
VERIFICATION AND CERTIFICATION REPORT

UNIVANICH TOPI BIOGAS PROJECT

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

Verification Period:
01/01/2011 - 31/12/2012

Report No. : SQAS-GS-EU02350009
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SQAS-GS-EU02350009		26 November 2013	5 September 2014															
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 second monitoring period reported for the 'Univanich TOPI Biogas Project'. The second monitoring period covers the period from 1/01/2011 to 31/12/2012. The project was registered by the UNFCCC Executive Board on 24 August 2009. The verification was based on the validated project design document (PDD)^[2/], Revised PDD^[3/], previous Verification Report^[6/], Monitoring Reports^{[7/][66/]}, ER spreadsheets^{[8/][67/]}, the Registered Gold Standard Annex^[69/], the Gold Standard Monitoring Report Annex^[70/], 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>01/1/2011 – 31/12/2011</th> <th>01/1/2012 – 31/12/2012</th> </tr> </thead> <tbody> <tr> <td>Emissions reduction AMS III.H</td> <td>56,314.00 tCO₂e</td> <td>53,719.00 tCO₂e</td> </tr> <tr> <td>Emissions reduction I.D</td> <td>7,537.00 tCO₂e</td> <td>6,847.00 tCO₂e</td> </tr> <tr> <td>Total emissions reduction for the project activity by year</td> <td>63,851.00 tCO₂e</td> <td>60,566.00 tCO₂e</td> </tr> <tr> <td>Total emissions reduction for monitoring period (rounded value)</td> <td colspan="2">124,417 tCO₂e</td> </tr> </tbody> </table>					01/1/2011 – 31/12/2011	01/1/2012 – 31/12/2012	Emissions reduction AMS III.H	56,314.00 tCO ₂ e	53,719.00 tCO ₂ e	Emissions reduction I.D	7,537.00 tCO ₂ e	6,847.00 tCO ₂ e	Total emissions reduction for the project activity by year	63,851.00 tCO ₂ e	60,566.00 tCO ₂ e	Total emissions reduction for monitoring period (rounded value)	124,417 tCO ₂ e	
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Subject : CDM/GS Verification																		
Work carried out by : Aminah Ang - Verification Team Leader		☒ No distribution without permission from the Client or responsible organisational unit ☐ Limited distribution ☐ Unrestricted distribution																
Report Reviewed by : Dr.Yeoh Bee Ghin & Akmar Hisham Saat																		
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)
GS	Gold Standard
IPCC	Intergovernmental Panel on Climate Change
m ³	Cubic meter
MR	Monitoring Report
MP	Monitoring Plan
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 6.0

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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 01/01/2011 - 31/12/2012. 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-EU02350009 dated 22 May 2014) and issued by the CDM EB on 15 August 2014.

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 methodology;
- To verify that the data reported were accurate, complete, consistent, transparent and free of material error or omission by checking the monitoring records and the emissions reduction calculation; and
- To verify and certify GHG emission reduction reported for "*Univanich TOPI Biogas Project*" for the period from "*1/01/2011 to 31/12/2012*"

1.2 Scope

The scope of the verification was the independent and objective review and ex-post determination of the monitored reductions in GHG emissions from "**Univanich TOPI Biogas Project**". The verification of this CDM project 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 6.0)^{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
Registered date	: 24 August 2009
GS registration No.	: 460
Registered date	: 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. The project activity involves construction of a covered lagoon anaerobic reactor with a biogas capture system. The biogas from the covered anaerobic reactor is captured and used in three units of biogas engines each with 952kW capacity. The generated electricity is exported to the Provincial Electricity Authority (PEA) grid and used on-site in the project activity. The excess biogas is combusted in an open flare system. The project activity contributes to GHG reduction in two ways. The first is by avoiding 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.

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 validation 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 a lead auditor for environmental management systems (ISO 14001) for the past 16 years.

