
VERIFICATION AND CERTIFICATION REPORT

PROJECT TITLE

UNIVANICH TOPI BIOGAS PROJECT

Gold Standard Ref. No.GS460
(UNFCCC Registration Ref. No. 2661)

Verification Period:
01/01/2013 - 31/12/2013

Report No. : SQAS-GS-EU02350012
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Report No.:		Date of first issue:	Date of this revision :								
SQAS-CDM-EU02350012		20 July 2014	18 January 2016								
Project title	:	Univanich TOPI Biogas Project									
DOE	:	SIRIM QAS International Sdn Bhd									
Client	:	Univanich Palm Oil Public Co. Ltd.									
Summary: Univanich Palm Oil Public Co. Ltd. had appointed SIRIM QAS International Sdn. Bhd. to perform verification and certification of the emission reductions for the third monitoring period reported for the 'Univanich TOPI Biogas Project'. The third monitoring period covers the period from 1/01/2013 to 31/12/2013. The project was registered by the UNFCCC Executive Board on 24 August 2009 and by the GS Executive Board on 23 July 2010 with GS ID.no of 460 . The verification was based on the approved Revised PDD^{/2/}, previous Verification Report^{/5/}, Monitoring Reports^{/6/52/55/}, ER spreadsheets^{/7/53/56/}, the Registered Gold Standard Annex^{/57/}, the Gold Standard Monitoring Report Annex^{/58/} and other supporting documents made available to the verification team by the client. The project activity is an anaerobic digestion project, which treats wastewater from the TOPI Palm Oil Mill in Krabi Province, Southern Thailand. The project activity involved the construction of a covered lagoon anaerobic reactor with a biogas capture system. The biogas from the covered anaerobic reactor is captured and used in the biogas engines. Three units of gas engines of 952kW capacity each were installed to generate electricity which is exported to the Provincial Electricity Authority (PEA) grid. The excess biogas is combusted 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 electricity that replaces the Thai grid electricity which predominantly uses fossil fuels for its electricity generation. As a result of the verification, SIRIM QAS Intl. verification team confirms that the project has achieved emission reductions for the monitoring period as below: <table border="1"> <thead> <tr> <th></th> <th>01/1/2013 – 31/12/2013</th> </tr> </thead> <tbody> <tr> <td>Emissions reduction AMS III.H</td> <td>56,314.00 tCO₂e</td> </tr> <tr> <td>Emissions reduction I.D</td> <td>6,541.00 tCO₂e</td> </tr> <tr> <td>Total emissions reduction</td> <td>62,855.00 tCO₂e</td> </tr> </tbody> </table>					01/1/2013 – 31/12/2013	Emissions reduction AMS III.H	56,314.00 tCO ₂ e	Emissions reduction I.D	6,541.00 tCO ₂ e	Total emissions reduction	62,855.00 tCO ₂ e
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Subject : CDM Verification											
Work carried out by :		☒ No distribution without permission from the Client or responsible organisational unit ☐ Limited distribution ☐ Unrestricted distribution									
Aminah Ang - Verification Team Leader											
Report Reviewed by : Aernida Abdul Kadir Report Approved by : Parama Iswara Subramaniam											

Abbreviations

CAR	Corrective Action Request
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CH ₄	Methane
CL	Clarification Request
DOE	Designated Operational Entity
EB	Executive Board
ER	Emissions Reduction
FAR	Forward Action Request
FFB	Fresh Fruit Bunches
GHG	Greenhouse Gas(es)
IPCC	Intergovernmental Panel on Climate Change
m ³	Cubic meter
MR	Monitoring Report
MP	Monitoring Plan
MPE	Maximum Permissible Error
Nm ³	Normalised cubic meter
P	Pressure
PEA	Provincial Electricity Authority
PDD	Project Design Document
POME	Palm Oil Mill Effluent
PP	Project Participant
SIRIM QAS Intl.	SIRIM QAS International Sdn Bhd
T	Temperature
UNFCCC	United Nations Framework Convention for Climate Change
VVS	Validation and Verification Standard version 7.0

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ANNEX 1 : Verification Protocol

1.0 INTRODUCTION

Univanich Palm Oil Public Co. Ltd. had appointed SIRIM QAS International Sdn. Bhd. to carry out the verification of the emission reductions reported for the CDM/GS project activity 'Univanich TOPI Biogas Project' (hereafter referred to as the project activity) for the period from 01/1/2013 – 31/12/2013. The emission reductions for the CDM project activity for the monitoring period starting for the same monitoring period have already been verified (verification report ref number. SQAS-CDM-EU02350012 dated 8 July 2015) and issued by the CDM EB on 25 September 2015.

The verifiers have reviewed the implementation of the monitoring plan (MP) in the registered Gold Standard GS registry project number GS 460, GHG data for the monitoring period was verified in detailed manner applying the set of requirements, audit practices and principles as required under the Validation and Verification Standard of the UNFCCC. This report summarizes the findings and conclusions of this verification of the above mentioned registered project activity.

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 revised PDD, as well as with the applicable methodologies;
- 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 "Univanich TOPI Biogas Project" for the period from "1/01/2013 to 31/12/2013"

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 "Univanich TOPI Biogas Project". The verification of this project activity was based on the approved revised project design document (PDD), previous verification report, monitoring reports, the GS monitoring report annex and the Registered Gold Standard Annex for the project 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 7.0)^{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	Univanich Palm Oil Public Co. Ltd / Thailand Carbon Bridge Pte Ltd / Thailand Foundation myclimate - The Climate Protection Partnership / Liechtenstein
Title of project activity	: Univanich TOPI Biogas Project
UNFCCC registration No	: 2661
GS registration No.	GS460
Registered date	: CDM : 24 August 2009, GS : 23 July 2010
Crediting period	: 7 years
Location of the project activity	: Plaipaya District, Krabi Province, Southern Thailand
GPS coordinates	: N08° 35.097', E098° 55.235'

The 'Univanich TOPI Biogas Project' (hereafter referred to as the project activity) is an anaerobic digestion project, which treats wastewater from the TOPI Palm Oil Mill in Krabi Province, Southern Thailand. Both the palm oil mill and the project activity belong to Univanich Palm Oil Public Co. Ltd.

1.4 Verification Team

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

Verification Team Leader : Aminah Ang

Aminah Ang, the verification team leader, holds a degree in Chemical Engineering. Aminah is a qualified CDM lead auditor in accordance with SIRIM QAS Intl.'s qualification criteria and had been qualified for sectoral scope 1 and 13. She has also been trained in the Gold Standard Requirements as well as the Host Country's sustainability requirements. She is also experience in the palm oil milling processes including the wastewater treatment system. She has been a lead auditor for environmental management systems (ISO 14001) for the past 15 years.

1.5 Technical Reviewer

Aernida Abdul Kadir holds a Degree in Electrical-Electronics Engineering and a Diploma in Palm Oil Milling and Technology Management. She has several years of working experience in palm oil milling including the operation of POME treatment plant, biomass boilers and diesel generators. She has been trained in CDM validation and verification processes, and has been qualified as a CDM lead auditor and technical reviewer (with competency in sectoral scope 1, 13 and 15) in accordance with SIRIM QAS Intl.'s qualification criteria.

2.0 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 June 2014 until March 2015, with details as follows:

Off site preparation / document review and planning	: 20 June 2014
On-site verification	: 23 – 24 June 2014
Preparation of draft report	: July 2014
Preparation of final report	: February – April 2015
Revision of the final CDM report	: July 2015
Preparation of final GS report	October 2015

The project assessment was based on the methodology developed in the VVS version 7.0 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:

- Revised PDD^{/2/}
- Previous Verification and Certification Report^{/5/}
- Methodologies^{/3//4/}
- Monitoring reports^{/6//52//55/}
- ER spreadsheets^{/7//53//56/}
- Flare tool spreadsheets^{/8//54/}
- Registered Gold Standard Annex, version 7.2 July 2010^{/57/}
- GS Monitoring Report Annex, version 2^{/58}

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 at TOPI Palm Oil Mill from 23 to 24 June 2014. 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	Persons interviewed / organization
• 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 • Review of physical components • Plant operation • Collection of measurements • Data logging and reporting • Maintenance of monitoring equipment • Calibration of equipment	1) Mr. Phiphit Khlaisombat – Group Engineer 2) Mr. Sakol Tantanawat - CDM Biogas Manager/QC Manager 3) Ms. Bridget McIntosh – Carbon Bridge 4) Ms. Watcharea Kongsan – TOPI Biogas Supervisor

Local stakeholder consultation on odour issue (refer to verification of GS parameter SD 2)	i) Ms. Watthana Boorag – villager from Plaiphraya Community located in front of the factory ii) Mr.Krasorn Nasongram – villager at Soi Sri Saw located behind the biogas plant iii) Ms. Chom Chonsrijun – villager at Soi Sri Saw 1 located at behind the biogas plant
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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.

3.0 VERIFICATION FINDINGS

During this periodic verification nine (9) CARs and six (6) CLs were raised after the on-site audit carried out on 23 and 24 June 2014. Details of the findings are in the verification checklist in Annex 1.

3.1 Remaining Issues From Previous Validation or Verification

There were no outstanding issues from the previous verification. All findings had been satisfactorily closed before the submission for the request for issuance.

3.2 Project Implementation

The project activity involved the construction of a covered lagoon anaerobic reactor with a biogas capture system. The treated effluent from the digester is pumped to the existing open lagoons for further treatment. The biogas from the covered anaerobic reactor is captured and treated before it is used in the biogas engine. Three units of biogas engines (brand Guascor) each with 952kW capacity were installed to generate electricity that was sold to the local Provincial Electricity Authority (PEA) grid and used on-site when the existing biomass steam turbine is not in operation. Any excess biogas is combusted in an open flare system. It can be confirmed that the project implementation is as described in the revised PDD^{/2/}.

3.3 Completeness of Monitoring

The monitoring was confirmed to be in accordance with the monitoring plan contained in the revised PDD^{/2/}, the approved methodologies^{/3//4/} applied by the CDM project activity.

All parameters stated in the revised monitoring plan^{/2/} were monitored and reported appropriately. The monitoring report had included each parameter required by the monitoring plan. The verification of each parameter was as follows:

Data/parameter:	$Q_{\text{biogas, total, y}}$
Data unit:	Nm ³
Description:	Total amount of biogas recovered from the covered lagoon
Source of data used:	Data logger report from on-line biogas flow meter
Means of verification :	An oscillator biogas flow meter (brand Kobold S/N 5814) labelled as FI60 was installed at the biogas outlet pipeline from the CIGAR prior to the scrubber system. The flow meter is linked to data logger no. 3. The data logger records and stores data on an hourly basis. On the same pipeline, pressure transducer (labelled as PI60) and temperature sensor (labelled as TI60) were also installed. With these measurements (i.e. pressure and temperature of the biogas) the reading in the data logger is automatically converted to the normalised value in Nm³. The information in the data logger is downloaded to Excel ER spreadsheet via a dedicated software. The data in the ER spreadsheet was checked with the downloaded raw data, and it can be confirmed that the data were consistent with each other. This parameter was used as checked and not used in the ER calculation.

Data/parameter:	$Q_{\text{biogas, engine, y}}$
Data unit:	Nm ³
Description:	Amount of biogas recovered and combusted for energy production
Source of data used:	Data logger report from flow meters
Means of verification :	There are three biogas engines each of which is equipped with an oscillator biogas flow meter (located at the inlet to the biogas engines), identified by PP as FI61, FI62 and FI63 respectively. The flow meter labelled as FI61 is for biogas engine no. 1, FI62 is for biogas engine no. 2, and FI63 is for biogas engine no. 3. The flow meters are connected to data logger no.1 which is located at the biogas engine control room. At the pipeline to each of the biogas engines, pressure transducer and temperature sensor were also installed (labelled as PI61 and TI61 for biogas engine no.1, PI62 and TI62 for biogas engine no.2, and PI63 and T63 for biogas engine no.3). With the P and T measurements of the

	biogas, the flow meter reading is converted automatically to a normalised value by the data logger. Verification of raw data and the ER spreadsheet revealed that a formula had been added in the spreadsheets to ensure the flow of the biogas is within the equipment detection range. No data transfer error was found. During the on-site visit to the biogas engine room, it was found that the serial number for TI61, PI63 and PI61 was not as reported in the Monitoring Report. CL 1 was raised to request PP to provide the explanation. From the review of 2013 calibration certificates for all the above equipment, it was found that the reported errors for all the pressure transducers were higher than that specified in the equipment specification. CAR 7 was raised on this issue. Details of the above findings and the closure are as in Table 2 of Annex 1 of this report.
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Data/parameter:	$Q_{\text{biogas,flare}}$
Data unit:	Nm ³
Description:	Amount of biogas recovered and flared
Source of data used:	Data logger report from on-line biogas flowmeter
Means of verification :	The amount of biogas recovered and flared is measured using an oscillator flow meter (Kobold S/N. 5815) labelled as FI64. The flow meter is linked to data logger no. 2 which is dedicated for the flare system. At the same pipeline, pressure transducer and temperature sensor were also installed (labelled as PI64 and TI64). The information in the data logger was downloaded to Flare tool spreadsheet via a dedicated software. Verification of the raw data in the spreadsheet revealed no data transfer error. The data is being recorded on an hourly basis. During the verification, the following findings were raised: - CAR 1, PP needs to ensure that the recorded flowrate is within the flow meter specification; - CAR 8, review of the 2013 calibration certificates of all the measuring equipment, it was found that the reported error for PI64 was higher than that specified in the equipment specification. CAR 8 was raised on this issue; - CL 1 was raised as PP needs to explain for "Methane Combusted" spreadsheet why the data on 2 May 13:00 and 2 Sep 13 11:00:00 was a lump sum figures instead of an hourly data and PP needs to explain why the figures for parameter $Q_{\text{biogas,flare,y}}$, for parameter FVRG,h do not match with each other; All of the above findings have been satisfactorily resolved. Details of the findings and the resolutions are as in Annex 1 of this report.

