ oil}$	77.367	tCO_2/TJ	IPCC 2006

Lagoon surface area	2.09	Ha	Official site diagram
Flare efficiency	50	%	Tool to determine project emissions from flaring gases containing methane
RSO_4^{2}	651	kg/tonne (kg_{COD}/tSO_4^{2-})	AM0022 ver.04

Emission reductions calculation:

In accordance with equation 12 of AM0022 version 04, the emission reductions is to be determined as follow:

$ER = E_{BL} – E_{project}$

Where

ER = Emissions reductions of the project activity (tCO_2e)

E_{BL} = Baseline emissions (tCO_2e)

$E_{project}$ = Project emissions in year y (tCO_2e)

Accordingly, the baseline emissions are calculated as per equation 8 of AM0022 version 04 as follows:

$E_{BL} = E_{CH4\_lagoon\_BL} + E_{CO2\_heat\_BL} + E_{CO2\_power\_BL}$

Where:

$E_{CH4\_lagoon\_BL}$ Fugitive methane emissions from lagoons in the baseline case (tCO_2e)

$E_{CO2\_heat\_BL}$ CO_2 emissions from on-site fossil heat in the baseline case (tCO_2) that are displaced by generation based on biogas collected in the anaerobic treatment facility

$E_{CO2\_power\_BL}$ CO_2 emissions from on-site power generation in the baseline case (tCO_2) that are displaced by generation based on biogas collected in the anaerobic treatment facility. The project activity does not involved any on-site power generation, hence, $E_{CO2\_power\_BL} = 0$.

Following are the equations involved in the calculation:

Calculation of fugitive methane emissions from lagoons in the baseline case:

According to equation 2 of AM0022 version 04, this baseline emission is determined as follows:

$E_{CH4\_lagoon\_BL} = M_{lagoon\_anaerobic} * EF_{CH4} * GWP_{CH4} /1000$

Where:

$M_{lagoon\_anaerobic}$ Amount of organic material removed by anaerobic processes in the lagoon System (kg COD)

EF_{CH4} Methane emission factor (kg CH_4 / kg COD)

GWP_{CH4} Global Warming Potential of methane for the commitment period (tCO_2e/tCH_4)

Based on the input values provided, the $E_{CH4\_lagoon\_BL}$ for this monitoring period was determined to be 99,065 tCO_2e.

Calculation of CO_2 emissions from on-site fossil heat in the baseline case (tCO_2) that are displaced by generation based on biogas collected in the anaerobic treatment facility:

According to equation 9 of AM0022 version 04, this baseline emission is determined as follows:

$E_{CO2\_heat\_BL} = F*NCV*EF$

Where:

F	Corresponding amount of fossil fuel displaced by the use of biogas for the generation of on-site heat (dm^3)
NCV	Net calorific value of the fossil fuel considers (TJ/unit)
EF	CO_2 emission factor of the fossil fuel considers (tCO_2/TJ)

Based on the input values provided, the $E_{CO2\_heat\_BL}$ for this monitoring period was determined to be 14,162 tCO_2e.

Based on equation 8 of AM0022, E_{BL} for the monitoring period was determined to be 113,227 tCO_2e (round-down value).

Project emissions:

As per equation 1 of AM0022 version 04, all potential project emission sources are calculated as follows:

$E_{project} = E_{CH4\_lagoon} + E_{CH4\_NAWTF} + E_{CH4\_IC+Leak}$

Where:

$E_{project}$	Total project emission (tCO_2e)
$E_{CH4\ lagoon}$	Fugitive methane emissions from lagoons (tCO_2e)
$E_{CH4\ NAWTF}$	Fugitive methane emissions from the new anaerobic wastewater treatment facility (tCO_2e)
$E_{CH4\ IC+Leak}$	Methane emissions from inefficient combustion and leaks (tCO_2e)

Following are the equations involved in the calculation:

Calculation of fugitive methane emissions from lagoons (E_{CH4_lagoon}):

As described above, according to equation 2 of AM0022 version 04, this project emission is determined as follows:

$E_{CH4\_lagoon} = M_{lagoon\_anaerobic} * EF_{CH4} * GWP_{CH4} /1000$

Where:

$M_{lagoon\_anaerobic}$	Amount of organic material removed by anaerobic processes in the lagoon System (kg COD)
EF_{CH4}	Methane emission factor (kg CH_4 / kg COD)
GWP_{CH4}	Global Warming Potential of methane for the commitment period (tCO_2e/tCH_4)

Based on the input values provided, the E_{CH4_lagoon} for this monitoring period was determined to be 25,467 tCO_2e.

Calculation of fugitive methane emissions from the new anaerobic wastewater treatment facility (E_{CH4_NAWTF})

According to AM0022 version 04, methane emission from the specific anaerobic wastewater treatment facility that is implemented with the project should be assessed and estimated based on measurements, technology supplier data and expert estimates. They may be neglected if documented evidence for their insignificance is given.

It was assessed through records and interviews at site; the leakage of wastewater treatment facility was inspected by the operational staff on a daily basis and inspected and checked by a third party on annual basis. It was confirmed that the result during the whole monitoring period from 1 April 2011 to 31 December 2012, showed there were no leakages that could allow fugitive methane emissions from the new anaerobic wastewater treatment facility. Therefore, this emission is neglected in the project during this monitoring period.

Calculation of methane emissions from inefficient combustion and leaks ($E_{CH4\_IC+Leak}$)

According to equation 7 of AM0022 version 04, this baseline emission is determined as follows:

$$E_{CH4\_IC+Leaks} = (\sum_{r} V_r \cdot C_{CH4\_r} \cdot (1 - f_r) \cdot GWP_{CH4}) + PE_{flare}$$

Where:
The sum is made over two routes r for methane destruction (heating and power generation)

V_r	Biogas combustion process volume in route r (Nm^3)
C_{CH4}	methane concentration in biogas (tCH_4/Nm^3) to be measured on wet basis
GWP_{CH4}	Global Warming Potential of methane for the commitment period (tCO_2e/tCH_4)
PE_{flare}	Project emissions from flaring of the residual gas stream (tCO2e) calculated following the procedures described in the "Tool to determine project emissions from flaring gases containing methane"

Based on the input values provided, the $E_{CH4\_IC+Leaks}$ for this monitoring period was determined to be 1,491 tCO_2e.

Based on the above equation, the total project emissions ($E_{project}$) of the monitoring period were determined to be 26,958 tCO_2e (round-up value).

Calculation of leakage

In accordance with the methodology, leakage calculations are not required since the technology being employed in this project is not transferred from or to another activity.

Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

The formulae used in the emission reductions calculation spreadsheet to calculate the emission reductions were also verified and found to be in accordance to that in the PDD. The emissions in the project and the baseline scenario were correctly calculated. The emissions in the project and the baseline scenario were correctly calculated. The following table summarizes the calculation of the emission reductions:

Monitoring period	
Total baseline emissions E_{BL}= total fugitive methane emissions from lagoons in the baseline, $E_{BL\_CH4\_lagoons}$ and baseline emission from heat generation, $E_{CO2\_heat\_BL}$	113,227.00 tCO_2e
Total project emissions E_{PA} = sum of the methane emissions from lagoons project emissions $E_{CH4\_lagoons}$, fugitive methane emissions from inefficient combustion and leaks; $E_{CH4\_IC + leaks}$ consists of E_{CH4_heat} and the emissions resulting from incomplete combustion (PE_{flare})	26,958.00 tCO_2e
Total emission reductions (using equation (12) of AM0022) $ER = E_{BL} - E_{Project}$	86,269.00 tCO_2e
Conservativeness check using equation 13 of AM0022 $E_{conservativeness} = E_{CH4\_lagoons\_BL} - (E_{CH4lagoon} + E_{CH4\_nawtf} + E_{CH4\_coll})$ In accordance with AM0022, if the difference is positive, it has to be deducted from the result obtained from equation 12)	- 8,407.00 tCO_2e
Total emission reductions for the period (after application of equation 13)	86,269.00 tCO_2e

Time Period	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)	Emission reductions or net anthropogenic GHG removals by sinks (tCO_2e)
Total	113,227	26,958	0	86,269

The total emission reductions being requested for this monitoring period is rounded down to **86,269 tCO_2e.**

The comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD is shown in the table as follows:

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (tCO_2e)	84,589	86,269

There was an increase of actual emission reductions achieved during the current monitored period, compared to the estimated value during the validation. This was due to the amount of wastewater treated which was 14.22% higher than expected in the registered PDD. It is confirmed that this CER increase does not affect the additionality of the project activity.