1.5 Technical Reviewer

Dr. B.G.Yeoh holds a D.Eng. in Environmental Engineering. He possesses extensive experience in the areas of environmental technology and energy technology, covering environmental pollution and waste management, bioenergy, sustainable renewable energy, cleaner production, and GHG emissions reduction. He has managed projects in the various stages of the CDM cycle from PDD development through validation, monitoring, verification and CER issuance, covering various sectors, including renewable energy, cogeneration, fuel switch, methane capture, manure management, etc.

Akmar Hisham Saat holds a degree in Mechanical Engineering. He has been trained in the CDM validation and verification processes and is a qualified CDM lead auditor.

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 October 2013 to August 2014 with details as follows:

Off site preparation / document review and planning	: October 2013
On-site verification	: 30 – 31 October 2013

Preparation of draft report	: 26 November 2013
Preparation of final CDM report	: April - May 2014
Preparation of final GS report	: July - August 2014

The project assessment was based on the methodology developed in the VVS version 6.0. In order to ensure transparency, a verification protocol was customized for the project, according to the VVS. The protocol shows, in a transparent manner, requirements, means of verification and the results. The verification protocol serves the following purpose;

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

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

2.1 Review of Documentation

The following documentation were reviewed and verified:

- Registered PDD^{/2/}
- Revised PDD^{/3/}
- Previous Verification and Certification Report^{/6/}
- Monitoring reports^{/7//66/}
- ER spreadsheets^{/8//67/}
- Flare tool spreadsheets^{/9//68/}
- Methodologies^{/4//5/}
- Registered Gold Standard Annex, version 7.2 July 2010^{/69/}
- GS Monitoring Report Annex, version 1^{/70/}

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 *Univanich TOPI Biogas Project* from 30 – 31 October 2013. The on-site audit consisted of a visit to the project site to verify the project implementation, the location of the monitoring equipment and the review of documents and the monitored data available at project site. 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

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, five (5) CARs and eleven (11) CLs were raised after the on-site audit carried out on 30 and 31 October 2013. Details of the findings are in the verification protocol in Annex 1 of this report.

3.1 Remaining Issues From Previous Validation or Verification

During the first verification, one FAR was raised on the measurement unit for the 'Other flare operation parameters – flowrate of biogas at flare' which was subsequently addressed through the revision of the PDD. The measurement unit was revised from m³/h to Nm³/h. The revised PDD was approved on 18 February 2014.

3.2 Project Implementation

The project activity involves the construction of a covered lagoon anaerobic reactor with a biogas capture system. The biogas from the covered anaerobic reactor is captured, treated and 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 boiler is not in operation. The excess biogas is combusted in an open flare system. The project activity contributes to GHG reduction in two ways. The first is by avoiding methane release into the atmosphere and the second is by generating clean electricity that partially replaces the electricity from Thailand's PEA grid which predominantly consumes fossil fuels for its electricity generation. It can be confirmed that the project implementation is as described in the revised PDD^{/3/}.

3.3 Completeness of Monitoring

The monitoring was confirmed to be in accordance with the monitoring plan contained in the revised PDD^{/3/}, the approved methodologies^{/4//5/} applied by the CDM project activity.