Data/parameter:	F_{CH_4}
Data unit:	%
Description:	Fraction of methane in biogas
Source of data used:	Data logger report from on-line methane analyser or Genset Data Report Checksheet
Means of verification :	Measured using on-line methane analysers which are installed at the biogas plant and at the biogas engines. The methane gas analyser at the biogas engines is used as back up when the main methane gas analyser at the biogas plant is out of order/malfunctions. Digital display on the panel indicates the fraction in percentage (%) terms. The main methane gas analyser at the biogas plant is linked to data logger no. 2 which measures and records data on a minutely basis. This data is downloaded to the ER spreadsheet using dedicated software. The backup analyser at the biogas engines are not linked to any data logger. Data measured from these analysers were manually recorded in 'Genset Data Report Checksheet'^{7/9/} on an hourly basis by the technician. These data was used when the main methane gas analyser was out of order or malfunctioned. The data in the spreadsheet was checked against the raw data from the data logger and the Genset Data Report form. It was found that the data was consistent with each other. In the ER spreadsheet, PP had included a programme to eliminate the data which was below 40% (limit for combusting the methane in the biogas engine and flare). However, there were still some data which were below 40%. Further, in the ER spreadsheet the title of column D 'Biogas Methane Concentration After Add Error' as there was no delay in calibration of the analysers and hence there was no need to add the error.. CAR 2 was raised on this issues. Details of the findings and the closure are as in Table 2 of Annex 1 of this report.

Data/parameter:	T_{biogas}
Data unit:	°C
Description:	Temperature of biogas
Source of data used:	Measured continuously using thermocouple
Means of verification :	An N type thermocouple (S/N. N0185334) was installed at the biogas pipeline to measure the temperature of biogas. This thermocouple was identified by PP as TI60 and installed next to the biogas flow meter FI60. Together with the pressure of biogas (P_{biogas}), this parameter is used to calculate the normalized value of the biogas volume ($Q_{biogas, total, y}$) which is computed in the data logger.

Data/parameter:	P _{biogas}
Data unit:	mBar
Description:	Pressure of biogas
Source of data used:	Measured continuously using pressure transducer
Means of verification :	A Honeywell ST924 pressure transducer (S/N 80023860001) identified by PP as PI60 was installed at the biogas pipeline next to the thermocouple (T _{biogas}). Together with the T _{biogas} , the measured data is used to calculate the normalized value of the biogas volume (Q _{biogas,total,y}) which is computed in the data logger.

Data/parameter:	Other flare operation parameters – Flame detector
Data unit:	On/off
Description:	Flame on or off detector
Source of data used:	Data logger
Means of verification :	The open flare system is equipped with a flame ionization detector which gives a signal to data logger no.2 when the flame is detected. The data logger will record the signal every minute. If no flame is detected, the data logger will record a '0' voltage reading and when flame is detected, it will record as '5' voltage reading. The counting of the '5v' as every one minute was included in the system, whereby only when it is meeting the 20 minutes then the flare efficiency was considered as 50%. Anything less than 20 minutes, the efficiency was considered as 0%. No calibration is required for the FID. However, checking on the functionality of the detector was carried out by the Biogas Supervisor on a quarterly basis and the results recorded in TOPI Biogas quarterly checklist and safety walk through (TBP009)^{10/}. The records were checked and it was found that the FID was functioning well during the monitoring period. From the review of the raw data, it was confirmed that the data was recorded every minute and occasionally the FID provided reading of more than '0V' but less than '5V'. PP had applied a programme in the spreadsheet to ensure such data was considered as '0V', i.e. the flame is not in operation. For the purpose of determining the flare efficiency, PP had applied a programme in the spreadsheet to ensure that only when the signal is giving '5V' and pressure of flare is more than 20mBar then the minute is counted. And only if the 20 minutes in an hour have been met then the efficiency of the flare was taken as 50%. Otherwise a flare efficiency of 0% was considered. This programming was found to be appropriate. One CL, CL 2 was raised to request PP to explain how the determination of the flare efficiency was considered. Details of the findings and the resolutions are as in Annex 1 of this report.

Data/parameter:	Other flare operation parameters – pressure of biogas at flare
Data unit:	mBar
Description:	Pressure of biogas
Source of data used:	Measured continuously using a pressure transmitter
Means of verification :	According to the revised monitoring plan, the pressure reading of the inline pressure transmitter at the flare flow meter is to be logged on a quarterly basis to ensure the biogas at flare is within the manufacturer's specification of 20 – 100mbar. It was confirmed through the on-site visit that the pressure transmitter identified by PP as PI64 is used for this purpose. The on-line pressure transmitter is connected to data logger no. 2. The measured value from PI64 was recorded in TOPI Biogas quarterly checklist and safety walk through (TBP009)^{10/}. In the monitoring report, it was indicated that PI60 was used instead of PI64 and under the purpose of data, the pressure range indicated was found not consistent with that in the PDD. CAR 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:	Other flare operation parameters – flowrate of biogas at flare
Data unit:	Nm ³ /h
Description:	Flowrate of biogas sent to the flare
Source of data used:	Data logger report
Means of verification :	This parameter is measured continuously using an oscillator flow meter labelled as FI64 (brand Kobold) , which is located at the flare inlet. This flow meter is also used to monitor the amount of biogas recovered and flared ($Q_{\text{biogas,flare}}$). The meter records the flowrate in m³/hr and this is converted to total quantity of biogas in Nm³/hr in the data logger. The supplier of the flow meter (ST Control Co. Ltd.), who set up the equipment provided a summary of the equipment setting and how the flow computer algorithm calculates the normalised flowrate in Nm³/hr^{10/}. The algorithm provided was confirmed to be in accordance with the standard formula used in the calculation for normalisation of gas volume. The information in the data logger was downloaded to Excel ER spreadsheet via a dedicated software. Verification of the data in the spreadsheet revealed no data transfer error. During the verification, CL 1 was raised requesting PP to explain why the data in $Q_{\text{biogas,flare}}$ and this parameter was not match with each other. Details of the findings and the resolutions are as in Annex 1 of this report.

Data/parameter:	EL _{grid}
Data unit:	kWh
Description:	Net electricity generated from the biogas collected in the anaerobic treatment facility sent to the grid
Source of data used:	Daily Electricity Meter Record
Means of verification :	The net electricity generated is calculated based on measured data using the power meters. Following were the power meters available to measure the electricity sold to the grid and electricity used by the project activity : • M5 – total kWh electricity sold to PEA • M7 – total kWh electricity from PEA and used in the biogas plant only The net electricity sent to grid is based on the difference between the readings from meter M5 and meter M7. The data in the PEA invoices were also used to compare with the metered reading and for any data inconsistency PP will apply the most conservative value. The kWh cumulative readings from the power meters were recorded in the Daily Electricity Meter Record (TBP004_1)^{11/} on a 24 hour basis, i.e. every 8am of the day by the technician. Data from this record were checked against those in the spreadsheet. During the verification of these data, it can be confirmed that data for M7 was consistent with each other. However, for M5, PP had only included data from the PEA invoice. The manual recorded meter reading was not in the spreadsheet. Further to that, it was also found that the data presented for January and December 2013 was not consistent with that in the PEA invoices. CAR 6 was raised on this issue. Details of the findings and the closure are as in Table 2 of Annex 1 of this report.

Data/parameter:	Q _{y,ww}
Data unit:	m ³ /year
Description:	Volume of Wastewater treated in year
Source of data used:	Data logger report from magnetic flow meter
Means of verification :	The volume of the wastewater entering the anaerobic digester is measured continuously using a magnetic flow meter (brand Kobold) labeled as FI01. The flow meter is linked to data logger no. 3 which captures and records data on an hourly basis. The data from the data logger which is in *.FDT format is viewed using the data logger software (i.e. Data Viewer) before it is converted into spreadsheet *.CSV format. The conversion of the data is carried out by the Biogas Plant Supervisor. Data from this *.CSV file is then copied and pasted into the reporting file daily by the Biogas Plant Supervisor. The cumulative flowrate meter reading is also recorded in the Covered Lagoon Report (TBP005)^{12/} on a daily basis by the biogas technician. . The raw data was checked with that in the ER spreadsheet and found to be consistent with each other.

Data/parameter:	COD _{y,ww,untreated}
Data unit:	tonnes/m ³
Description:	COD entering anaerobic system in year "y"
Source of data used:	Wastewater Analysis Report
Means of verification :	According to the revised monitoring plan^{/2/}, the analysis of this parameter is to be carried out on-site monthly and sent to an outside laboratory on a quarterly basis. In actual practice, the COD sampling and analysis was conducted monthly by the in-house laboratory using the standard bar-coded vials of the spectrophotometer. This method had been used since the beginning of the project activity. The sampling point and method was checked during the on-site audit. It was confirmed that samples were taken after the screen at the bottom of the mixing tank. The method was found to be in accordance with the SOP for COD sampling and analysis ^{/13/}, which was as per the HACH method recommended by the equipment supplier. The results of the analysis were recorded in Wastewater Analysis Report^{/14/}. Quarterly analysis of COD was carried out by Saint Envir Co. Ltd., an accredited laboratory. The results of the analysis^{/15/} were also included in the spreadsheet and taken into account when taking the average value of the COD_{y,ww,untreated}. The results in the laboratory reports^{/15/} and the internal reports^{/14/} were checked against that in the ER spreadsheet. No data transfer error was found.

Data/parameter:	COD _{y,ww,treated}
Data unit:	tonnes/m ³
Description:	COD of treated wastewater in year "y"
Source of data used:	Wastewater Analysis Report
Means of verification :	According to the revised monitoring plan^{/2/}, the analysis of this parameter is to be carried out on-site monthly and sent to an outside laboratory on a quarterly basis. The actual practice was found to be in accordance with the revised monitoring plan. As in COD_{y,ww,untreated}, the sampling and analysis of this parameter was conducted monthly by the in-house laboratory using the same method as in COD_{y,ww,untreated}. The sampling point was verified during the on-site audit. It was confirmed that samples were taken at the outlet of the clear water tank and the method was found to be in accordance with the SOP for COD sampling and analysis ^{/13/}. The results of the analysis were recorded in Wastewater Analysis Report^{/14/}. Quarterly analysis of COD was carried out by Saint Envir Co. Ltd., an accredited laboratory. The results of the analysis^{/15/} were also included in the spreadsheet and taken into account when taking the average value of the COD_{y,ww,treated}.

	The results in the laboratory reports ^{/15/} and the internal reports ^{/14/} were checked against the values in the ER spreadsheet. One data transfer error was found. CAR 5 was raised on this issue. Details of the findings and the closure are as in Table 2 of Annex 1 of this report.
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Data/parameter:	Sludge application
Data unit:	-
Description:	End use of final sludge
Source of data used:	Sludge removal report
Means of verification :	A magnetic flow meter labelled as FI02 was installed to continuously measure the removal of the sludge. Data from this flow meter is manually recorded in the sludge removal report. From the sludge removal report, it was confirmed that no sludge had been removed from the system during the monitoring period. During the on-site visit, it was confirmed that monthly checking on the flowmeter was carried out to ensure that the flowmeter is functioning. Further to that, the calibration of FI02 was carried out on 26 March 2013. This confirmed that the flowmeter is in good condition. During the verification, one CAR (CAR 4) was raised as the information reported in the monitoring report for this parameter was not consistent with that described in the PDD. Details of the findings and the closure are as in Table 2 of Annex 1 of this report.