3.5 Quality of Evidence to Determine Emission Reductions

The equipment used to monitor and measure the parameters in the monitoring plan had been calibrated accordingly. PP had provided the information of removal and replacements and an equipment calibration list/19/ to ensure that the equipment history and the calibration status are being tracked. Reasons for replacement have also been recorded. Calibrations were carried out by qualified third parties, mostly by the equipment manufacturers and the frequency of calibration was based on the recommendation by the equipment manufacturers. Following are the calibration status of the equipment:

	Equipment	Equipment number and operation	Calibration date	Frequency of calibration	Remarks
1.	Flow meter to measure WW_{input}	SN: 000469020/X002 (converter); 024436 (detector) In operation from 19-Aug-10 until end of the monitoring period	19-Aug-10/20/ (1st) 16-Aug-12/21/ (2nd)	Once in every 2 years/22/	• One unit of ABB electromagnetic flow meter has been used to measure POME flow during this monitoring period ABB COPA-XE DE43F s/n: 000469020/X002 (converter); s/n: 024436 (detector) • Accuracy class: ± 0.5 %Calibration frequency is as specified by the manufacturer • CAR 2 was raised for the inconsistency of date and validity period reported in the MR and actual date of calibration in the certificate for second calibration
2.	Flow meters to measure WW_{output}	First unit: SN: 000422483/X002 (converter); 019442 (detector) In operation from 19-Aug-10 until 21-Sep-12	19-Aug-10/23/ (1st) 16-Aug-12/24/ (2nd)	Once in every 2 years/22/	Two units of ABB electromagnetic flow meter has been used to measure POME flow during this monitoring period i.e.: ABB COPA-XE DE43F s/n: 000422483/X002 (converter); s/n: 019442 (detector) • Accuracy class: ± 0.5 % • Replaced by s/n: 3K672012180486 on 21-Sep-12 ABB ProcessMaster s/n:
		Second unit: SN: 3K672012180486 In operation from 21-Sep-12 until end of monitoring period	14-May-12/25/		

					3K672012180486 • Accuracy class: ± 0.4 % • The calibration frequency is as specified by the manufacturer.
3.	Spectrophotometer to measure COD_{input}, COD_{output}, $C_{SO4^{2-}\ in}$ & $C_{SO4^{2-}\ out}$	SN: 1156884 In operation from start of the project activity until present	4-Oct-10[/26/] (1st) 22-Sep-11[/27/] (2nd) 22-Sep-12[/28/] (3rd)	Annually[/29/]	One unit Hach spectrophotometer Hach/DR2800 s/n: 1156884 has been used during this monitoring period. Calibrations of the unit were done by SPC Calibration Center, Bangkok, Thailand.
4.	Flow meter to measure $WW_{bypassing}$	SN: 000420831/Y004 (converter); 000282153/X001 (detector) In operation from 8-Sep-10 until 8-Apr-11 and from 23-Sep-11 until 25-Jan-12	7-Sep-10[/30/]	Once in every 2 years[/22/]	Three units ABB electromagnetic flow meter were used to measure wastewater flow during this monitoring period i.e. ABB DE41F s/n: 000420831/Y004 (converter); s/n: 000282153/X001 (detector) • Accuracy class: ± 0.5 % • Replaced by s/n: 6711071069 on 8-Apr-11 and subsequently by s/n: 3K67201450101 on 25-Jan-12 ABB ProcessMaster s/n: 6711071069 • Accuracy class: ± 0.4 % • Replaced by s/n: 000420831/Y004 on 23-Sep-11 ABB ProcessMaster s/n: 3K67201450101 • Accuracy class: ± 0.4 %
		SN: 6711071069 In operation from 8-Apr-11 until 23-Sep-11	23-Feb-11[/31/]		
		SN: 3K67201450101 In operation from 25-Jan-12 until present	17-Nov-11[/32/]		
5.	Flow meter to measure V_{heat}	SN: 27751279 In operation from 15-Aug-08 until 30-	29-Jul-08[/33/]	Once in every 3 years[/36/]	Three units ABB thermal mass flow meter has been used to measure

		May-11			biogas flow into heater (boiler) during this monitoring period i.e.: ABB Sensyflow IG-EX s/n: 27751279 • Accuracy class: ± 0.5 % • Replaced by s/n: 27751278 on 30-May-11 ABB Sensyflow IG-EX s/n: 27751278 • Accuracy class: ± 0.5 % • Replaced by s/n: 241163131 X001 on 14-Feb-12 ABB Sensyflow FMT500 IG s/n: 241163131 X001 • Accuracy class: ± 0.5 %
		SN: 27751278 In operation from 30-May-11 until 14-Feb-12	14-Oct-09[/34/]		
		SN: 241163131 X001 In operation from 14-Feb-12 until present	25-Nov-11[/35/]		
6.	Flow meter to measure V_{flare}	SN: 26750814 In operation from 28-Aug-09 until 10-Jul-12	24-Jun-09[/37/]	Once in every 3 years[/36/]	Two units ABB thermal mass flow meter has been used to measure biogas flow to flare during this monitoring period i.e.: ABB Sensyflow IG-EX s/n: 26750814 • Accuracy class: ± 0.5 % • Replaced by s/n: 241151957 Y001 on 10-Jul-12 ABB Sensyflow FMT500 IG s/n: 241151957 Y001 (converter); s/n: 241151957 X001 (sensor) • Accuracy class: ± 0.5 %
		SN: 241151957 Y001 (converter); 241151957 X001 (sensor) In operation from 10-Jul-12 until end of monitoring period	15-Dec-11[/38/]		
7.	Gas analyser to measure C_{CH4}	SN: LFB-028 In operation from 1-Apr-11 until end of monitoring period	9-Sep-10[/39/] (1st) 2-Sep-11[/40/] (2nd) 15-Aug-12[/41/] (3rd)	• Annually[/42/]	One unit of near infrared spectrometry gas analyser was installed in the common biogas pipeline outlet from CIGAR prior to the distribution to boiler and flare pipelines i.e.: • ANRI CAM-3L s/n:

					LFB-028 • Type: infrared spectrometry • Accuracy class: ± 0.5 of full scale

The calibration records were reviewed and the verification team found that the calibration results were within the permissible range and acceptable. It can be confirmed that all the equipment were functioning properly during the monitoring period. All values used in determining emissions reduction were substantiated and free of any material errors.

3.6 Management System and Quality Assurance

The roles and responsibilities for monitoring of emissions reduction data had been clearly defined. TBEC had established a team of personnel to operate and maintain the CDM project activity. The site biogas-plant manager is responsible to ensure that the data is appropriately measured and recorded according to registered monitoring plan, and rechecks with the primary data sources. The site biogas plant manager is responsible to report the data to the QESH Engineer who is located at the headquarters of TBEC in Bangkok. QESH Engineer is responsible to review the measured data and prepare the ER calculation and the monitoring report. . A CDM project manager (located at the headquarters in Bangkok) is designated to oversee the preparation of monitoring report. The monitoring report is reviewed before submitting to DOE for verification.

4 VERIFICATION AND CERTIFICATION STATEMENT

SIRIM QAS International Sdn. Bhd. was engaged by the Thai Biogas Energy Company, Thailand to perform the second periodic verification and certification of the emissions reduction for the CDM project 'Chao Khun Agro Biogas Energy Project' for the period from 1 April 2011 to 31 December 2012.