All parameters stated in the revised monitoring plan^{/3/} 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 _{biogas,total,y}
Data unit:	Nm ³
Description:	Total amount of biogas recovered from the covered lagoon
Source of data used:	Measured using an on-line biogas flow meter, identified by PP as FI60 which is connected to a data logger.
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. In 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 Nm^3. The supplier of the flow meter (ST Control Co. Ltd.)^{10/}, who set up the equipment provided a summary of the equipment setting and how flow computer algorithm calculates the normalised value (Nm^3). 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 is downloaded to Excel ER spreadsheet via a dedicated software. During the verification of the ER spreadsheets, it was noted that there were some readings which were very low (i.e. below $10\text{Nm}^3/\text{hour}$). CL 5 was raised requesting PP to check with the flow meter specification on the detection limit. Details of the findings and the closure are as in Table 2 of Annex 1 of this report.
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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:	Measured using flow meters which are connected to data logger.
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 to automatically to a normalised value by the data logger. The supplier of the flow meter (ST Control Co. Ltd.)^{10/}, who set up the equipment provided a summary of the equipment setting and how flow computer algorithm calculates the value in Nm^3. 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 is downloaded to Excel ER spreadsheet via a dedicated software. During the verification of the ER spreadsheets, it was found that there were some readings which were very low (i.e. below $10\text{Nm}^3/\text{hour}$). CL 5 was raised requesting PP to check with the flow meter specification on the detection limit. Details of the findings and the closure are as in Table 2 of Annex 1 of this report. There were also delay in the re-calibration of all the temperature sensors from 07/10/2011 to 07/03/2012. During this period, PP had applied the maximum permissible error of the sensors as specified in

	the equipment specification as the error was higher than the measured error. The method of adjustment of the data is in accordance with the manufacturer's recommendation. This was found to be in accordance with accordance with para 273 of the VVS ^{1/} .
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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:	Measured using an on-line biogas flowmeter, identified by PP as FI64 which is connected to a data logger.
Means of verification :	The amount of biogas recovered and flared is measured using an oscillator flow meter (brand Kobold) 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 is also installed (labelled as PI64 and TI64). With the P and T measurement of the biogas, the flow meter reading is converted automatically to the normalised value (Nm³) by the data logger. The supplier of the flow meter (ST Control Co. Ltd.)^{10/}, who set up the equipment provided a summary of the equipment setting and how flow computer algorithm calculates the value in Nm³. 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. However, one CL (CL6) was raised as occasionally the recorded data was not within the typical range of data. 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:	Measured using on-line methane analyser
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/malfunxions. 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 engine is not linked to any data logger. Data measured from this analysers was manually recorded in 'Genset Data Report Checksheet'^{/15/} on an hourly basis by the technician. These data was used when the main methane gas analyser was out of order or malfunctioned. This has been clearly indicated in the ER spreadsheet and in the revised monitoring report. During the verification, CL 7 was raised on issues relating to low methane concentration, the use of the backup analysers, data inconsistency, application of error due to delay in calibration and the reporting in the monitoring report. Details of the findings and the closure are as in Table 2 of Annex 1 of this report.
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Data/parameter:	T_{biogas}
Data unit:	$^{\circ}\text{C}$
Description:	Temperature of biogas
Source of data used:	Measured continuously using thermocouple
Means of verification :	An N type thermocouple (S/N. 0185334) was installed at the biogas pipeline to measure the temperature of biogas. This thermocouple is 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 for the normalization of the biogas volume ($Q_{\text{biogas, total, y}}$) which is computerized 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 for the normalization of the biogas volume ($Q_{\text{biogas, total, y}}$) which is computerized 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. 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)^{16/}. The records were checked and it was found that the FID was functioning well during the monitoring period. During the verification of the raw data spreadsheet, CL 4 was raised for some of the data which occasionally detected readings of >0 volt but <5 volt and was considered as flame 'on'. Details of the findings and the closure are as in Table 2 of Annex 1 of this report.
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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 10 – 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)^{16/}. During the verification, CAR 2 was raised due to information and data inconsistency. 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:	Measured.
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/h and this is converted to total quantity of biogas in Nm³ 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.
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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:	Measured using kWh meters
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 – kWh total sold to PEA • M7 – kWh total biogas use only from PEA The net electricity sent to grid is based on the difference between the readings from meter M5 and meter M7. The kWh cumulative readings from the power meters were recorded in the Daily Electricity Meter Record (TBP004_1)^{17/} 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 was found that the data in the spreadsheet for M5 was based on PEA invoice and not from TBP004_1^{17/} as required by the monitoring plan. CAR 3 was raised on this issue. In response to the findings, PP had revised the spreadsheet to include data from TBP004_1 which had been confirmed during the on-site verification. Data from the PEA invoice had been used for comparison purposes. During the verification, CL 8 was also raised on the power meters which were used to monitor M5 during this monitoring period including the delay in the calibration. CL 9 was raised on M7 power meter. 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:	Measured continuously using 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)^{11/} on a daily basis by the biogas technician. There was no data transfer error found in the ER spreadsheet. During the verification of data, CL1 was raised on the following issues: - the total POME flow to CIGAR from 16 Jan 2011 to 18 Jan 2011, was 6976m³ which was too large an amount for two days flow. On other days, it was observed that the total flowrate was less than 1000m³/day; - during the period from 8/6/2012 (20:00) to 12/6/2012 (23:00) records showed that FFB had been processed, but there was no wastewater recorded. In response to the findings, PP had removed the abnormal data and during the above mentioned periods, since the parameter is used for the determination of the project emissions, the maximum flowrate of the flow meter was applied. This was found to be in accordance with Appendix 1 of the CDM Project Standard. Hence, a post registration changes on this temporary deviation is submitted along with the request for issuance. With that approach, the CL was closed.