Gold Standard Monitoring Parameters

ID No. :	GS 1
Data/parameter:	SD1 – Water Quality Improvement in wastewater quality released to the existing wastewater treatment system
Data unit:	mg/L
Description:	-
Means of verification :	The COD sampling and analysis was conducted monthly by the in-house laboratory using the standard bar-coded vials of the spectrophotometer. A standard operating procedure (SOP)^{/13/} was established to guide the laboratory technician to carry out the analysis. The sampling point and method was verified during the on-site audit. The method was found to be in accordance with the SOP for COD sampling and analysis^{/13/}. The results of the analysis were recorded in Wastewater Analysis Report TBP003^{/14/} Quarterly analysis of COD was carried out by Saint Envir Co. Ltd. (Bangkok)^{/15/}, an accredited laboratory. From the analysis, the following was reported:

		2013
	COD _{y,ww,untreated}	0.06394mg/L
	COD _{y,ww,treated}	0.01125mg/L
The results above showed that the quality of the wastewater released to existing wastewater treatment system had improved.		

ID No. :	GS 2
Data/parameter:	SD2 – Air Quality There is a reduction in odour from the plant from the Project Activity
Data unit:	Interview with surrounding stakeholders
Description:	-
Means of verification :	A random visit to the nearby stakeholders was carried out during the on-site visit to the project site. The stakeholders interviewed were mainly staying within less than 1km distance from the biogas plant Interview with the following stakeholders were carried out during the on-site verification. iv) Ms. Watthana Boorag – villager from Plaiphraya Community located in front of the factory v) Mr.Krasorn Nasongram – villager at Soi Sri Saw located behind the biogas plant vi) Ms. Chom Chonsrijun – villager at Soi Sri Saw 1 located at behind the biogas plant Among the questions asked and feedback obtained were as follow : i) the lenght of stay in the area where they lived – generally all of the interviewed villagers have stayed in the area for many years(i.e. even before the installation of the biogas plant); ii) whether they are familiar with the biogas project – one of the interviewed villager had attended the local stakeholders consultation process while the others did not aware of such installation; iii) any unpleasant smell from the factory or the effluent treatment plant – all of the interviewed villagers agreed that there were no bad smell from the factory; iv) whether any change in condition from 2009 until now – all of the interviewed villagers cannot recall any change in the surrounding environment; and v) wherther they know whom they can turn to if there were bad smell from the plant – all of the interviewed knew the employees of Univanich whom they can turn to in case they need to complaint. The stakeholders have confirmed that no problem of odour from the factory. Hence, this indicator has been met. During the audit days, the verification team also confirmed that there was no bad smell from the project site.

ID No. :	GS 3
Data/parameter:	SD4 – Soil Condition Organic sludge from the biogas plant is used on the plantations or nursery.
Data unit:	-
Description:	-
Means of verification :	It was confirmed during the site visit that there was no desludging carry out during this monitoring period.

ID No. :	GS 4
Data/parameter:	SD5 - Biodiversity Avoidance of POME spill during construction.
Data unit:	-
Description:	No POME spill during construction
Means of verification :	Internal memo was issued by the Group Engineer to the Biogas Engineer on 3 November 2008 to ensure the procedures were followed during the transfer of wastewater to the new biogas digester. There was no spill reported during this process.

ID No. :	GS 5
Data/parameter:	SD5 - Biodiversity Avoidance of POME spill during operation.
Data unit:	-
Description:	i) Used HDPE pipe to transfer POME and (ii) No POME spill from pipes during operation
Means of verification :	The purchase of HDPE pipe was checked against the receipt of purchasing the pipe. It was confirmed that HDPE pipe was purchased for the purpose of transferring of POME to the biogas plant. The monitoring of this parameter was also carried out through the quarterly safety walk through in which inspection on the pipes integrity was check. The inspection was recorded in the Quarterly checklist and safety walk through (TBP009) ^{10/} . The filled checklists were checked and found that no leaks or spill was recorded.

ID No. :	GS 6
Data/parameter:	SD6 – Employment Quality. Ensure safety of workers
Data unit:	-
Description:	-
Means of verification :	Safety Review of biogas plant on quarterly basis sighting at least the following: • Leaks or cracks in pipes and joints • Leaks or cracks in the CIGAR cover • Potential equipment that could spark in engine room

	• Sufficient ventilation in engine room • Potential sparks at any pumps or blowers This activity was carried out on quarterly basis by the Biogas Supervisor. These criteria were included in the Quarterly checklist and safety walk through (TBP009)^{10/}. The filled reports were cited and can be confirmed that the checked were carried out on every quarter. Issues detected during this process were immediately rectified.
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ID No. :	GS 7
Data/parameter:	SD9 - Human and Institutional Capacity Raising environmental awareness amongst the community including schoolchildren
Data unit:	-
Description:	Maintain visitors Logbook of site visits to TOPI Biogas Plant to show the use of site as learning centre about biogas plant.
Means of verification :	During this monitoring period, only one educational visit carried out by the Thaksin University on 11 March 2013. This was evident in the Visitor Log Book and the photograph. About 39 students and staff of the university included in the group.

ID No. :	GS 8
Data/parameter:	SD10 – Employment Numbers Number of new jobs created for Biogas Project.
Data unit:	No. of staff
Description:	Test that at least 5 new jobs were created by showing payroll, payslips or other appropriate way to prove employment during the period.
Means of verification :	Since the beginning of the project, 5 new staffs (1 Biogas Supervisor, 3 technicians and 1 general worker) have been recruited to operate and maintain the biogas plant. During this period, one new staff was appointed as a result of the resignation of previous staffs: • Mr. Pinit Wongpornpenpap – Biogas Supervisor, appointed on 16/11/2013 The payrolls for the staffs were provided from Jan 2013 to December 2013 which confirmed that there were 5 staffs for the biogas plant. Training on the biogas plant has also been provided to the new supervisor. This was evident from the training records.

ID No. :	GS 9
Data/parameter:	New legislation mandating biogas plants.
Data unit:	-
Description:	Confirm there is no new legislations that mandate methane recovery

	from wastewater treatment plant at Agro-processing plants through confirmation from relevant government authority.
Means of verification :	Email from the Director of Review and Monitoring Office, of TGO on 14 July 2014 ^{/59/} confirmed that up till now there are no new legislation mandating biogas plants in Thailand.

ID No. :	GS 10								
Data/parameter:	Minimum 65% of biogas used for energy purposes								
Data unit:	%								
Description:	Monitor biogas continuously to engines and flare. On annual basis, calculate the % of biogas flow to engine is more than and equal to 65% of sum of biogas flow to engines and flare.								
Means of verification :	From the ER spreadsheet, the following was confirmed: <table border="1"> <thead> <tr> <th></th><th>2013</th></tr> </thead> <tbody> <tr> <td>Total amount of biogas flared and combusted in gas engines</td><td>7,990,093.6 Nm³</td></tr> <tr> <td>Amount of biogas combusted in gas engines</td><td>7,105,301.5 Nm³</td></tr> <tr> <td>% of biogas sent to gas engine</td><td>88.9%</td></tr> </tbody> </table> From the data above, it was confirmed that the amount of biogas used for energy purpose was more than 80%, which was more than the stipulated target of 65%.		2013	Total amount of biogas flared and combusted in gas engines	7,990,093.6 Nm ³	Amount of biogas combusted in gas engines	7,105,301.5 Nm ³	% of biogas sent to gas engine	88.9%
	2013								
Total amount of biogas flared and combusted in gas engines	7,990,093.6 Nm ³								
Amount of biogas combusted in gas engines	7,105,301.5 Nm ³								
% of biogas sent to gas engine	88.9%								

ID No. :	GS11
Data/parameter:	Land for oil palm expansion
Data unit:	-
Description:	Provide documentation from relevant Government Authority showing the source of land for new oil palm plantation in Krabi to show that it is not increasing pressure on primary forest.
Means of verification :	A letter from Krabi Agriculture Office dated 29 May 2014 ^{/60/} , confirmed that the sources of land for new oil palm in year 2013 was due to the conversion of the rubber plantation. There was no forests cleared for the expansion of oil palm. plantations.

ID No. :	GS12
Data/parameter:	Status of RSPO
Data unit:	-
Description:	Update on status of RSPO membership and action towards

	certification
Means of verification :	The Univanich Palm Oil Public Co.Ltd has been certified to RSPO P&C criteria for its TOPI Factory by Tuv Nord (Indonesia) on 3/6/2013. The certificate no. is TNI-RSPO-F-1311 and is valid until 2/6/2018 ^{61/} .

In addition to the GS monitoring parameters, PP had also included the 'changes to the key sustainable development indicators' in the GS Monitoring Report Annex. The information for each indicator were checked and verified. It was confirmed that the information provided in the report correct and that there were no changes in the score of these indicators.

3.4 Accuracy of Emission Reduction Calculations

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

- data recorded from meters installed in the project activity;
- default/fixed values determined during the validation period; and
- data provided by the internal and third party laboratory.

The data recorded from the meters installed in the plant were as follows:

Parameter	Equipment	Unit
$Q_{\text{biogas, total, y}}$	Biogas flow meter	Nm ³
$Q_{\text{biogas, engine, y}}$	Biogas flow meter	Nm ³
$Q_{\text{biogas, flare}}$	Biogas flow meter	Nm ³
F_{CH_4}	Methane gas analyser	%
T_{biogas}	Temperature sensor	°C
P_{biogas}	Pressure transducer	mBar
Flow rate of biogas at flare	Biogas flow meter	Nm ³ /hr
Pressure biogas at flare	Pressure transmitter	mBar
Temperature of biogas at flare	Temperature sensor	°C
EL_{grid}	kWh meters	kWh
$Q_{\text{y, ww}}$	Magnetic flow meter	m ³ /year
Sludge removal	Magnetic flow meter	m ³ /year

For the default values, the values determined during the validation were used except for the GWP for methane. These values will remain 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
ρ_{CH_4}	0. 716	kg CH ₄ /m ³ CH ₄	PDD page 27
GWP_CH4	25	tCO ₂ /CH ₄	EB69 Annex 3

$B_{o,ww}$	0.21	kg CH ₄ / kg COD	AMS III.H
DOC _F	0.5	-	AMS III.H
MCF _{ww,final}	0.2	-	Table III.H.I of AMS III.H
MCF _{ww,treatment}	1.0	-	Table III.H.I of AMS III.H
MCF _{s,final}	0.09	-	AMS III.G
DOC _{y,s final}	0.09	-	AMS III.H
F	0.5	-	AMS III.H
CFE _{ww}	0.9	-	AMS III.H
[CH ₄] _{y,ww,treated}	0.0001	t/m ³	AMS III.H
EF _{project}	0.534	kg CO ₂ e/kWh	Ex-ante value determined for Thailand Grid.
η_{flare}	0 or 50	%	AMS III.H default value for open flare system.

As for the data from the internal laboratory analysis and third party laboratory report, the summary of the parameters is as follow:

Parameter	Value	Unit	Remarks
COD _{y,ww,treated}	As in Excel spreadsheet	Tonnes/ m ³	- Internal Wastewater Analysis Report^{/14/} - Third party laboratory report^{/15/}
COD _{y,ww,untreated}	As in Excel spreadsheet	Tonnes/ m ³	- Internal Wastewater Analysis Report^{/14/} - Third party laboratory report^{/15/}

Emission reductions calculations:

In accordance with paragraph 34 of AMS-III.H version 9^{/3/},

‘... the calculation of emission reductions shall be based on the amount of methane recovered and fuelled or flared that is monitored ex-post. Also for these cases, the project emissions and leakage will be deducted from the emission reductions calculated from the methane recovered and combusted, except where it can be demonstrated that the technology implemented does not increase the amount of methane produced per unit of COD removed and outflow of COD, compared with the technology used in the baseline.’

In accordance with paragraph 9 of AMS-I.D version 13^{/4/},

‘...the baseline for the electricity component is the kWh produced by the renewable generating unit multiplied by an emission coefficient’.