The verification was based on the CDM registered PDD/2/, the approved methodology AM0022 Avoided Wastewater and On-site Energy Use Emissions in the Industrial Sector (version 04)/3/, the Monitoring Reports/5/&/43/, emission reduction calculation spreadsheets/6/&/44/ and other supporting documents made available to SIRIM QAS International verification team by the client.

The management of Thai Biogas Energy Company, Thailand was responsible for the preparation and reporting of GHG emissions data and the reported GHG emissions reduction on the basis set out within the project monitoring plan.

It is the responsibility of SIRIM QAS Intl. verification team to express an independent verification opinion on the GHG emissions from the project for the period from 1 April 2011 to 31 December 2012 and on the calculation of GHG emission reductions from the project based on the verified emissions for the same period.

The verification was carried out in accordance with the requirements of the Validation and Verification Standard version 03.0/1/. As a result of the verification, the verification team confirms that for the reporting period:

- all operations of the project were implemented as described in the registered PDD/2/,
- the monitoring plan is in accordance with the approved monitoring methodology, AM0022 Avoided Wastewater and On-site Energy Use Emissions in the Industrial Sector (version 04)/3/ applied by the CDM project activity,

- the monitoring has been carried out in accordance with the monitoring plan contained in the registered PDD[/2/],
- the monitoring aspects (i.e. additional monitoring parameters, monitoring frequency and calibration frequency) were in place and functional, with the installed equipment essential for generating emissions reduction operating appropriately and the calibration of all the equipment had been carried out accordingly, and
- the GHG emissions reduction achieved were calculated correctly on the basis of approved monitoring methodology AM0022 Avoided Wastewater and On-site Energy Use Emissions in the Industrial Sector (version 04)[/3/].

We have verified that the information included in the final monitoring report[/43/] (version 02, dated 4 May 2013) was correct and that the emissions reduction achieved had been determined correctly. In our opinion, the GHG emissions reduction for the period from 1 April 2011 to 31 December 2012 stated in the final monitoring report[/43/] (version 02, dated 4 May 2013) for the project are fairly stated.

The verifier confirms that the GHG emission reductions were calculated without material misstatements for the whole monitoring period. Our opinion is based on the project's GHG emissions and resulting GHG emission reductions reported, and, to the valid and registered project baseline and monitoring documents. Based on the information we have seen and evaluated, we confirm the following:

Monitoring period	1 April 2011 to 31 December 2012
Total Baseline Emissions	113,227.00 tCO_2e
Total Project Emissions	26,958.00 tCO_2e
Emission Reduction - before application of equation for conservativity criteria	86,269.00 tCO_2e
Emission Reductions - including equation 13 (rounded value)	86,269.00 tCO_2e

Prepared by :

(Hafriazhar Mohd. Mokhtar)
Verification Team Leader

Approved by :

(Parama Iswara Subramaniam)
DOE Representative

5 REFERENCES

/1/	Validation and Verification Standard (version 03.0)
/2/	Registered PDD dated 19 February 2009 (version 04)
/3/	Applied Methodology: AM0022 Avoided Wastewater and On-site Energy Use Emissions in the Industrial Sector (version 04)
/4/	Validation Report by DNV, report no. 2005-1475 rev. no. 02 dated 20 February 2009
/5/	Monitoring Report dated 3 January 2013 (version 01)
/6/	ER Calculation Spreadsheet dated 3 January 2013 (version 01)
/7/	Notice of Official Commercial Operations Date dated 15 December 2006
/8/	Chao Khun Biogas Plant Daily Production Midnight Report for period from 1 April 2011 to 31 December 2012
/9/	Chao Khun Biogas Plant Laboratory procedure for COD concentration data collection
/10/	Chao Khun Biogas Plant Laboratory daily wastewater analysis report for period from 1 April 2011 to 31 December 2012
/11/	Chao Khun Biogas Plant Laboratory procedure for C_{SO4}^{2-} concentration data collection
/12/	Chao Khun biogas pipelines integrity test reports by SIWA Testing Inspection & Consulting Co. Ltd. dated 22 August 2011
/13/	Chao Khun biogas pipelines integrity test reports by SIWA Testing Inspection & Consulting Co. Ltd. dated 17 August 2012
/14/	Chao Khun biogas calorific value test report by PTT Chemical Public Company Limited dated 25 July 2011
/15/	Chao Khun biogas calorific value test report by PTT Chemical Public Company Limited dated 14 August 2012
/16/	CDM Tool to determine project emissions from flaring gases containing methane, EB 28 Annex 13
/17/	Chao Khun biogas burner combustion efficiency test report by Thai Burner Industrial Heat Co. Ltd. dated 1 June 2011
/18/	Chao Khun biogas burner combustion efficiency test report by Thai Burner Industrial Heat Co. Ltd. dated 29 May 2012
/19/	Chao Khun Biogas Plant list of equipment removal and replacements history and calibrations
/20/	SN: 000469020/X002 (converter); 024436 (detector): 1st calibration by MIT on 19-Aug-10 (cert. no.: L1008-187)
/21/	SN: 000469020/X002 (converter); 024436 (detector): 2nd calibration by MIT on 16-Aug-12 (cert. no.: L1208-085)
/22/	ABB electromagnetic flow meter specifications and calibration requirement
/23/	SN: 000422483/X002 (converter); 019442 (detector): 1st calibration by MIT on 19-Aug-10 (cert. no.: L1008-188)
/24/	SN: 000422483/X002 (converter); 019442 (detector): 2nd calibration by MIT on 16-Aug-12 (cert. no.: L1208-086)
/25/	SN: 3K672012180486: calibration by ABB on 14-May-12 (cert. no.: 12/2/2/500457)
/26/	SN: 1156884: 1st calibration by SPC Calibration Center on 4-Oct-10 (cert. no.: C06100204)
/27/	SN: 1156884: 2nd calibration by SPC Calibration Center on 22-Sep-11 (cert. no.: C06110236)
/28/	SN: 1156884: 3rd calibration by SPC Calibration Center on 22-Sep-12 (cert. no.: C06120262)
/29/	Hach spectrophotometer specifications and calibration requirement
/30/	SN: 000420831/Y004 (converter); 000282153/X001 (detector): calibration by MIT on 7-Sep-10 (cert. no.: L1009-028)
/31/	SN: 6711071069: calibration by ABB on 23-Feb-11 (cert. no.: 11/4/2/210339)
/32/	SN: 3K67201450101: calibration by ABB on 17-Nov-11 (cert. no.: 11/4/2/215103)
/33/	SN: 27751279: calibration by ABB on 29-Jul-08 (cert. no.: 1612 DKD-K-05701 2008-07)
/34/	SN: 27751278: calibration by ABB on 14-Oct-09 (order no.: 240236990)
/35/	SN: 241163131 X001: calibration by ABB on 25-Nov-11 (cert. no.: 0184 D-K-15081-01-00 2011-11)

/36/	ABB thermal mass flow meter specifications and calibration requirement
/37/	SN: 26750814: calibration by ABB on 24-Jun-09 (order no.: 240236990)
/38/	SN: 241151957 Y001 (converter); 241151957 X001 (sensor): calibration by ABB on 15-Dec-11 (cert. no.: 0186 D-K-15081-01-00 2011-12)
/39/	SN: LFB-028: 1st calibration by Entech on 9-Sep-10 (cert. no.: G 530268)
/40/	SN: LFB-028: 2nd calibration by Entech on 2-Sep-11 (cert. no.: G 540277)
/41/	SN: LFB-028: 3rd calibration by Entech on 15-Aug-12 (cert. no.: G 550249)
/42/	ANRI near infrared spectrometry (gas analyser) specifications and calibration requirement
/43/	Monitoring report dated 4 May 2013 (version 02)
/44/	ER Spreadsheet dated 4 May 2013 (version 02)
/45/	Verification and Certification Report – 1st Periodic – TBEC Chao Khun Agro Biogas Energy Project, Report no.: 11CDMTH010005-11/422 dated 18 June 2013
/46/	SCI Plant Services Company Limited weekly cross-checking COD analysis reports