Thus, the total emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:

$$BE_y = MD_{y,combustion} + BE_{elec,y} , \text{ and}$$

$$PE_y = PE_{flare} + PE_{wastewater}$$

ER_y	Emission reductions in the year 'y' (tCO ₂ e)
BE_y	total baseline emission in year 'y'(tCO ₂ e)
PE_y	total project activity emissions in the year 'y' (tCO ₂ e)
$MD_{y,combustion}$	Baseline methane emissions destroyed through combustion for energy production or flaring (tCO ₂ e)
$BE_{elec,y}$	Baseline emissions from displaced electricity from grid (tCO ₂ e)
PE_{flare}	Project emissions from flaring (tCO ₂ e)
$PE_{wastewater}$	Project emissions from wastewater treatment (tCO ₂ e)

Baseline emissions calculation:

The baseline methane emissions destroyed through combustion for energy production or flaring ($MD_{y,combustion}$) which is under the AMS III.H was calculated based on the following formula:

$$MD_{y,combustion} = Q_{biogas,combust} \times F_{CH_4} \times \rho_{CH_4} \times 0.001 \times GWP_{CH_4}$$

Where:

$Q_{biogas,combust}$	Volume of biogas combusted as fuel or flared (Nm ³)
F_{CH_4}	Fraction of methane in the biogas
ρ_{CH_4}	Density of methane at normal conditions (kg/Nm ³)
GWP_{CH_4}	Global warming potential for CH ₄

During this monitoring period, $MD_{y,combustion}$ was determined to be 82,573.00 tCO₂e

The baseline emissions from the displaced electricity from grid ($BE_{elec,y}$) which is under the AMS I.D, was calculated based on the following formula:

$$BE_{elec,y} = EG_{d,y} \times EF_d$$

Where:

$EG_{d,y}$	Amount of electricity generated utilizing the biogas and exported to the grid (kWh)
EF_d	Carbon emissions factor for the displaced electricity source (kgCO ₂ e/kWh)

The $BE_{elec,y}$ for this monitoring period was determined as 6,541.05 tCO_{2e}.

Project emissions calculations:

In accordance with paragraph 12 of AMS III.H version 9, the related project emissions from the wastewater treatment plant were consisted of the following:

$$PE_{wastewater} = PE_{y,power} + PE_{y,ww,treated} + PE_{y,s,final} + PE_{y,fugitive} + PE_{y,dissolved}$$

where:

$PE_{y,power}$	Emissions from electricity consumption in the year 'y' (tCO _{2e}). The electricity consumption of project has been accounted in baseline calculations of net electricity. Hence, $PE_{y,power}$ was considered as zero.
$PE_{y,ww,treated}$	Emissions from degradable organic carbon in treated wastewater in year 'y' (tCO _{2e})
$PE_{y,s,final}$	Emissions from anaerobic decay of the final sludge produced in the year 'y' (tCO _{2e}).
$PE_{y,fugitive}$	Emissions from methane release in capture and flare systems in year 'y' (tCO _{2e})
$PE_{y,dissolved}$	Emissions from dissolved methane in treated wastewater in year "y".

For the project emissions from flaring, the following formula was applied:

$$PE_{flare} = V_{CH_4,flare} \times \rho_{CH_4} \times (1 - \eta_{flare}) \times 0.001 \times GWP_{CH_4}$$

where:

$V_{CH_4,flare}$	Volume of methane combusted by flaring (Nm ³ /year)
ρ_{CH_4}	Density of methane at normal conditions (kg/Nm ³)
η_{flare}	flare efficiency
GWP_{CH_4}	Global warming potential for CH ₄

Detail calculation of all the project emissions were contained in the Excel ER spreadsheet. The spreadsheet was verified accordingly and it can be concluded that all related project emissions namely, $PE_{y,ww,treated}$, $PE_{y,s,final}$, $PE_{y,fugitive}$, $PE_{y,dissolved}$ and PE_{flare} were accounted in the emissions reduction calculation. Based on the input values provided, the total PE_y for this monitoring period was determined as follows:

	01/1/2013 – 31/12/2013
PE_{flare}	7,169.08 tCO _{2e}
$PE_{y,ww,treated}$	4,004.03 tCO _{2e}
$PE_{y,fugitive}$	9,375.32 tCO _{2e}
$PE_{y,dissolved}$	847.36 tCO _{2e}

PE _{power}	0 tCO _{2e}
PE _y	21,395.78 tCO _{2e}

Based on all of the above, the following were confirmed for the monitoring period:

1) Emissions reduction under AMS III.H:

	01/1/2011 – 31/12/2011
Baseline emissions (= MD _{y,combustion})	82,573.00 tCO _{2e}
Project emissions (= PE _y)	21,395.78 tCO _{2e}
Emission reduction (rounded value)	61,177.22 tCO _{2e}
Emissions reduction as per PDD	56,314.00 tCO _{2e}

The emissions reductions under AMS III.H component had exceeded the small scale CDM project threshold value of 60,000tCO_{2e}. PP had provided the reasons for the increase which was due to the application of the revised GWP of methane from 21 to 25. The mill capacity was confirmed to be the same as in the baseline and the project design itself had not changed. Thus, in accordance with the revised PDD^[2/], The emissions reduction under this methodology is capped at the PDD level of 56,314 tCO_{2e}. This approach has been accepted as it is considered as conservative and had been practiced in the previous monitoring period.

2) Emissions reduction under AMS I.D

	01/1/2013 – 31/12/2013
Baseline emissions (BE _{elec,y})	6,541.05 tCO _{2e}
Project emissions	0 tCO _{2e}
Emission reductions (rounded value)	6,541.00 tCO _{2e}

Hence, the total emissions reduction is as follow:

	01/1/2013– 31/12/2013
Emissions reduction AMS III.H	56,314.00 tCO _{2e}
Emissions reduction I.D	6,541.00 tCO _{2e}
Total emissions reduction	62,855.00 tCO _{2e}

The total emissions reduction for this monitoring period has been determined as 62,855 tCO_{2e}. The formulae in the spreadsheets^[53/] was checked and it can be confirmed that PP had applied the formulae in accordance with the methodologies requirements.

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. Calibrations were carried out by qualified third parties. In cases where there have been delays in equipment calibration compared with the planned calibration frequency, the affected data have been corrected in line with para 273 of the VVS^{1/} for the period of delay. Following are the calibration status of the equipment:

No.	Name of equipment	Equipment serial no.	Calibration date	Frequency of calibration	Remarks
1.	Biogas flow meter (FI60) to measure $Q_{\text{biogas, total, y}}$	S/N 5814	13/01/2011 ^{/16/} and 01/04/2013 ^{/17/}	Every 3 years	- Oscillator flow meter (Kobold Technology) with accuracy class of 1.5% of measured volume (as per equipment specs). - Calibration frequency recommended by Kobold is 3 years.
2.	Pressure meter (PI60) to measure P_{biogas}	S/N 80023860001	07/03/2012 ^{/18/} and 26/03/2013 ^{/19/}	Every 2 years	- A Honeywell STD924 pressure transducer identified by PP as PI60 installed on line at the biogas pipeline next to the thermocouple. - The calibration frequency is as per manufacturer recommendation.
3.	Thermocouple (TI60) used to measure T_{biogas}	S/N N0185334	07/03/2012 ^{/20/} and 28/03/2013 ^{/21/}	Once a year	- N type thermocouple, brand Kobold TWD-B9410213T installed on line at the biogas pipeline identified by PP as TI60. The meter was installed next to the biogas flow meter FI60. - No calibration frequency determined by the manufacturer, but PP had decided to carry out 1/year

					There was a delay in calibration from 07/03/2013 to 27/03/2013. However, since the data from F160 is not in used in the calculation of the ER, the error application was not done.
4.	Biogas flow meters to measure $Q_{\text{biogas, engine,y}}$	S/N 5813 (for biogas engine no.1, FI61) S/N 5811 (for biogas engine no.2, FI62) and S/N 5812 (for biogas engine no.3, FI63)	06/03/2012 ^{/22/} and 09/05/2013 ^{/23/}	Every 3 years	- Each biogas engine is equipped with one flow meter. - All meters are Oscillator flow meter (Kobold Technology) with accuracy class of 1.5% of measured volume - Calibration was carried out by PTT Public Co Ltd.
5.	Pressure transducers for normalisation of $Q_{\text{biogas, engine,y}}$	S/N.260TUTO (PI61 for biogas engine no.1) S/N.2063135 (PI62 for biogas engine no. 2) S/N.260SUOX (PI63, for biogas engine no. 3)	07/03/2012 ^{/24/} and 26/03/2013 ^{/25/}	Every 2 years	- All of the pressure transducers are of Kobold brand, model SEN-3251 - The calibration frequency is as defined by the manufacturer. - Review of the calibration reports for 2013, found that the reported errors were higher than the specification error. CAR 7 was raised on this issues.
6.	Temperature sensors for normalisation of $Q_{\text{biogas, engine,y}}$	S/N.N0851.965110 (TI61, for biogas engine no. 1) S/N.N0851.965113 (TI62, for biogas engine no. 2) and	07/03/2012 ^{/26/} and 28/03/2013 ^{/27/}	Once a year	- All of the temperature sensors are Kobold TWD-B9410213T model. - Calibration frequency is as recommended by Kobold - There was a delay in calibration during the period from

		S/N. N0851.965101 (TI63, for biogas engine no. 3)			07/03/2013 to 27/03/2013. In accordance with para 273 of the VVS ^{/1/} PP had applied the MPE of the sensor to the measured values. The method used was found to be in accordance with the manufacturer's recommendation.
7.	Biogas flow meter (FI64) to measure $Q_{\text{biogas, flare,y}}$	S/N 5815	06/03/2012 ^{/28/} and 09/05/2013 ^{/29/}	Every 3 years	- Oscillator flow meter (Kobold Technology) with accuracy class of 1.5% of measured volume (as per equipment specs). - Calibration frequency is as recommended by Kobold. - No delay in calibration during this monitoring period.
8.	Pressure transducer (PI64) for normalisation of $Q_{\text{biogas, flare,y}}$	S/N 260TUT1	07/03/2012 ^{/30/} and 26/03/2013 ^{/31/}	Every 2 years	- Pressure transmitter is of brand Kobold SEN-3251. - The calibration frequency is recommended calibration by Kobold - Review of the calibration report for 2013, found that the reported errors were higher than the specification error. CAR 8 was raised on this issues.
9.	Temperature sensor (TI64) for normalisation of $Q_{\text{biogas, flare,y}}$	S/N. N0906.979554	06/03/2012 ^{/32/} and 28/03/2013 ^{/33/}	Once a year	- Temperature sensor is of brand Kobold TWD-B9410213T - Calibration frequency is as recommended by Kobold. - There was a delay in calibration from 06/03/2013 to

					27/03/2013. During this period, PP had applied the MPE of the sensor to the measured values. The method used was found to be in accordance with the manufacturer's recommendation.
10.	Methane analyser to measure fraction of methane in biogas F_{CH_4}	S/N.10034A4-203 (analyser at the biogas plant)	19/12/2012 ^{/34/} and 19/12/2013 ^{/35/}	Once a year	- Methane gas analysers is installed at the biogas plant and at each of the biogas engines. The methane gas analysers at the gas engines are used as back up when the main methane gas analyser at the biogas plant is out of order or malfunctioned - Calibration frequency was defined by the PP as the supplier had not defined such requirements. - Analyser at the biogas plant is of OLCT IR brand while at the gas engines of JE brand. - There was no delay in calibration. However, from the review of the calibration reports for the gas engines analyser, it was found that the reported errors was higher than the errors specified in the equipment specification. PP
		S/N.29196 (at gas engine no. 1)	19/12/2012 ^{/36/} and 19/12/2013 ^{/37/}		
		S/N. 28961 (gas engine no. 2)	19/12/2012 ^{/38/} and 19/12/2013 ^{/39/}		

		S/N.27894 (gas engine no.3)	19/12/2012 ^{/40/} and 19/12/2013 ^{/41/}		had applied the measured errors and adjusted the measured data accordingly. The application of the errors was found to be appropriate as the error was added when the parameter is used for project emissions and deducted when it is used for baseline emissions.
11.	COD meter to measure COD _{y,ww,treated,j} , COD _{y,ww,untreated}	S/N. 1275172	27/01/2012 ^{/42/} and 25/01/2013 ^{/43/}	Once a year	• Spectrophotometer brand Hach model DR2800 • Calibration was carried out by Bangkok Lab Co Ltd • Calibration frequency was not specified by the manufacturer, but PP had decided to calibrate once a year. • No issue on calibration was found during this period.
12.	Flowmeter(FI01) to measure Q _{y,ww}	S/N 265044	07/03/2012 ^{/44/} and 12/07/ 2013 ^{/45/}	Every 2 years	• Magnetic flow meter Brand Kobold with accuracy class of $\pm 0.3\%$ • Calibration frequency is as recommended by Kobold • Recalibration was carried out by Science Magic Grow Co. Ltd. The reported error was within the equipment specification range.
13.	Flowmeter (FI02) to measure sludge remove S _{y,final}	S/N265047	07/03/2012 ^{/46/} and 26/03/2013 ^{/47/}	Every 2 years	• Kobold magnetic flow meter with accuracy class of $\pm 0.3\%$ • Calibration

					frequency is recommended by Kobold Calibration was carried out by Science Magic Grow Co.Ltd.
14.	Power meters (M5) & (M7) to measure EL _{grid}	EDMI Genius S/N 202008352 (M5)	28/11/2012 ^{/48/} and 12/11/2013 ^{/49/}	Every 3 years	- M5 power meter is owned and controlled by PEA. - The calibration was carried out by PEA
		PM710 S/N 4A9515d5 (M7)	27/11/2012 ^{/50/} and 12/11/2013 ^{/51/}	Once a year	- The power meter brand Schneider Electric PowerLogic - Calibration was carried out by PEA - There was no information provided by the supplier on the calibration frequency. PP had decided to carry it out once a year.

The equipment specifications and calibration records were reviewed and the verification team can confirm that the equipment was functioning properly during the monitoring period. All findings raised above had been satisfactorily resolved. Details of the findings and the resolutions are as in Table 2 of Annex 1 of this report.

3.6 Management System and Quality Assurance

The roles and responsibilities for monitoring of emission reduction data had been clearly defined. The monitoring of the GHG parameters is part of the biogas plant normal operations. The CDM Manager and the biogas plant supervisor are the key persons managing the GHG data records

4.0 VERIFICATION AND CERTIFICATION STATEMENT

SIRIM QAS International Sdn Bhd was engaged by Univanich Palm Oil Public Co. Ltd. to verify the greenhouse gas (GHG) emissions reduction reported from 'Univanich TOPI Biogas Project' for the period from 1 January 2013 and 31 December 2013. The crediting period for this project is from 1 October 2009 to 30 September 2016 (renewable).

The verification was based on the approved revised PDD^{/2/}, the applied methodologies, AMS III.H.- Methane recovery in wastewater treatment, version 9^{/3/} and AMS I.D. – Grid connected renewable electricity generation version 13^{/4/}, the Monitoring Reports^{/6//52//55/}, the registered Gold Standard Annex^{/57/}, Gold Standard Monitoring Report Annex^{/58/}, emissions reduction calculation spreadsheets^{/7//53//56/} and other supporting documents made available to SIRIM QAS Intl.'s verification team by the client. SIRIM QAS Intl. expresses no opinion on the baseline methodology of both the project and the validated and registered PDD.

The management of Univanich Palm Oil Public Co. Ltd. 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. The development and maintenance of records and reporting procedures in accordance with the monitoring plan, including the calculation and determination of GHG emissions reduction from the project was the responsibility of the management of the project.

It is the responsibility of SIRIM QAS Intl. verification team to express an independent GHG verification opinion on the GHG emissions from the project for the monitoring period starting from 1 January 2013 and 31 December 2013 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^{/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 revised PDD^{/2/};
- the monitoring plan is in accordance with the approved monitoring methodology, AMS III.H version 9 and AMS I.D version 13 applied by the CDM project activity,
- 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 emission reduction operating appropriately, and
- the GHG emission reductions achieved were calculated correctly on the basis of approved monitoring methodology AMS III.H version 9 and AMS I.D version 13.

We have verified that the information included in the final monitoring report^{/55/} (version 4, dated 7 July 2015) was correct and that the emission reductions achieved had been determined correctly. In our opinion, the GHG emission reductions for the period from 1 January 2013 and 31 December 2013 stated in the latest revised monitoring report^{/55/} 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:

	01/1/2013– 31/12/2013
Emissions reduction AMS III.H	56,314.00 tCO ₂ e
Emissions reduction I.D	6,541.00 tCO ₂ e
Total emissions reduction	62,855.00 tCO ₂ e

Prepared by :



(Aminah Ang)
Verification Team Leader

Approved by :



(Parama Iswara Subramaniam)
DOE Representative

5.0 REFERENCES

- /1/ Validation and Verification Standard (version 7.0)
- /2/ Revised PDD version 006, approved on 18/2/2014
- /3/ AMS III.H.- Methane recovery in wastewater treatment,version 9
- /4/ AMS I.D. – Grid connected renewable electricity generation version 13
- /5/ Verification Report (SQAS-CDM-EU02350009) Revision 2
- /6/ Monitoring Report version 1, 07/06/2014
- /7/ UNIV TOPI ER Calculation version 1, June 2014
- /8/ UNIV TOPI Flare Tool spreadsheet version 1, June 2014
- /9/ Genset Data Report Checksheet
- /10/ TOPI Biogas quarterly checklist and safety walk through (TBP009)
- /11/ Daily Electricity Meter Record Form TBP004_1
- /12/ TOPI Biogas Project – Covered Lagoon Report (TBP005)
- /13/ SOP for COD sampling and analysis procedure
- /14/ Wastewater Analysis Report TBP003
- /15/ COD report by Saint Envir Co.,Ltd
- /16/ Calibration report for oscillator flow meter S/N 5814 (FI60) dated 13/01/2011 by PTT Public Company Limited
- /17/ Calibration report for oscillator flow meter S/N 5814 (FI60) dated 18/07/2013 by Miracle International Technology Co. Ltd.
- /18/ Honeywell STD924 S/N80023860001 calibration reports dated 14/03/2012 by Science Magic Grow Co. Ltd.
- /19/ Honeywell STD924 S/N80023860001 calibration reports dated 10/04/2013 by Science Magic Grow Co. Ltd..
- /20/ Calibration report for thermocouple S/N N0185334 dated 14/03/2012 by Science Magic Grow Co. Ltd.
- /21/ Calibration report for thermocouple S/N N0185334 dated 10/04/2013 by Science Magic Grow Co. Ltd.
- /22/ Calibration report for oscillator flow meter S/N 5813(FI61), S/N 5811(FI62) and S/N 5812 (FI63) dated 06/03/2012 by PTT Public Company Limited
- /23/ Calibration report for oscillator flow meter S/N 5813(FI61), S/N 5811(FI62) and S/N 5812 (FI63) dated 09/05/2013 by PTT Public Company Limited
- /24/ Calibration reports for pressure transducers S/N.260TUTO (PI61), S/N.2063135 (PI62) and S/N.260SUOX (PI63) dated 14/03/2012 by Science Magic Grow Co. Ltd.
- /25/ Calibration reports for pressure transducers S/N.260TUTO (PI61), S/N.2063135 (PI62) and S/N.260SUOX (PI63) dated 10/04/2013 by Science Magic Grow Co. Ltd.
- /26/ Calibration reports for temperature sensors S/N.N0851.965110 (TI61), S/N.N0851.965113 (TI62) and S/N. N0851.965101 (TI63) dated 14/03/2012 by Science Magic Grow Co. Ltd.

- /27/ Calibration reports for temperature sensors S/N.N0851.965110 (TI61), S/N.N0851.965113 (TI62) and S/N. N0851.965101 (TI63) dated 10/04/2013 by Science Magic Grow Co. Ltd.
- /28/ Calibration report for oscillator flow meter S/N 5815 (FI64) dated 06/03/2012 by PTT Public Company Limited
- /29/ Calibration report for oscillator flow meter S/N 5815 (FI64) dated 09/05/2013 by PTT Public Company Limited
- /30/ Certificate report for pressure transmitter S/N 260TUT1(PI64) dated 14/03/2012 by Science Magic Grow Co. Ltd.
- /31/ Certificate of calibration for pressure transmitter S/N 260TUT1(PI64) dated 10/04/2013 by Science Magic Grow Co. Ltd.
- /32/ Certificate of calibration for temperature transmitter with probe S/N N0906.979554 (TI64) dated 14/03/2012 by Science Magic Grow Co. Ltd.
- /33/ Certificate of calibration for temperature transmitter with probe S/N N0906.979554 (TI64) dated 10/04/2013 by Science Magic Grow Co. Ltd.
- /34/ Calibration certificate for CH4 gas analyser S/N 10034A4-203 dated 19/12/2012 by Entech Associate Co. Ltd.
- /35/ Calibration certificate for CH4 gas analyser S/N 10034A4-203 dated 19/12/2013 by Entech Associate Co. Ltd.
- /36/ Calibration certificate for CH4 gas analyser S/N.29196 dated 19/12/2012 by Entech Associate Co. Ltd.
- /37/ Calibration certificate for CH4 gas analyser S/N.29196 dated 19/12/2013 by Entech Associate Co. Ltd.
- /38/ Calibration certificate for CH4 gas analyser S/N. 28961 dated 19/12/2012 by Entech Associate Co. Ltd.
- /39/ Calibration certificate for CH4 gas analyser S/N. 28961 dated 19/12/2013 by Entech Associate Co. Ltd.
- /40/ Calibration certificate for CH4 gas analyser S/N.27894 dated 19/12/2012 by Entech Associate Co. Ltd.
- /41/ Calibration certificate for CH4 gas analyser S/N.27894 dated 19/12/2013 by Entech Associate Co. Ltd.
- /42/ Certificates of calibration for HACH Meter 1275172,dated 27/01/2012 by Bangkok Lab Co Ltd
- /43/ Certificates of calibration for HACH Meter 1275172,dated 01/03/2013 by Bangkok Lab Co Ltd
- /44/ Calibration reports by Science Magic Grow Co. Ltd. for magnetic flow meter S/N 265044 (FI01) dated 19/03/2012
- /45/ Calibration reports by Science Magic Grow Co. Ltd. for magnetic flow meter S/N 265044 (FI01) dated 19/07/2013
- /46/ Calibration report by Science Magic Grow Co. Ltd. for magnetic flow meter S/N 265047 dated 07/03/2012
- /47/ Calibration reports by Science Magic Grow Co. Ltd. for magnetic flow meter S/N 265047 dated 01/04/2013
- /48/ PEA Tested Report Energy Meter for M5 power meter dated 28/11/2012
- /49/ PEA Tested Report Energy Meter for M5 power meter dated 12/11/2013

- /50/ Field Inspection and Test Report by PEA for M7 power meter dated 27/11/2012
- /51/ Field Inspection and Test Report by PEA for M7 power meter dated 12/11/2013
- /52/ Monitoring Reports version 03 dated 16/04/2015
- /53/ UNIV TOPI ER Calculation version 3, 16/04/2015
- /54/ UNIV TOPI Flare Tool spreadsheet version 3, 07/04/2015
- /55/ Monitoring Reports version 04 dated 7 July 2015
- /56/ UNV TOPI Biogas ER V4 7 July 2015
- /57/ Registered Gold Standard Annex version 7.2 July 2010
- /58/ Gold Standard Monitoring Report Annex Version 2.Oct 2015
- /59/ Confirmation email from Thailand Greenhouse Gas Management Organization dated 14 July 2014
- /60/ Letter from Krabi Agriculture Office dated 29 May 2014
- /61/ RSPO certificate TNI-RSPO-F-1311 by TuV Nord (Indonesia)

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ANNEX 1
VERIFICATION PROTOCOL
REPORT NO: SQAS-GS- EU02350012

SIRIM QAS INTERNATIONAL SDN BHD

Verification checklist

Project name : Univanich TOPI Biogas Project (UNFCCC no. 2661)
Monitoring period 1/1/2013 to 31/12/2013

TABLE 1: VERIFICATION REQUIREMENTS BASED ON CDM VALIDATION AND VERIFICATION STANDARD VERSION 7.0

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	262	Yes, an on-site audit to the project site was carried out by Aminah Ang on 23 – 24 June 2014.	OK	OK
1.2 Are all physical features of the CDM project activity proposed in the registered PDD in place?	VVS	262	Yes, all physical features of the CDM project activity is as per the registered PDD.	OK	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
1.3 Have the project participants operated the proposed CDM project activity as per the registered PDD or any approved revised PDD?	VVS	262 & 265	Yes, the PP had operated the project activity as in the registered PDD. The following was verified: i) The effluent collection system ii) The covered lagoon digester (CIGAR) iii) Biogas extraction and cleaning system iv) Biogas sent to 3 units of gas engines, each with capacity of 952kW v) Biogas sent to open flare (1200m3/hr).	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 verification team shall describe the status of implementation and starting date of operation for each site.	VVS	263 (a)	The project is only at one site.i.e. at the Univanich TOPI Factory (a palm oil mill) in Krabi, Thailand.	OK	OK
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	263 (a)	There is no phase implementation.	OK	OK
1.5 Describe the actual operation of the project activity.	VVS	263 (b)	Project activity consisted of one unit of covered lagoon CIGAR (60,000m3), 3 units of 952kW Guascor biogas engines and one open flare system. Biogas cleaning system includes the scrubber. The electricity generated from the biogas engine is used internally and sold to PEA.	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	263 (c)	No such situation found for the data and variables. However, PP had yet to apply the GWP for methane considering the second commitment period of Kyoto Protocol emission factor.	Refer to CAR-9	OK
2. Compliance of the monitoring plan with the monitoring methodology including applicable tool(s) and the standardized baseline. The monitoring plan of the proposed CDM project activity shall comply with the applied methodology and, where applicable, the applied standardized baseline.					
2.1 For monitoring aspects that are not specified in the methodology and, where applicable, the standardized baseline, 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	266	All aspects of the monitoring requirements have been included in the monitoring plan.	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 Is 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.?	VVS	268	Yes, the monitoring of the parameters has been implemented in accordance with the revised monitoring plan. These have also complied with the requirements of AMS III.H version 9 and AMS I.D version 13.	OK	OK
3.2 Has the monitoring plan been properly implemented and followed by the project participants?	VVS	269 (a)	Yes, the monitoring plan has been implemented and followed by the PP.	OK	OK
3.3 Have all parameters stated in the monitoring plan, and relevant CDM Executive Board decisions been sufficiently monitored and updated as applicable, including: i) Parameters used to determine both baseline and project emissions	VVS	269 (b)	i) Amount of biogas recovered and flared ($Q_{\text{biogas,flare,y}}$) and Other flame operation parameters – flowrate of biogas at flare • The amount of biogas recovered and flared is measured using an oscillator flow meter (Kobold S/N. 5815) labelled as FI64 which is installed at the flare inlet. • The flow meter is linked to data logger no. 2 which is dedicated for the flare system.		