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ANNEX 1
VERIFICATION PROTOCOL
REPORT NO: SQAS-CDM- ET07850004

SIRIM QAS INTERNATIONAL SDN BHD
Verification checklist

Project name : Chao Khun Agro Biogas Energy Project (2138)
Period of monitoring from 1 April 2011 to 31 December 2012 (2nd Monitoring Period)

TABLE 1: VERIFICATION REQUIREMENTS BASED ON CDM VALIDATION AND VERIFCATION STANDARD VERSION 3.0

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
1. Compliance of the project implementation with the registered project design document					
1.1 Was an on-site visit conducted for this verification? If no, please justify the rationale of the decision.	VVS	227	Yes, an on-site audit was carried out by Hafriazhar Mohd. Mokhtar and Syed Anuar Shah Syed Mansor on 28 and 29 January 2013 at the project site in Chao Khun Agro Products Project, 44 Moo 2, Songkorn, Kaengkoi, Saraburi, 18110, Thailand	OK	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
1.2 Are all physical features of the CDM project activity proposed in the registered PDD in place?	VVS	227	Yes, the physical features of the project activity were in place as per PDD and further detailed out in the Monitoring Report.	OK	OK
			There was one lagoon (denoted as CIGAR in Figure 2 in the Monitoring Report) covered with HDPE membrane with one unit of open flare installed.	OK	OK
			One unit of thermal boiler with a steam generation capacity of 15mt/hr was being installed with the biogas burner at a rated capacity range from 1,400kW to 10,800kW thermal.	OK	OK
			In terms of the monitoring system, the relevant sampling and measuring points for parameters such as COD_{input} and COD_{output}, wastewater flow rate, biogas flow rate and CH_4 concentration were also noted and found to be correct	OK	OK
1.3 Have the project participants operated the proposed CDM project activity as per the registered PDD or any approved revised PDD?	VVS	227 & 230	Yes, the project activity has been operated as in the PDD.	OK	OK
1.4 For this monitoring period, what is the status of the implementation of the project? For project activities that consist of more than one site, the DOE shall describe the status of implementation and starting date of operation for each site.	VVS	228 (a)	The project activity has been fully operated since 16-Dec-06 based on the information reported in the MR on the operation start date. This was reflected by the operation of new anaerobic wastewater treatment facility. PP is required to provide the evidence of the first operation start date stipulated.	~~CL 1~~	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
For project activities with phased implementation, what is the progress of the proposed project activity achieved in each phase under verification. If the phased implementation is delayed, describe the reasons and present the expected implementation dates;	VVS	228 (a)	The project activity has only 1 single project, i.e. no phases.	OK	OK
1.5 Describe the actual operation of the project activity.	VVS	228 (b)	The project activity is located at Chao Khun Agro Products Project, 44 Moo 2, Songkorn, Kaengkoi, Saraburi, 18110, Thailand. The project developed by Thai Biogas Energy Company Ltd (TBEC) is an industrial anaerobic wastewater treatment which treats wastewater from the cassava processing factory. The project activity involves the installation of a Covered In-Ground Anaerobic Reactor (CIGAR) to treat the wastewater. The CIGAR has a treatment capacity of 41,000m^3 where organic material within the wastewater digested and producing biogas. The generated biogas is captured in the digester and supplied to one unit thermal boiler with a steam generation capacity of 15mt/hr being installed with a biogas burner at a rated capacity range from 1,400kW to 10,800kW thermal. The biogas being utilized replaces the fossil fuel in the thermal energy generation while the surplus biogas is flared in an open flaring system. The residual wastewater from the CIGAR is directed into the existing open lagoons.	OK	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
1.6 Any information (data and variables) provided in the monitoring report that is different from that stated in the registered PDD or any approved revised PDD? (that has caused an increase in estimates of the emission reductions in the current monitoring period or is highly likely to increase the estimates of emission reductions in the future monitoring)	VVS	228 (c)	A complete set of data for the specified monitoring period was made available during the site audit. PP is required to provide all raw data records copy of the following: i) Production Midnight Reports Chao Khun Agro Biogas Energy Project (1 April 2011 to 31 December 2012) • Total wastewater flows entering system boundary • Total wastewater flows leaving treatment system • Total volume of biogas sent to facility heaters • Total biogas sent to flare • Total flow of wastewater directly to the current water treatment system and bypassing the new wastewater treatment facility • Biogas methane concentration ii) Daily wastewater analysis report • Total wastewater organic material concentration entering the project boundary • Total wastewater organic material concentration leaving the treatment facility • Amount of chemical oxidizing agents entering system boundary • Amount of chemical oxidizing agents out of the digester iii) Third party lab analysis/measurements record • Loss of biogas from pipeline • Biogas calorific value • Heating system combustion efficiency	~~CL 2~~	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			iv) Daily operation record • Project emissions from flaring of the residual gas stream • Fossil fuel volume equivalent to generate the same amount of heat generated from the biogas collected in the anaerobic treatment facility • Organic material removed from wastewater facility		
2. Compliance of the monitoring plan with the monitoring methodology including applicable tool(s) **The monitoring plan of the proposed CDM project activity shall comply with the applied methodology.**					
2.1 For monitoring aspects that are not specified in the methodology, particularly in the case of small-scale methodologies (e.g. additional monitoring parameters, monitoring frequency and calibration frequency), these should be brought to the attention of the Board issues which may enhance the level of accuracy and completeness of the monitoring plan.	VVS	231	The project activity uses large-scale methodology. It was confirmed through the document review and site visit that no additional monitoring parameters, monitoring frequency and calibration frequency in the monitoring aspects that are not specified in the methodology.	OK	OK
2.1 Is the monitoring plan of the CDM project activity complying with the methodology applied by the registered CDM project activity or an approved revised PDD?	VVS	232	Yes, the monitoring plan in the PDD was found to be in accordance to the applied methodology, AM 0022 Version 04-Avoided Wastewater and On-site Energy Use Emissions in the Industrial Sector.	OK	OK

3.	**Compliance of monitoring activities with the registered monitoring plan.** **Determine whether the monitoring of parameters related to the GHG emissions reductions in the project activity has been implemented in accordance with the monitoring plan contained in the registered PDD or any accepted revised monitoring plan.**					
3.1	Has the monitoring plan been properly implemented and followed by the project participants?	VVS	234 (a)	Yes, the PP had implemented the monitoring requirements as required in the monitoring plan of the registered PDD and as specified in ACM 0014 Version 02.1.	OK	OK
3.2	Have all parameters stated in the monitoring plan, and relevant CDM Executive Board decisions been sufficiently monitored and updated as applicable, including:	VVS	234 (b)	In accordance with the monitoring plan of the registered PDD, the following parameters were monitored :		
	i) project emission parameters			i) WW_{input} • The total wastewater flows entering system boundary is measured continuously with a cumulative flow meter located at the incoming pipe to the CIGAR and reading recorded daily • ABB electromagnetic flow meter has been used to measure wastewater flow during this monitoring period as reported in the MR i.e.: ABB COPA-XE DE43F s/n: 000469020/X002 (converter); s/n: 024436 (detector) • The flow meters are connected to SCADA system which is programmed to enable the viewing of totalizer volume reading record and will produce a daily cumulative volume record through the Production Midnight Report generated every 24 hours	OK OK OK	OK OK OK

			• Data from the SCADA system through this Production Midnight Report is transferred manually into the calculation working spread sheet daily by the Shift Leader and Process Operator • No data transfer error was found. However, it was noted that there were few days throughout the monitoring period where the volume of wastewater are recorded as zero and no Production midnight report available for these days due to host factory shutdown and public holidays. PP need to provide the factory operation calendar as supporting documents.	OK ~~CL 3~~	OK OK
			ii) WW_{output} • The wastewater flows leaving treatment system is measured continuously with a cumulative flow meter located at the pipe leaving the CIGAR and reading recorded daily • Two units ABB electromagnetic flow meter has been used to measure wastewater flow during this monitoring period as reported in the MR i.e.: ⇒ ABB ProcessMaster s/n: 3K672012180486 ⇒ ABB COPA-XE DE43F s/n: 000422483/X002 (converter); s/n: 019442 (detector) • The flow meters are connected to SCADA system which is programmed to enable the viewing of totalizer volume reading record and will produce a daily cumulative volume record through the Production Midnight Report generated every 24 hours • Data from the SCADA system through this Production Midnight Report is transferred manually into the calculation working spread sheet daily by the Shift Leader and Process Operator •	OK OK OK OK	OK OK OK OK