			• The meter is recording the flowrate in m³/hr and converted to total quantity of biogas at flare Nm³/hr in the data logger. • Data in the Flare Tool spreadsheets and the ER spreadsheets was checked against the raw data from the data logger and found to be consistent. However, PP needs to check on the recorded flowrate which was not within the flowmeter specification detection limit. • Further, PP need to explain why the data on 2 May 13:00 and 2 Sep 13 11:00:00 was a lump sum figures instead of an hourly data. • Please explain why the figures in $Q_{\text{biogas,flare,y}}$ not consistent with the flowrate of biogas at flare.	CAR-1 OK	
			ii) Fraction of methane in the biogas • Measured using an online methane analysers which were installed at the biogas plant and at the gas engines. The methane gas analysers at the gas engines were used as back up when the main methane gas analyser at the biogas plant is out of order/malfunction. Each gas engines are equipped with methane gas analysers. • The main methane gas analyser at the biogas plant is linked to data logger no.2 that measured and recorded data on every minute. • For the methane gas analyser at the gas engines, the analysers were not linked to any data logger. However, the data from the analysers were recorded in the Genset Data Report form on hourly basis by the technician. • Verification of the data in the spreadsheet and the raw data from the data logger and the Genset Data Report form revealed that the data was consistent with each other.	OK OK	

			In the ER spreadsheet, PP had included a programme to eliminate the data which was below 40% (limit for combusting the methane in the biogas engine and flare). However, there were still some data which were below 40%. Further, in the ER spreadsheet the title of column D 'Biogas Methane Concentration After Add Error' may need to be revised as there was no delay in calibration of the analysers.	CAR-2	OK
			iii) Other flame operation parameters – pressure bio-gas at flare - This parameter was monitored using a pressure transmitter PI64 which was also used for the normalisation of $Q_{\text{biogas flare}}$. The pressure transmitter is connected to data logger no. 3. - The pressure reading was also quarterly checked and recorded in the Quarterly Check List TBP009. - In the monitoring report, it was indicated that P160 was used to monitor this parameter and the values included in the report were not from the PI64. The pressure range indicated was found not consistent with that in the PDD.	CAR-3	OK
i) project emission parameters			i) Volume of wastewater ($Q_{y,ww}$) - Measured continuously using magnetic flowmeter identified as FI01 (S/N 265044) - The flowmeter is connected to data logger no. 3 that record the data on an hourly basis. - The cumulative flow rate meter reading is also recorded in the Covered Lagoon Report Checksheet (TBP005) on daily basis by the technician - Data from the data logger downloaded electronically in the spreadsheet using a special software. The raw data was checked with that in the ER spreadsheet and found to be consistent with each other.	OK	OK

			ii) COD_{y,ww,untreated} • Sampling by the site technician and analyse by the laboratory supervisor on monthly basis and sent to external laboratory on quarterly basis. • Sampling point and method was verified and found appropriate as sample was taken after the screen at the bottom of the mixing tank by using a scope. • Quarterly samples were sent to external accredited laboratory – Saint Envir Co.,Ltd. • In house laboratory test method was established – “SOP for COD sampling and analysis procedure”. The method included the samples preparation and operation of the equipment. The method was in accordance with the HACH method. Results of the analysis were recorded in the Wastewater Analysis Report. • External lab results were also included in the spreadsheets. • Review of data between the Wastewater Analysis Report, external test reports and the spreadsheet revealed that all data are consistent with each other.	OK	OK
			iii) Other flame operation parameters – flame detector • The open flare system is equipped with a flame ionization detector (FID) which gives signal to data logger no.2 when the flame is detected. The data logger will record the signal every minute. If no flame, the data logger will record as ‘0’ voltage and with flame as 5V. • The detection limit provides information regarding the flare efficiency.	OK	OK

			• From the raw data, it was found that occasionally the FID provided reading of more than '0V' but less than '5V'. For these cases, PP had considered the flare is not operational. • PP to clarify how the flare efficiency of 50% was determined using the signal from FID.	CL2	
			iv) Sludge Application • A flow meter (FI02) has been installed to monitor the amount of sludge remove. FI02 is connected to data logger no. 3. • A 'sludge removal report' template has been established to ensure that the information on desludging is recorded. • There was no sludge removed from the project activity during this monitoring period as the sludge is internally recycled to the digester. • Monthly checking on the flowmeter was carried out to ensure that the flowmeter is functioning. • Further, the calibration report of FI02 carried out on 26 March 2013 also confirmed that the flowmeter is in good condition. • The reported information in the monitoring report needs to be amended to ensure the description and the data/parameter are consistent with that described in the PDD.	CAR-4	OK
ii) baseline emission parameters			i) Total amount of biogas recovered from the covered lagoon ($Q_{\text{biogas, total, y}}$) • An oscillator biogas flow meter labelled as FI60 Kobold S/N 5814 was installed at the biogas outlet pipeline from the CIGAR prior to the scrubber system. • The flow meter is linked to data logger no. 3. The data is recorded on every minute.	OK	OK

			• On the same pipeline, pressure transducer (labelled as PI60) and temperature sensor (labelled as TI60) were also installed. With these measurements (i.e. pressure and temperature of the biogas) the reading in the data logger is automatically calculated at Nm³. • The information in the data logger was downloaded to Excel ER spreadsheet via dedicated software. • Verification of data between the raw data and that in the ER spreadsheet confirmed that the data were consistent with each other.		
			ii) Temperature of biogas (T_{biogas}) • This parameter is monitored using an N type thermocouple (identified by PP as TI60) installed next to FI60. • The data from this thermocouple is used to normalise the flow of biogas ($Q_{\text{biogas, total, y}}$) at the data logger.	OK	OK
			iii) Pressure of biogas (P_{biogas}) • This parameter is monitored using a Honeywell STD924 pressure transducer (identified by PP as PI60) installed next to TI60. • The data from this thermocouple is used to normalise the flow of biogas ($Q_{\text{biogas, total, y}}$) at the data logger.	OK	OK
			iv) Amount of biogas recovered and combusted for energy production ($Q_{\text{biogas, engine, y}}$) • Measured using oscillator biogas flowmeters attached to each biogas engines. The flowmeter labelled as FI61 for biogas engine no. 1, FI62 for biogas engine no. 2, and FI63 for biogas engine no. 3.	OK	OK

			- The flowmeters are linked to data logger no.1 that is dedicated for recording biogas to the biogas engines - At the same pipeline, pressure transducer and temperature sensor were also installed (labelled as PI61 and TI61 for biogas engine no.1, PI62 and TI62 for biogas engine no.2, and PI63 and TI63 for biogas engine no.3). With the P and T measurements of the biogas, the flow meter reading is converted to Nm³ automatically by the data logger. - All the meters are linked to a data logger that recorded the data on every minute. The data from the data logger was transferred into the ER spreadsheet via a dedicated software. - Verification of raw data and the ER spreadsheet revealed that a formula in the spreadsheets was added to ensure the flow of the biogas not exceeded the equipment detection range. No data transfer error was found - During on-site visit to the biogas engine room, it was found that the serial number for TI61, PI63 and PI61 not the same as indicated in the Monitoring Report. Please clarify to whether if the equipment had been changed. If so, provide the documentation when it was changed.	CL-3	OK
			v) COD_{y,ww,treated} - Sampling by the site technician and analyse by the laboratory supervisor on monthly basis and sent to external laboratory quarterly - Sampling point is at the outlet of the clear water tank, where an opening was provided to take sample. - Quarterly samples were sent to external accredited laboratory – Saint Envir Co.,Ltd. - The same procedure is used in the COD analysis above.	OK	OK

			- External lab results were also included in the spreadsheets. - Review of data between the Wastewater Analysis Report, external test reports and the spreadsheet revealed that one data in the spreadsheet, i.e. on 15/12/2013 was not consistent with that in the Wastewater Analysis Report.	CAR-5	OK
			v) EL _{grid} - In accordance with the revised monitoring plan , this parameter is the net electricity from the biogas collected in the anaerobic treatment facility sent to the grid, and to be measured continuously using electricity meter at the electricity grid. Further, the biogas technician will log the meter readings on the Daily Electricity Meter Record form TBP004_1 every day and on monthly basis transfer the amount to the electronic spreadsheet. PEA invoice records will be used for cross-checked. - The on-site verification confirmed the following power meters were available - M5 – kWh total sold to PEA - M1 - kWh from gas engine no.1 - M2 – kWh from gas engine no.2 - M3 – kWh from gas engine no. 3 - M7 – kWh total biogas use only from PEA - For the purpose of emission reductions, data from M5 and M7 have been used. - The net electricity sent to grid was based on the difference between the readings from meter M5 and meter M7. - Verification of data between TBP004_1 and that in the spreadsheet revealed no data transfer error for M7.		

			• However, for M5, PP had only included data from the PEA invoice. No manual recorded meter reading was included in the spreadsheet. • The title of this parameter in the spreadsheet under column I of the spreadsheet should be the same as in the MR. • Verification of data between the PEA invoice and that in the spreadsheet revealed that data presented for January and December 2013 was not consistent with that in the invoices. • Verification of data between the PEA invoice and that recorded in TBP004_01 for M5 revealed that only in the month of November 2013, the data in the invoice was lower than that in the meter reading. This was due to the fact that the M5 was calibrated by the PEA. PP need to ensure the most conservative approached is to be applied for this issue.	CAR-6	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.Phiphit Khlaisombat – Factory Manager ii) Mr.Sakol Tantanawat – CDM Biogas Manager vi) Ms.Watcharee Kongsan – Biogas Supervisor (resigned) vii) Mr. Pinit Wongpornpenpab – Biogas Supervisor (new) viii) Ms. Bridget McIntosh – CDM Consultant. In total there are 1 Biogas Supervisor, 4 technicians and 1 general worker appointed to operate and monitor the operation of the biogas plant.	OK	OK