			• No data transfer error was found. However, it was noted that there were few days throughout the monitoring period where the volume of wastewater are recorded as zero and no Production midnight report available for these days due to host factory shutdown and public holidays. PP need to provide the factory operation calendar as supporting documents	~~Refer CL 3~~	OK
			iii) COD_{input} • Samples of the total wastewater organic material concentration entering the project boundary were taken through the sampling cork on the inlet pipe of mixing tank prior to CIGAR daily. The sampling points were checked and it can be confirmed that the sampling points are the correct points as it is just before entering the CIGAR. • The sampling and analysis of the daily COD of influent entering to the digester was carried out at the in-house laboratory by the Senior Lab Technician using the COD analyzer as reported in the MR i.e. HACH DR-2800 Spectrophotometer s/n: 1156884 • In house laboratory test method was established i.e. the "Procedure for COD concentration data collection". The procedure includes the method of samples preparation and operation of the equipment. The method was in accordance with the HACH method. • The results of the COD analysis are recorded in the daily "Wastewater analysis report". • No data transfer error was found. However, it was noted that there were few days throughout the monitoring period where the volume of wastewater are recorded as zero and no COD analysis results available for these days due to host factory shutdown and public holidays. PP need to provide the factory operation calendar as supporting documents	OK OK OK OK ~~Refer CL 3~~	OK OK OK OK OK

			iv) COD_{output} • Samples of the total wastewater organic material concentration leaving the treatment facility were taken through the sampling cork on the outlet pipe of CIGAR daily. The sampling points were checked and it can be confirmed that the sampling points are the correct points as it is just after exiting the CIGAR. • The sampling and analysis of the daily COD of effluent exiting from the CIGAR was carried out at the in-house laboratory by the Senior Lab Technician using the COD analyzer as reported in the MR i.e. HACH DR-2800 Spectrophotometer s/n: 1156884 • In house laboratory test method was established i.e. the "Procedure for COD concentration data collection". The procedure includes the method of samples preparation and operation of the equipment. The method was in accordance with the HACH method. • The results of the COD analysis are recorded in the daily "Wastewater analysis report". • No data transfer error was found. However, it was noted that there were few days throughout the monitoring period where the volume of wastewater are recorded as zero and no COD analysis results available for these days due to host factory shutdown and public holidays. PP need to provide the factory operation calendar as supporting documents	OK OK OK OK ~~Refer CL 3~~	OK OK OK OK OK

			v) $C_{SO4}^{2-}{}_{in}$ • Samples of the amount of chemical oxidizing agents entering system boundary were taken through the sampling cork on the outlet pipe of CIGAR daily. The sampling points were checked and it can be confirmed that the sampling points are the correct points as it is just after exiting the CIGAR. • The sampling and analysis of the daily chemical oxidizing agents entering system boundary was carried out at the in-house laboratory by the Senior Lab Technician using the COD analyzer as reported in the MR i.e. HACH DR-2800 Spectrophotometer s/n: 1156884 • In house laboratory test method was established i.e. the "Procedure for C_{SO4}^{2-} concentration data collection". The procedure includes the method of samples preparation and operation of the equipment. The method was in accordance with the HACH method. • The results of the C_{SO4}^{2-} analysis are recorded in the daily "Wastewater analysis report". • No data transfer error was found. However, it was noted that there were few days throughout the monitoring period where the volume of wastewater are recorded as zero and no C_{SO4}^{2-} analysis results available for these days due to host factory shutdown and public holidays. PP need to provide the factory operation calendar as supporting documents	OK OK OK OK ~~Refer CL 3~~	OK OK OK OK OK

			vi) $C_{SO4}^{2-}{}_{out}$ • Samples of the amount of chemical oxidizing agents out of the digester were taken through the sampling cork on the outlet pipe of CIGAR daily. The sampling points were checked and it can be confirmed that the sampling points are the correct points as it is just after exiting the CIGAR. • The sampling and analysis of the daily chemical oxidizing agents out of the digester was carried out at the in-house laboratory by the Senior Lab Technician using the COD analyzer as reported in the MR i.e. HACH DR-2800 Spectrophotometer s/n: 1156884 • In house laboratory test method was established i.e. the "Procedure for C_{SO4}^{2-} concentration data collection". The procedure includes the method of samples preparation and operation of the equipment. The method was in accordance with the HACH method. • The results of the C_{SO4}^{2-} analysis are recorded in the daily "Wastewater analysis report". • No data transfer error was found. However, it was noted that there were few days throughout the monitoring period where the volume of wastewater are recorded as zero and no C_{SO4}^{2-} analysis results available for these days due to host factory shutdown and public holidays. PP need to provide the factory operation calendar as supporting documents	OK OK OK OK ~~Refer CL 3~~	OK OK OK OK OK

			vii) $WW_{bypassing}$ • The wastewater flows directly to the current water treatment system and bypassing the new wastewater treatment facility is measured continuously with a cumulative flow meter located at the bypass pipeline of CIGAR and reading recorded daily	OK	OK
			• Three units ABB electromagnetic flow meter has been used to measure wastewater flow during this monitoring period as reported in the MR i.e.: ⇒ ABB ProcessMaster s/n: 3K67201450101 ⇒ ABB ProcessMaster s/n: 6711071069 ⇒ ABB DE41F s/n: 000420831/Y004 (converter); s/n: 000282153/X001 (detector)	OK	OK
			• The flow meters are connected to SCADA system which is programmed to enable the viewing of totalizer volume reading record and will produce a daily cumulative volume record through the Production Midnight Report generated every 24 hours	OK	OK
			• Data from the SCADA system through this Production Midnight Report is transferred manually into the calculation working spread sheet daily by the Shift Leader and Process Operator	OK	OK
			• It was noted and confirmed during the site review that there was no any bypassing of wastewater occurred during the whole monitoring period	OK	OK
			• PP also need to report on the operational period of all installed flow meters accordingly as of "Noted" for other installed flow meters reported in the MR	~~Refer CL 4~~	OK

			viii) Biogas loss from pipeline • The loss of biogas from pipeline is measured through external laboratory which conducted the integrity test of biogas pipeline for losses of biogas methane • This test is conducted once a year through pressurizing the system and establishing pressure drops monitoring that might occur due to leakage • PP need to provide the copy of the pressure test report which was conducted by CK Thai in 2010 and SWA in 2011 and 2012. PP also need to include the result of the test as in the test report and MR in the calculation spreadsheet	OK OK ~~CL 5~~	OK OK OK
			ix) NCV_{biogas} • The biogas calorific value is measured through external laboratory which conducted the sampling and analysis of NCV of biogas combusted • This analysis is conducted once a year through balance method to determine the methane calorific value which also include the analysis base on ASTM D 1945-03 method • PP has provided the copy of the biogas calorific value test report which was conducted by PTT in 2010, 2011 & 2012 • However PP need to clarify the appropriateness to use the value from the 2010 test in the calculation since this monitoring period started from April 2011	OK OK OK ~~CL 6~~	OK OK OK OK

			x) PE_{flare} • The project emissions from flaring of the residual gas stream is determined through calculation • The calculation is done according to the "Tool to determine project emissions from flaring gases containing methane" which is appropriately applied all its equation • However PP need to provide the specification of the flare and all its related equipment installed in the project activity	OK OK ~~CL 7~~	OK OK OK
			xi) f_{heat} • The heating system combustion efficiency is measured through external laboratory which conducted the burner combustion efficiency test of the boiler • This test is conducted once a year through during annual service of boiler in which the burner efficiency was tested its combustion efficiency through the feeding of biogas at different capacity load ranging from 22.5% up to 100% • PP has provided the copy of service report and test sheet which was conducted by Thai Burner Industrial Heat in 2011 & 2012 • The reported combustion efficiency were derived from the average of these multiple results of fuel feeding which found to be accurate	OK OK OK OK	OK OK OK OK
			xii) $M_{removed}$ • The organic material removed from wastewater facility is determined through calculation • The calculation is done by multiplying the wastewater input volume with its COD value deducted by the multiplication of wastewater output volume and its COD value	OK OK	OK OK