			On-job-training for the new staffs were also provided, and within the 120 days of probation period, the staffs were evaluated for their competence. All staffs were confirmed.		
3.4 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 applied standardized baseline, the Board guidance, local/national standards, or as per the manufacturer's specification?	VVS	269 (c)	The following equipment calibration was verified: i. Flow meter to measure volume of waste water treated $Q_{y,w}$ - Kobold magnectic flow meter with S/N265044 identified as FI01 was installed at POME inlet to the CIGAR - Accuracy class of the flow meter is ± 0.3 - Calibration: 07/03/2012 and 12/07/ 2013 - Calibration frequency recommended by Kobold is 2 years. - Recalibration was carried out by Science Magic Grow Co.Ltd.. The error recorded during the calibration was within the specification range.	OK	OK
			ii. COD meter to measure $COD_{y,ww,treated,j}$, $COD_{y,ww,untreated}$ - Spectrophotometer with S/N. 1275172 - Calibration : 27/01/2012 and 25/01/2013 by Bangkok Lab Co Ltd - Calibration frequency was not specified by the manufacturer, but PP had decided to calibrate once a year.	OK	OK
			ii. Flowmeter to measure sludge remove $S_{y,final}$ - Kobold magnectic flow meter with S/N265047 identified as FI02 - Accuracy class of the flow meter is ± 0.3 - Calibration: 07/03/2012 and 26/03/2013 - Calibration frequency recommended by Kobold is 2 years. - Recalibration was carried out by Science Magic Grow Co.Ltd. The error recorded during the calibration was within the specification range.	OK	OK

			v. Power meters to measure kWh total sold to PEA (M5) and kWh total biogas use only from PEA (M7) - M5 power meter is supplied and controlled by the Provincial electricity Authority (PEA). The location of the meter was verified and found that the meter was sealed to ensure only authorised personnel from PEA to take the reading. M5 is an EDM1 Genius meter with serial number of 202008352. For this monitoring period, the power meter was calibrated on 28/11/2012 and 12/11/2013 by PEA. - M7 – using power meter Schneider Electric Power-Logic S/N 4A9515d5. Calibration by PEA was carried out on 27/11/2012 and 12/11/2013. The error recorded during calibration as found to be within the specification range.	OK	OK
			v. Biogas flowmeter to measure $Q_{\text{biogas, engine, y}}$ - Each biogas engine is equipped with one flowmeter, FI61 for gas engine no.1, FI62 for gas engine no. 2 and FI63 for gas engine no.3. - All meters are oscillator flowmeter (Kobold Technology). Accuracy class of the meter is 1.5% of measured volume (i.e. as evident in the equipment specification) - Calibration frequency recommended by Kobold is every 3 years. - All the flowmeters were calibrated by PTT Public Co Ltd. on 06/03/2012 and 09/05/2013 - All the biogas flowmeters are also equipped with pressure transmitters and temperature sensors which are used for normalizing the measured volume. - All the pressure transmitters are of brand Kobold SEN-3251. The recommended calibration frequency by the manufacturer is every 2 years. Calibration was carried out by Science Magic Grow Co. Ltd. on		

			• 07/03/2012 and 26/03/2013. From the calibration records for 2013, it was found that the errors detected during calibration were higher than the specification error. PP needs to clarify on this situation. • All the temperature sensors are of brand Kobold TWD-B9410213T and the recommended calibration for the sensor is once per year. Calibrations for the sensors were carried out by Science Magic Grow Co. Ltd. on 07/03/2012 and 28/03/2013. The errors detected during calibration were found to be within the specification range. There were delayed in calibration from 07/03/2013 to 27/03/2013. PP had applied the equipment specification errors (which was higher than the measured error) to determine the factor to be multiplied to the recorded values. This method was as recommended by the equipment supplier. It can be confirmed that the application of the errors to the measured data was found to be correct.	CAR-7	OK
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			vi. Biogas flowmeter to measure $Q_{\text{biogas, flare,y}}$ and flowrate of biogas at flare • Oscillator flowmeter (Kobold Technology) with S/N.5815 identified by PP as FI64. Accuracy class of the meter is 1.5% of measured volume (i.e. as evident in the equipment specification) • Calibration was carried out by PTT Public Co Ltd. on 06/03/2012 and 09/05/2013 • Calibration frequency recommended by Kobold is every 3 years. • The biogas flowmeter is equipped with pressure transducer (PI64) and temperature sensor (TI64) which are used for normalizing the measured volume. • Pressure transmitter (PI64) is of brand Kobold SEN-3251. The recommended calibration by Kobold is every 2 years. Calibrations were carried out by Science Magic Grow Co. Ltd. on 07/03/2012 and 26/03/2013. From the calibration report, it was indicated that the error detected during the calibration was higher as compared to the specification error. PP needs to clarify on this situation. • Temperature sensor (TI64) is of brand Kobold TWD-B9410213T and the recommended calibration for the sensor is once a year. Calibration of the sensor was carried out by Science Magic Grow Co. Ltd. on 06/03/2012 and 28/03/2013. Recalibration was delayed from 06/03/2013 to 27/03/2013. During this period, PP had applied the equipment specification errors (which was higher than the measured error) to determine the factor to be multiplied to the recorded values. This method was as recommended by the equipment supplier. It can be confirmed that the application of the errors to the measured data was found to be correct	CAR-8	OK
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			vii. Methane analyser to measure fraction of methane in biogas F_{CH_4} • Methane gas analysers were installed at the biogas plant and at the gas engine. The methane gas analyser at the gas engine is used as back up when the main methane gas analyser at the biogas plant is out of order/malfunction. • The main methane gas analyser (OLCT IR with S/N.10034A4-203) at the biogas plant is linked to data logger no.2 that measured and recorded data every minute. The calibration was carried out by Entech Associate Co. Ltd. on 19/12/2012 and 19/12/2013. No recommendation by the manufacturer on the calibration frequency. PP had adopted 1/year. From the calibration report, it was indicated that the detected error was within the specification range. • Methane gas analyser at the biogas engine was used as back up whenever, the main methane analyser at the biogas plant is malfunction or when the reading is abnormal. • Each biogas engine is equipped with methane analyser. JE CH₄ analyser (S/N.29196) for gas engine no. 1, S/N. 28961 for gas engine no. 2 and S/N.27894 for gas engine no.3. Calibration information in the MR was confirmed to be correct. There was no delay in calibration. However, from the calibration reports it was indicated that the error was higher than the error specified in the equipment specification. PP had applied the measured errors and adjusted the measured data accordingly. The application of the errors was found to be appropriate as the error was added when the parameter is used for project emissions and deducted when it is used for baseline emissions.	OK	OK
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			viii. Flame detector - Flame ionization detector was installed at the flare system to detect the flame. The FID was linked to data logger no. 2 - No calibration required but the checking on the functionality of the detector was carried out by the Biogas Supervisor on a quarterly basis and recorded the results in Quarterly Checklist TBP009.	OK	OK
			ix. Thermocouple used to measure T_{biogas} - N type thermocouple (S/N. N0185334) installed on line at the biogas pipeline identified by PP as TI60. The meter was installed next to the biogas flow meter FI60. This thermocouple is used for the normalization of the biogas volume. - No calibration frequency determined by the manufacturer, but PP had decided to carry out once a year. Calibration of the thermocouple was carried out on 07/03/2012 and 28/03/2013. Delay in calibration was observed from 07/03/2013 to 27/03/2013. However, the data from FI60 is not in used in the calculation of the ER, the error application is not applicable.	OK	OK
			x. Pressure meter to measure P_{biogas} - A Honeywell STD924 pressure transducer (S/N 80023860001) identified by PP as PI60 installed on line at the biogas pipeline next to the thermocouple. - Calibration was carried out on 07/03/2012 and 26/03/2013. - The calibration frequency is as per manufacturer recommendation.	OK	OK

			xi. Pressure meter to measure pressure of biogas at flare • The same pressure transmitter PI64 used for the normalization of the $Q_{\text{biogas, flare,y}}$ was used for the monitoring of the pressure of biogas at flare. • In the monitoring report, it was indicated PI60 is used instead of PI64 and under the purpose of data, the pressure range indicated was found not consistent with that in the PDD.	CAR-3	OK
			xii. Biogas flowmeter to measure $Q_{\text{biogas, total,y}}$ • Oscillator flowmeter (Kobold Technology) with S/N.5814 identified by PP as FI60. Accuracy class of the meter is 1.5% of measured volume (i.e. as evident in the equipment specification) • Calibration was carried out by PTT Public Co. Ltd. on 13/01/2011 and 01/04/2013. • Calibration frequency recommended by Kobold is 3 years. • This parameter was used as checked and not used in the ER calculation.	OK	OK
3.5 Are monitoring results consistently recorded as per approved frequency?	VVS	269 (d)	Yes, all of the monitoring results have been consistently recorded as per approved frequency defined in the revised monitoring plan.	OK	OK
3.6 Have quality assurance and quality control procedures been applied in accordance with the monitoring plan or revised monitoring plan?	VVS	269 (e)	Yes, the QA and QC procedures have been implemented as required in the revised monitoring plan.	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	272	The calibration of the measuring equipment was verified and as explained in section 3.3. of the protocol there were several occasion the calibration of the monitoring equipment was delayed. However, PP was aware of the situation, and based on that, PP had applied the error to the measured data.	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	273	Yes, the following equipment calibration was delayed and application of 4.2(a) was made; i) Temperature sensors for biogas going to gas engines TI61, TI62 and TI63 ii) Temperature sensor for measurement of biogas to flare TI64 The application of the MPE was verified and found to be correct.	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	274	Yes, it can be confirmed that the error has been applied in a conservative manner.	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	275	No such situation was found.	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, the applied standardized baseline, 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	276	No such situation was found.	OK	OK

4.6	In cases where neither the applied monitoring methodology, where applicable, the applied standardized baseline nor the monitoring plan specify any requirement 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	277	Calibration frequency is mainly following the recommendation by the supplier/manufacturer. For those that without the supplier confirmation, PP had adopted a once a year frequency, which is appropriate.	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 methodology and, where applicable, the selected standardized baseline					
5.1	Is a complete set of data for the specified monitoring period is available?	VVS	280 (a)	Yes, all data as required by the methodology and PDD were available.	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	280 (a)	No such situation found.	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	280 (b)	Yes, the information in the monitoring report has been cross-checked with the various log sheets and reports. The following were verified: • Wastewater flow and biogas flow - raw data was cross checked with data in the daily report TBP005. • COD analysis – cross checked with the daily analysis results recorded in the Wastewater Analysis Report TBP003, and external laboratory analysis report • Electricity to the grid – cross checked with PEA Electricity monthly meter reading report for VSPP • Electricity use by the biogas plant – cross checked with Daily Electricity Meter Record Form TBP004_1 • CH4 monitoring from gas engine no. 1 - TOPI Biogas Plant – cross checked with data recorded hourly in the Genset Data Report • Quarterly monitored parameters – cross checked with the information recorded in Quarterly Parameter Report TBP009	OK	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 and where applicable the applied standardized baseline ?	VVS	280 (c)	The formulae for calculations of baseline emissions and project emissions as in the ER spreadsheet were found to be correct.	OK	OK

5.5	Any assumptions used in emission calculations? If yes, they been justified?	VVS	280 (d)	There were no assumptions used in the calculation of emission reductions.	OK	OK
5.6	Have appropriate emission factors, IPCC default values and other reference values been correctly applied?	VVS	280 (e)	Yes, 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. However, the GWP for this monitoring period needs to be updated. These parameters have been included in Section D.1 in the Monitoring Report.	CAR-9	OK
5.7	For a registered CDM project activity using an approved standardized baseline that standardizes baseline emissions, have the standardized value(s) of the parameter(s) was(were) applied using the correct version of the applied standardized baseline in accordance with the Project standard?	VVS	280 (f)	Not applicable as the project activity does not use the standardized baseline.	OK	OK

TABLE 2 : GOLD STANDARD MONITORING PARAMETERS

No.	Parameter	Assessment
GS1	SD1 – Water Quality Improvement in wastewater quality released to the existing wastewater treatment system	Improvement in the wastewater quality discharged was confirmed to be achieved through the reduction in the average inlet and outlet of the COD values.
GS2	SD2 – Air Quality There is a reduction in odour from the plant from the Project Activity	A random visit to the nearby stakeholders was carried out during the on-site visit to the project site. The stakeholders interviewed were mainly staying within less than 1km distance from the biogas plant Interview with the following stakeholders were carried out during the on-site verification.