ii) baseline emission parameters			i) V_{heat} • The total volume of biogas sent to facility heaters is measured in normalized volume using thermal mass flow meter installed prior to the facility heater in a dedicated pipeline tapped from a common biogas pipeline outlet of CIGAR • Two units ABB thermal mass flow meter has been used to measure biogas flow into heater (boiler) during this monitoring period i.e.: ⇒ ABB Sensyflow FMT500 IG s/n: 241163131 X001 ⇒ ABB Sensyflow IG-EX s/n: 27751279 • The flow meters are connected to SCADA system which is programmed to enable the viewing of totalizer volume reading record and will produce a daily cumulative volume record through the Production Midnight Report generated every 24 hours • Data from the SCADA system through this Production Midnight Report is transferred manually into the calculation working spread sheet daily by the Shift Leader and Process Operator • However based on the document provided by PP entitled **"List of equipment removal and replacements history and calibrations"**, there was another flow meter being used which is not reported in the MR i.e. ABB Sensyflow s/n: 27751278. PP need to report on this equipment accordingly since the use of this flow meter was within this monitoring period • PP also need to report on the operational period of all installed flow meters accordingly as of "Noted" for other installed flow meters reported in the MR	OK OK OK OK ~~CAR 1~~ ~~Refer CL 4~~	OK OK OK OK OK OK

			ii) V_{flare} • The total volume of biogas sent to flare is measured in normalized volume using thermal mass flow meter installed prior to the flare in a dedicated pipeline tapped from a common biogas pipeline outlet of CIGAR • Two units ABB thermal mass flow meter has been used to measure biogas flow to flare during this monitoring period i.e.: ⇒ ABB Sensyflow FMT500 IG s/n: 241151957 Y001 (converter); s/n: 241151957 X001 (sensor) ⇒ ABB Sensyflow IG-EX s/n: 26750814 • The flow meters are connected to SCADA system which is programmed to enable the viewing of totalizer volume reading record and will produce a daily cumulative volume record through the Production Midnight Report generated every 24 hours • Data from the SCADA system through this Production Midnight Report is transferred manually into the calculation working spread sheet daily by the Shift Leader and Process Operator	OK OK OK OK	OK OK OK OK
			iii) F • The fossil fuel equivalent to generate the same amount of heat generated from the biogas collected in the anaerobic treatment facility is determined through calculation • The calculation is based on the monitored V_{heat} multiplied with the monitored NCV_{biogas} and divided by the pre-determined (*ex-ante*) fixed parameter of NCV_{fuel} • The calculation is correctly applied in the spreadsheet	OK OK OK	OK OK OK

			iv) C_{CH4} • The fraction of methane in the biogas is measured continuously using the gas analyser i.e. near infrared spectrometry • ANRI CAM-3L s/n: LFB-028 gas analyser were being installed in the common biogas pipeline outlet from CIGAR prior to the distribution to boiler and flare pipe-lines • No data transfer error was found. However, it was noted that there were few days throughout the monitoring period where the volume of wastewater are recorded as zero and no C_{CH4} value recorded for these days due to host factory shutdown and public holidays. PP need to provide the factory operation calendar as supporting documents	OK OK ~~Refer CL 3~~	OK OK OK
iii) leakage parameters			Leakage is not applicable as the equipment used in the project activity was all new equipment. It is not transferred from or to another project activity.	OK	OK
iv) Management and operational system: the responsibilities and authorities for monitoring and reporting are in accordance with the responsibilities and authorities stated in the monitoring plan?			The following personnel was involved in the monitoring and reporting of the CDM project activity: i) Mr. S. Sittisak – CDM Manager ii) Mr. S. Pasu – CDM Officer iii) Mr. P. Niwat – Plant Manager iv) Ms. P. Pornthip – Lab Technician v) Mr. A. Pradit – Shift Leader vi) Mr. O. Isarang – Shift Leader	OK	OK

3.3 Has the equipment used for monitoring is in accordance with section 4 below and is controlled and calibrated in accordance with the monitoring plan, the applied methodology, the Board guidance, local/national standards, or as per the manufacturer's specification?	VVS	234 (c)	i) Flow meter to measure WW_{input} • One unit of ABB electromagnetic flow meter has been used to measure POME flow during this monitoring period i.e.: • ABB COPA-XE DE43F s/n: 000469020/X002 (converter); s/n: 024436 (detector) • Type: Electromagnetic Flow meter • Manufacturer/ Model: ABB/ COPA-XE DE43F • Accuracy class: ± 0.5 % • Calibration frequency: every 2 years • Installed and operated from 19-Aug-10 until present • First calibration by MIT on 19-Aug-10 (cert. no.: L1008-187) • Second calibration by MIT on 16-Aug-12 (cert. no.: LC1208-085) • The second calibration date and its validity period reported in the MR was inconsistent to the date in the calibration certificate	~~CAR 2~~	OK

			ii) Flow meter to measure WW_{output} • Two units of ABB electromagnetic flow meter has been used to measure POME flow during this monitoring period i.e.: ⇒ ABB COPA-XE DE43F s/n: 000422483/X002 (converter); s/n: 019442 (detector) • Type: Electromagnetic Flow meter • Manufacturer/ Model: ABB/ COPA-XE DE43F • Accuracy class: ± 0.5 % • Calibration frequency: every 2 years • Installed and operated from 19-Aug-10 until 21-Sep-12 • First calibration by MIT on 19-Aug-10 (cert. no.: L1008-188) • Second calibration by MIT on 16-Aug-12 (cert. no.: LC1208-086) • Replaced by s/n: 3K672012180486 on 21-Sep-12 ⇒ ABB ProcessMaster s/n: 3K672012180486 • Type: Electromagnetic Flow meter • Manufacturer/ Model: ABB/ ProcessMaster • Accuracy class: ± 0.4 % • Calibration frequency: every 2 years • Installed and operated from 21-Sep-12 until present • Calibration done by ABB on 14-May-12 (cert. no.: 12/2/2/500457)	OK OK	OK OK

			iii) Spectrophotometer to measure COD_{input}, COD_{output}, $C_{SO4}^{2-}{}_{in}$ & $C_{SO4}^{2-}{}_{out}$
			• One unit Hach spectrophotometer has been used during this monitoring period with specifications i.e.:
			  • Type: Spectrophotometer
			  • Manufacturer/Model: Hach/DR2800
			  • Accuracy class: ± 1.5 nm
			  • Calibration frequency: every year
			  • Serial number: 1156884
			• Operation info:
			  • Being purchased and operated since the start of the project activity until present
			  • First calibration by SPC Calibration Center on 4-Oct-10 (cert. no.: C06100204)
			  • Second calibration by SPC Calibration Center on 22-Sep-11 (cert. no.: C06110236)
			  • Third calibration by SPC Calibration Center on 22-Sep-12 (cert. no.: C06120262)
				OK	OK

			iv) Flow meter to measure $WW_{bypassing}$ • Three units ABB electromagnetic flow meter has been used to measure wastewater flow during this monitoring period as reported in the MR i.e.: ⇒ ABB DE41F s/n: 000420831/Y004 (converter); s/n: 000282153/X001 (detector) • Type: Electromagnetic Flow meter • Manufacturer/ Model: ABB/ DE41F • Accuracy class: ± 0.5 % • Calibration frequency: every 2 years • Installed and operated from 8-Sep-10 until 8-Apr-11 and from 23-Sep-11 until 25-Jan-12 • Calibration done by MIT on 7-Sep-10 (cert. no.: L1009-028) • Replaced by s/n: 6711071069 on 8-Apr-11 and subsequently by s/n: 3K67201450101 on 25-Jan-12 ⇒ ABB ProcessMaster s/n: 6711071069 • Type: Electromagnetic Flow meter • Manufacturer/ Model: ABB/ ProcessMaster • Accuracy class: ± 0.4 % • Calibration frequency: every 2 years • Installed and operated from 8-Apr-11 until 23-Sep-11 • Calibration done by ABB on 23-Feb-11 (cert. no.: 11/4/2/210339) • Replaced by s/n: 000420831/Y004 on 23-Sep-11	OK OK	OK OK

			⇒ ABB ProcessMaster s/n: 3K67201450101 • Type: Electromagnetic Flow meter • Manufacturer/ Model: ABB/ ProcessMaster • Accuracy class: ± 0.4 % • Calibration frequency: every 2 years • Installed and operated from 25-Jan-12 until present • Calibration done by ABB on 17-Nov-11 (cert. no.: 11/4/2/215103)	OK	OK
			v) Flow meter to measure V_{heat} • Three units ABB thermal mass flow meter has been used to measure biogas flow into heater (boiler) during this monitoring period i.e.: ⇒ ABB Sensyflow IG-EX s/n: 27751279 • Type: Thermal Mass Flow meter • Manufacturer/ Model: ABB / Sensyflow IG-EX • Accuracy class: ± 0.5 % • Calibration frequency: every 3 years • Installed and operated from 15-Aug-08 until 30-May-11 • Calibration done by ABB on 29-Jul-08 (cert. no.: 1612 DKD-K-05701 2008-07) • Replaced by s/n: 27751278 on 30-May-11 ⇒ ABB Sensyflow IG-EX s/n: 27751278 • Type: Thermal Mass Flow meter • Manufacturer/ Model: ABB / Sensyflow IG-EX • Accuracy class: ± 0.5 % • Calibration frequency: every 3 years • Installed and operated from 30-May-11 until 14-Feb-12 • Calibration done by ABB on 14-Oct-09 (order no.: 240236990) • Replaced by s/n: 241163131 X001 on 14-Feb-12	OK OK	OK OK

			⇒ ABB Sensyflow FMT500 IG s/n: 241163131 X001 • Type: Thermal Mass Flow meter • Manufacturer/ Model: ABB/Sensyflow FMT500 IG • Accuracy class: ± 0.5 % • Calibration frequency: every 3 years • Installed and operated from 14-Feb-12 until present • Calibration done by ABB on 25-Nov-11 (cert. no.: 0184 D-K-15081-01-00 2011-11)	OK	OK
			vi) Flow meter to measure V_{flare} • Two units ABB thermal mass flow meter has been used to measure biogas flow to flare during this monitoring period i.e.: ⇒ ABB Sensyflow IG-EX s/n: 26750814 • Type: Thermal Mass Flow meter • Manufacturer/ Model: ABB / Sensyflow IG-EX • Accuracy class: ± 0.5 % • Calibration frequency: every 3 years • Installed and operated from 28-Aug-09 until 10-Jul-12 • Calibration done by ABB on 24-Jun-09 (order no.: 240236990) • Replaced by s/n: 241151957 Y001 on 10-Jul-12	OK	OK

			⇒ ABB Sensyflow FMT500 IG s/n: 241151957 Y001 (converter); s/n: 241151957 X001 (sensor) • Type: Thermal Mass Flow meter • Manufacturer/ Model: ABB / Sensyflow FMT500 IG • Accuracy class: ± 0.5 % • Calibration frequency: every 3 years • Installed and operated from 10-Jul-12 until present • Calibration done by ABB on 15-Dec-11 (cert. no.: 0186 D-K-15081-01-00 2011-12)	OK	OK
			vii) Gas analyser to measure C_{CH4} • One unit of near infrared spectrometry gas analyser were being installed in the common biogas pipeline outlet from CIGAR prior to the distribution to boiler and flare pipelines i.e.: • ANRI CAM-3L s/n: LFB-028 • Type: Near infrared spectrometry • Manufacturer/ Model: ANRI/ CAM-3L • Accuracy class: ± 0.5 of full scale • Calibration frequency: every year • Installed and operated from 1-Apr-11 until present • First calibration by Entech on 9-Sep-10 (cert. no.: G 530268) • Second calibration by Entech on 2-Sep-11 (cert. no.: G 540277) • Third calibration by Entech on 15-Aug-12 (cert. no.: G 550249)	OK	OK
3.4 Are monitoring results consistently recorded as per approved frequency?	VVS	234 (d)	Yes, the monitoring was carried out in accordance with the approved frequency. Refer to clause 3.2 above.	OK	OK

3.5	Have quality assurance and quality control procedures been applied in accordance with the monitoring plan or revised monitoring plan?	VVS	234 (e)	The QA/QC procedures have been implemented as per the monitoring plan except for the COD monitoring results.	OK	OK
4.	**Compliance with the calibration frequency requirements for measuring instruments.** **Determine whether the calibration of those measuring equipments that have an impact on the claimed emission reductions is conducted by the project participants at a frequency specified in the applied monitoring methodology and/or the monitoring plan.**					
4.1	Identify if there is any monitoring equipment not calibrated in accordance with the monitoring plan, the applied methodology, the Board guidance, local/national standards, or as per the manufacturer's specification?	VVS	238	All monitoring equipment has been calibrated in accordance with the monitoring plan/manufacturer's specification.	OK	OK

4.2 If there is delayed and the calibration has been implemented after the monitoring period in consideration (i.e. the results of delayed calibration are available), has the following conservative approach adopted in the calculation of emission reductions: (a) Applying the maximum permissible error of the instrument to the measured values taken during the period between the scheduled date of calibration and the actual date of calibration, if the results of the delayed calibration do not show any errors in the measuring equipment, or if the error is smaller than the maximum permissible error; or (b) Applying the error identified in the delayed calibration test, if the error is beyond the maximum permissible error of the measuring equipment.	VVS	238	Not applicable	OK	OK
4.3 Confirm that the error has been applied: (a) In a conservative manner, such that the adjusted measured values of the delayed calibration shall result in fewer claimed emission reductions; (b) For all measured values taken during the period between the scheduled date of calibration and the actual date of calibration.	VVS	239	Not applicable	OK	OK

4.4	In cases where the results of the delayed calibration are not available, or the calibration has not been conducted at the time of verification, the verification team, prior to finalizing verification, shall request the project participants to conduct the required calibration and shall determine whether the project participants have calculated the emission reductions conservatively using the approach mentioned in paragraph 4.3 above.	VVS	240	Not applicable	OK	OK
4.5	In cases where the verification team determines that it is not possible for the project participants to conduct the calibration at a frequency specified by either the applied methodology, guidance provided by the Board, and/or the registered monitoring plan due to reasons beyond the control of project participants (For example, due to the contractual terms between the project participant and purchasing/selling entities), the verification team, shall follow the requirements for post registration changes in section of E of the VVS.	VVS	241	Not applicable	OK	OK

4.6	In cases where neither the monitoring methodology nor the monitoring plan specify any requirements for calibration frequency for measuring equipments, the verification team shall determine whether the equipments are calibrated either in accordance with the specifications of the local/national standards, or as per the manufacturer's specification. If neither local/national standards nor the manufacturer's specification are available, international standards may be used. Refer to appendix 1 of the VVS for an illustrative example to apply the above requirements.	VVS	242	Not applicable	OK	OK
5.0	**Assessment of data and calculation of emission reductions** **Assess the data and calculations of GHG emission reductions achieved by/resulting from the project activity by the application of the selected approved methodology.**					
5.1	Is a complete set of data for the specified monitoring period is available?	VVS	245 (a)	Yes, a complete set of data is available for the calculation of the ER.	OK	OK
5.2	If only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, the verification team shall raise a CAR for the project participants to comply with the requirements of Appendix 1 of the Project Standard or submit a request for deviation prior to submitting the request for issuance, if appropriate;	VVS	245 (a)	No such situation happened during this monitoring period.	OK	OK