		i) Ms. Watthana Boorag – villager from Plaiphraya Community located in front of the factory ii) Mr.Krasorn Nasongram – villager at Soi Sri Saw located behind the biogas plant iii)Ms. Chom Chonsrijun – villager at Soi Sri Saw 1 located at behind the biogas plant The stakeholders have confirmed that is no problem of odour from the factory. During the audit days, the verification team also confirmed that there is no bad smell from the project site.
GS3	SD4 – Soil Condition Organic sludge from the biogas plant is used on the plantations or nursery.	It was confirmed during the site visit that there was no desludging activity carried out during this monitoring period.
GS4	SD5 - Biodiversity Avoidance of POME spill during construction.	There was no spill during the construction period which was in year 2008.
GS5	SD5 - Biodiversity Avoidance of POME spill during operation.	A quarterly check by the biogas supervisor was carried out to check for any spill or leak during the operations. This has been included in the Quarterly Checklist and Safety Walk Through report.
GS6	SD6 - Employment Quality Ensure safety of workers	Safety Review of biogas plant on quarterly basis sighting at least the following: • Leaks or cracks in pipes and joints • Leaks or cracks in the CIGAR cover • Potential equipment that could spark in engine room • Sufficient ventilation in engine room • Potential sparks at any pumps or blowers Carried out on quarterly basis by the Biogas Supervisor. These criteria have been included in the Quarterly Checklist and Safety Walk Through report. The filled reports were cited and can be confirmed that the

		checked were carried out on every quarter. Issues detected during this process were immediately rectified.
GS7	SD9 - Human and Institutional Capacity Raising environmental awareness amongst the community including schoolchildren	During this monitoring period, only one educational visit carried out by the Thaksin University on 11 March 2013. This was evident in the Visitor Log Book and the photograph. About 39 students and staff of the university included in the group.
GS8	SD10 – Employment Numbers Number of new jobs created for Biogas Project.	Since the beginning of the project, 5 new staffs (1 Biogas Supervisor, 3 technicians and 1 general worker) have been recruited to operate and maintain the biogas plant. During this period, one new staff was appointed as a result of the resignation of previous staffs: • Mr. Pinit Wongpornpenpap – Biogas Supervisor, appointed on 16/11/2013 The payrolls for the staffs were provided from Jan 2013 to December 2013 which confirmed that there were 5 staffs for the biogas plant. Training on the biogas plant has also been provided to the new supervisor. This was evident from the training records.
GS9	GS Rule Compliance There is no new legislation development that mandates methane recovery from wastewater treatment for this site.	Confirmation from Thailand Greenhouse Gas Office (TGO) during this period has yet to be provided to the verification team. (CL 4).
GS10	GS Rule Compliance Minimum 65% use of biogas for energy purposes	The % of biogas used for energy purposes will need to be reviewed once the corrective action requests and clarification request related to the used of biogas has been resolved (CL 5).
GS11	GS Rule Compliance Land for oil palm expansion	Letter from Krabi Agriculture Extension Office has yet to be provided to the verification team. (CL 6)
GS12	GS Rule Compliance Status of RSPO	The Univanich Palm Oil Public Co.Ltd has been certified to RSPO P&C criteria for its TOPI Factory by Tuv Nord (Indonesia) on 3/6/2013. The certificate no. is TNI-RSPO-F-1311 and is valid until 2/6/2018.

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: Amount of biogas recovered and flared ($Q_{\text{biogas,flare,y}}$) and Other flame operation parameters – flowrate of biogas at flare Verification of data in the ER spreadsheet and the Flare Tool spreadsheet revealed that there were some data which was below the range of detection limit of the flowmeter.	269 (b)	Already corrected the ER spreadsheet “Total methane combusted tab” column M,N,O if $<6.5\text{m}^3$ then made to zero and column P gas flow to flare if $< 30\text{m}^3$ then made to zero.	A programme had been included to filter out those data which was below the detection limit of $30\text{Nm}^3/\text{hr}$. The same was applied for the biogas to gas engines where the detection limit of $6.5\text{Nm}^3/\text{hr}$ was used. Conclusion: CAR 1 closed
CAR 2: Fraction of methane in the biogas In the ER spreadsheet, PP had included a programme to eliminate the data which was below 40% (limit for combusting the methane in the biogas engine and flare). However, there were still some data which were below 40%. Further, in the ER spreadsheet the title of column D ‘Biogas Methane Concentration After Add Error’ may need to be revised as there was no delay in calibration of the analysers.	269 (b)	Already filter methane combusted tab column D that if the methane $< 40\%$ then replace with the inline reading. The title of Column D has also been corrected	The title of Column D has been revised and PP had included a filtering programme to eliminate those reading $<40\%$ and replaced with the backup inline methane analyser reading. As described in the PDD, the backup inline methane analyser which is available at each of the gas engine was used whenever the reading by the main methane analyser was not within the detection limit. Conclusion: CAR 2 closed
CAR 3: Other flame operation parameters – pressure biogas at flare The following information in the monitoring report	269 (b)	MR pressure biogas at flare parameter already corrected to PI64 not PI60 and the range also corrected to 20-100 mbar.	The information in the MR had been corrected. The data included in the MR was as verified and it can be confirmed that the data was from PI64

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
was found in-correct: - PI60 was used to monitor this parameter - the values included in the report were not from the PI64. - The pressure range indicated was found not consistent with that in the PDD.			Conclusion: CAR 3 closed.
CAR 4 : Sludge Application The reported information in the monitoring report needs to be amended to ensure the description and the data/parameter are consistent with that described in the PDD.	269 (b)	Already correct the description of parameter in MR to consist with PDD.	Description in the MR had been corrected and found to be consistent with that in the PDD. Conclusion: CAR 4 closed.
CAR 5: COD_{y,ww,treated} Review of data between the Wastewater Analysis Report, external test reports and the spreadsheet revealed that one data in the spreadsheet, i.e. on 15/12/2013 was not consistent with that in the Wastewater Analysis Report.	269 (b)	Already update the correct COD values on 15/12/2013 in ER spreadsheet. The reason for the difference is because an error was found in the data transfer into the ER sheet	Data in the spreadsheet had been corrected and consistent with that recorded in the Wastewater Analysis Report. Conclusion: CAR 5 closed.
CAR 6: EL_{grid} - The data for M5 in the ER spreadsheet only included the data from the PEA invoice. - The title of this parameter in the spreadsheet under column G of the spreadsheet	269 (b)	Already update the electricity tab as follow ; - Add the new column (E) for M5 that logged from TBP004 - The title of parameter in column G has been changed to “ Total Electricity replace to grid (EL_{grid})”	- Data from the manual recording had been included in the spreadsheet column E - Title in the spreadsheet had been corrected. - The data in January and December had

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
should be the same as in the MR. • Verification of data between the PEA invoice and that in the spreadsheet revealed that data presented for January and December 2013 was not consistent with that in the invoices. • Verification of data between the PEA invoice and that recorded in TBP004_01 for M5 revealed that in the month of November 2013, the data in the invoice was lower than that in the recorded meter reading. This was due to the fact that the M5 was calibrated by the PEA. PP need to ensure the most conservative approached is to be applied for this issue.		- Use midnight at the end of the month for each electricity cumulative reading - In Nov 2013 the value from TBP004 was 728,160 kwh and PEA invoice was 727,200 kwh so the PEA invoice data was used for most conservative.	been corrected as per verified. - Approach taken for the month of November was found to be conservative as lower value is used. Conclusion: CAR 6 closed.
CAR 7: Biogas flowmeter to measure $Q_{\text{biogas, engine,y}}$ • The errors detected during calibration for all the pressure transmitters (PI61, PI62 and PI63) were higher than the specified range by the manufacturer.	269 (c)	For period 1 Jan to 25 Mar 2013 the error was deduct for FI61, FI62, FI63 (refer to “ method for calculation Nm3 accounting P error” file) due to the calibration results were higher than the specified range by the manufacturer.	PP had applied the same method used in the previous verification for the method to determine the error coefficient based on the measured error. The calculated error coefficients for project emission and baseline emission have been determined. The error coefficient was either added or deducted on the measured data of the flowmeters. Conclusion: CAR 7 closed.
CAR 8: Biogas flowmeter to measure $Q_{\text{biogas, flare,y}}$ and flowrate of biogas at flare • The error detected during calibration for all the pressure transmitters (PI64) was higher	269 (c)	For period 1 Jan to 25 Mar 2013 the error was deduct for FI64 (refer to “ method for calculation Nm3 accounting P error” file) due to the calibration result was higher than the specified range by the manufacturer.	Method as in CAR 7 was used to determine the error coefficient which was then applied to the measured data. The method was found to be accurate.

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
than the specified range by the manufacturer.			Conclusion: CAR 8 closed.
CAR 9: The GWP for methane had not considered the second commitment period of Kyoto Protocol emission factor.	280 (e)	GWP was corrected to 25.	The GWP of 25 had been applied in the spreadsheets. Conclusion : CAR 9 closed
CL 1: (i) PP need to explain for "Methane Combusted" spreadsheet why the data on 2 May 13:00 and 2 Sep 13 11:00:00 was a lump sum figures instead of an hourly data. (ii) PP need to explain why the figures for parameter $Q_{\text{biogas,flare,y}}$ for parameter FVRG,h do not match each other;	269 (b)	(i) The signal from FI64 was jammed at the data logger from 26 Apr 10.00 until released on 2 May 13:00 and from 21 Aug 16.00 until 2 Sep 11:00; so the lump sum values represent the total gas flow from the previous hours. This is why the previous hours show a reading of zero. Because the value is abnormal, it was excluded from the dataset to be conservative (lower baseline emissions). (ii) Parameter $Q_{\text{biogas,flare,y}}$ is cumulative flow measured continuously in Nm ³ and logged hourly. FVRG,h is flowrate measured continuously in Nm ³ /hr and logged every minute (to be able to calculate flare emissions for flare on/off 20 minutes in hour). The flare tool uses the 60 minutes to determine the average flowrate in the hour to calculate project emissions. Therefore the cumulative flow Nm ³ and the flowrate NM ³ /hr will not be identical.	i) The spreadsheet has been revised whereby for the data for these two occasions had been removed from the calculation in the determination of MD _y . This approach was accepted as it lowered the ER. ii) Explanation provided by the PP was accepted. The data logger is capable of logging the data either continuously in Nm ³ or in every minute or hour. This explained why the data will not be the same for these two parameters although using the same flowmeter. Conclusion : CL 1 closed

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
<u>CL 2</u> PP needs to explain how the flare efficiency of 50% was determined.		The flare efficiency is determined in the raw data flare tool calculations files "Flare Data Jan ... Dec 2013.xls". These were verified in detail on site during the verification site visit and files provided with this Verification Protocol. The flowrate, flare detector and methane content to the flare is logged in a data logger on a minute basis. The number of minutes per hour that the flare is on and operating within the manufacturers specifications is counted. If it is on for more than 20minutes then the excel sheet automatically includes this hour with 50% efficiency. If the flare is not operational for more than 20minutes then the efficiency is 0%. Each monthly file is very large because it has minute data values for all the instruments. To calculate the flare emissions for the year, the hourly values (including flare efficiency) for each month are copied across to the file "UNV TOPI Flare Tool v3.0 07Apr15.xls".	The raw data from the data logger is transferred to Excel sheet for the determination of the flare efficiency was provided to the verification team. The raw data is recording the information continuously at every minute. Programming in the spreadsheet was included where when the FID signal providing reading of 5v, the system will count that as 1 minute. The number of minute at each hour is counted and for those hour that meet the 20 minutes and above, the flare efficiency was considered as meeting the 50% efficiency. Otherwise the flare efficiency was considered as zero. The summarised information was then transferred to the UNV TOPI Flare Tool. Information provided adequate to explain the method use to determine the flare efficiency. Conclusion : CL 3 closed.
<u>CL 3:</u> Amount of biogas recovered and combusted for energy production ($Q_{\text{biogas,engine,y}}$) : During on-site visit to the biogas engine room, it was found that the serial number for TI61, PI63 and PI61 not the same as indicated in the Monitoring Report. Please		All equipments were not changed. For the TI61 the serial number indicated not same in the MR because the mistake from the supplier who calibrated our equipments (The serial of TI61 and TI60 was same) and supplier already corrected this. For PI63 and PI61 the maintenance team swap this equipment on 4th June 14 (out-	Explanation from PP is accepted. Conclusion: CL2 closed

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
clarify to whether if the equipment had been changed. If so, provide the documentation when it was changed.		side this monitoring period) to check if they have the problem with the control system.	
Findings on compliance to Gold Standard requirements:			
CL 4: Confirmation from Thailand Greenhouse Gas Office (TGO) during this period has yet to be provided to the verification team.		Please see attached letter.	Email from the Director of Review and Monitoring Office, of TGO on 14 July 2014 confirmed that up till now there are no new legislation mandating biogas plants in Thailand. Conclusion: CL 2 closed
CL 5 : The % of biogas used for energy purposes will need to be reviewed once the corrective action requests and clarification request related to the used of biogas has been resolved.		The % of biogas used for energy purposes is over 80%, which is much higher than the GS requirement of 65%.	The total methane captured = 7,990,093.6Nm ³ , the total methane combusted in the gas engines = 7,105,301.5Nm ³ . Hence the % of biogas used for energy purpose = 88.9%. Hence it can be concluded that the project activity had met the GS requirements. Conclusion : CL 5 closed.
CL 6: Letter from Krabi Agriculture Extension Office has yet to be provided to the verification team.		Please see attached letter.	Letter from Krabi Agriculture Extension Office dated 29 May 2014 had been provided. The letter confirmed that the expansion of land is from rubber plantation. Conclusion: CL 4 closed.