5.3 Has information provided in the monitoring report been crosschecked with other sources such as plant log books, inventories, purchase records, laboratory analysis?	VVS	245 (b)	Yes, data in the MR and ER spread sheet were cross-checked with all relevant raw data as specified in section 1.6 of this checklist above. However the copy of all raw data records reviewed at site was requested from client for safekeeping of evidence.	~~Refer CL 2~~	OK
5.4 Have calculations of baseline emissions, proposed CDM project activity emissions and leakage, as appropriate, been carried out in accordance with the formulae and methods described in the monitoring plan and the applied methodology document?	VVS	245 (c)	Yes, the calculation of baseline emissions and project activity emissions were carried out in accordance with the formula and methods described in the monitoring plan and the applied methodologies. From the spread sheet, the following need clarification: • Under tab EMISSION REDUCTIONS the total CERs is not on the actual monitoring period. Current monitoring period is 2nd. • Under tab CER Cal. 2012 the date for the monitoring period i.e. 01-Jan-11 to 31-Mar-11 is not the actual monitoring period		
5.5 Any assumptions used in emission calculations? If yes, they been justified?	VVS	245 (d)	There were no assumptions used in emission calculations.	OK	OK
5.6 Have appropriate emission factors, IPCC default values and other reference values been correctly applied?	VVS	245 (e)	The parameters determined during the validation (i.e. ex-ante) have included the emissions factors, IPCC values and default values as defined in the methodology. These parameters are included in Section D.1 in the Monitoring Report	OK	OK

TABLE 2: RESOLUTION OF CORRECTIVE ACTION AND CLARIFICATION REQUESTS

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 2	Summary of project owner response	Verification team conclusion
CAR 1 Based on the document provided by PP entitled **"List of equipment removal and replacements history and calibrations"**, there was another flow meter being used which is not reported in the MR i.e. ABB Sensyflow s/n: 27751278. PP need to report on this equipment accordingly since the use of this flow meter was within this monitoring period PP also need to report on the operational period of all installed flow meters accordingly as of "Noted" for other installed flow meters reported in the MR	3.2	The MR has been revised as follow; • Most of flow meters being used in this monitoring period has been reported in the MR version02, section D.2, including ABB Sensyflow S/N: 27751278 • The operational period of each flow meter for parameter V_{heat} has been reported in the MR version02, section D.2	The revised MR submitted, CKA-MR-ver02_PS has been corrected accordingly with the inclusion of missing information in the previously webhosted MR. Conclusion: CAR 1 close.
CAR 2 For WW_{input} flowmeter (ABB COPA-XE DE43F s/n: 000469020/X002 (converter); s/n: 024436 (detector), the second calibration date and its validity period reported in the MR was inconsistent to the date in the calibration certificate	3.3	The second calibration date of flow meter S/N: 000469020/X002 has been corrected to 16/08/2012 as well as the validity period has been revised to be 16/08/2012-15/08/2014 in the MR version02, section D.2	The revised MR submitted, CKA-MR-ver02_PS has been corrected the wrong information in the previously webhosted MR accordingly. Conclusion: CAR 2 close.
CL 1 PP is required to provide the evidence of the	1.4	The supported document of the Official Commercial Operations Date (COD) has been pro-	The copy of the letter from PP to the project owner i.e. Notice of Official Commercial Operations Date confirmed the

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 2	Summary of project owner response	Verification team conclusion
first operation start date stipulated (16-Dec-06).		vided to DOE.	date of first operation start date stipulated. Conclusion: CL 1 close.
CL 2 PP is required to provide all raw data records copy of the following: i) Production Midnight Reports Chao Khun Agro Biogas Energy Project (1 April 2011 to 31 December 2012) ii) Daily wastewater analysis report iii) Third party lab analysis/measurements record iv) Daily operation record	1.6	All raw data records copied of the following; i.) Production Midnight Reports Chao Khun Agro Biogas Energy Project (1 April 2011 to 31 December 2012) ii.) Daily wastewater analysis report iii.) Third party lab analysis/measurements record iv.) Daily operation record have been provided to DOE.	Copy of all raw data records provided confirmed to be accurate. Conclusion: CL 2 close.
CL 3 It was noted that there were few days throughout the monitoring period where the volume of wastewater are recorded as zero and no Production midnight report available for these days due to host factory shutdown and public holidays. PP need to provide the factory operation calendar as supporting documents.	3.2	The volume of wastewater has been recorded as zero because of the Host Factory Shutdown. Moreover it has been highlighted, also commented in the calculation spreadsheet version02. The supporting document for host factory shutdown has been provided to DOE.	The Host Factory Shutdown information provided confirmed to be accurate. Conclusion: CL 3 close.
CL 4 PP need to report on the operational period of	3.2	All installed flow meters accordingly as of 'Noted' have been revised by added in each monitored parameter in the MR version02, section D.2.	The revised MR submitted, CKA-MR-ver02_PS has been amended accordingly to include the information of operation-

<table>
<tr><th>Draft report clarifications and corrective action requests by validation team</th><th>Ref. to checklist question in table 2</th><th>Summary of project owner response</th><th>Verification team conclusion</th></tr>
<tr><td>all installed flow meters accordingly as of “Noted” for other installed flow meters reported in the MR</td><td></td><td></td><td>al period of all monitoring equipment.

Conclusion:
CL 4 close.</td></tr>
<tr><td>CL 5

PP need to provide the copy of the pressure test report which was conducted by CK Thai in 2010 and SWA in 2011 and 2012. PP also need to include the result of the test as in the test report and MR in the calculation spreadsheet</td><td>3.2</td><td>The pressure test report has been revised in the MR version02, section D.2 as table below;
<table><tr><th>Report Number</th><th>Testing date</th><th>Validity</th><th>Tester</th></tr><tr><td>Pressure test 2011</td><td>22/08/2011</td><td>22/08/2011-21/08/2012</td><td>SWA</td></tr><tr><td>Pressure test 2012</td><td>17/08/2012</td><td>17/08/2012-16/08/2013</td><td>SWA</td></tr></table>
The test in 2010 which mentioned in MR version01 has been removed since it was not related to this monitoring period. Then the report conducted by CK Thai is not necessary provided.
The pressure test report conducted by SWA in 2011 and 2012 has been provided to DOE. Also, the tested result has been included in the calculation spreadsheet version02.</td><td>The revised MR and calculation spreadsheet submitted, CKA-MR-ver02_PS and Calculation SpreadSheet-CKA-ver02 have been amended accordingly. The copy of test report provided confirmed to be valid.

Conclusion:
CL 5 close.</td></tr>
<tr><td>CL 6

PP need to clarify the appropriateness to use the value from the 2010 test in the calculation</td><td>3.2</td><td>The calculation spreadsheet version02 has been revised. The values from the 2010 test report mentioned in the MR version01; consist of NCV_{biogas}, f_{heat}, and Biogas loss from pipelines</td><td>The revised MR and calculation spreadsheet submitted, CKA-MR-ver02_PS and Calculation SpreadSheet-CKA-ver02 have been amended accordingly with the</td></tr>
</table>

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 2	Summary of project owner response	Verification team conclusion
spreadsheet since this monitoring period started from April 2011		has been removed because these values are not applicable in this monitoring period (01/04/2011 – 31/12/2012).	exclusion of the NCV_{biogas} test for 2010. This confirmed to be appropriate. Conclusion: CL 6 close.
CL 7 PP need to provide the specification of the flare and all its related equipment installed in the project activity.	3.2	The Specifications of lagoon (CIGAR), burner, boiler and flare have been provided to DOE.	The Specifications of lagoon (CIGAR), burner, boiler and flare provided by PP are confirmed to be accurate. Conclusion: CL 7 close.
CL 8 From the spread sheet, the following need clarification: • Under tab EMISSION REDUCTIONS the total CERs is not on the actual monitoring period. Current monitoring period is 2nd. • Under tab CER Cal. 2012 the date for the monitoring period i.e. 01-Jan-11 to 31-Mar-11 is not the actual monitoring period	5.4	Typo error has been corrected.	The revised calculation spreadsheet submitted, Calculation SpreadSheet-CKA-ver02 have been corrected the typo error accordingly. Conclusion: CL 8 close.