Data/parameter:	$COD_{y,ww,untreated}$
Data unit:	tonnes/m ³
Description:	COD entering anaerobic system in year "y"
Source of data used:	Measured by Univanich laboratory on a monthly basis and an external laboratory—on a quarterly basis.
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. 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 ^{/12/}. The results of the analysis were recorded in Wastewater Analysis Report^{/13/}. Quarterly analysis of COD was carried out by Saint Envir Co. Ltd., an accredited laboratory. Both the internal and external results were used in the ER spreadsheet. This parameter was used for the calculation of $COD_{y,removed}$, where $COD_{y,removed} = COD_{y,untreated} - COD_{y,ww,treated}$. The results in the laboratory reports^{/14/} and the internal reports^{/13/} were checked against that in the ER spreadsheet. No data transfer error was found. However, CL 2 was raised on the following issues: • In the TOPI Biogas ER spreadsheet, this parameter was labelled as COD_{input} and not $COD_{y,ww,untreated}$ • From the spreadsheet, it was found that for the month of March and April 2012 there were no internal COD data available and there was no remark provided. • For the data from external lab, the value for 1/10/2011 (0.037tCOD/m³) and 7/5/2012 (0.0172tCOD/m³) the values were considered abnormal as they were not within the typical POME concentration for COD. Details of the findings and the resolutions are as per Table 2 of Annex 1 of this report.
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Data/parameter:	$COD_{y,ww,treated}$
Data unit:	tonnes/m ³
Description:	COD of treated wastewater in year "y"
Source of data used:	Measured by Univanich laboratory on a monthly basis and an external laboratory on a quarterly basis.
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. The sampling point and method 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 ^{/12/} which had been in practice since the beginning of the project activity. The results of the analysis were recorded in Wastewater Analysis Report^{/13/}. Quarterly analysis of COD was carried out by Saint Envir Co. Ltd., an accredited laboratory. Both the internal and external results were used in the ER spreadsheet. This parameter was used for the calculation of

	$COD_{y,removed}$, where $COD_{y,removed} = COD_{y,untreated} - COD_{y,ww,treated}$. The results in the laboratory reports^{/14/} and the internal reports^{/13/} were checked against the values in the ER spreadsheet, and one clarification request, CL 3 was raised on the following issues: • In the TOPI Biogas ER spreadsheet, the COD is labelled as COD_{output} instead of $COD_{y,ww,treated}$ • In the spreadsheet, there was no COD data for the month of April 2012 and there was no explanation recorded for this. 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:	Monitored
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.

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)^{/12/} 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^{/12/}. The results of the analysis were recorded in Wastewater Analysis Report TBP003^{/13/} Quarterly analysis of COD was carried out by Saint Envir Co. Ltd. (Bangkok), an accredited laboratory. From the analysis, the following was reported:

	2011	2012
COD _{y,ww,untreated}	80,550 mg/L	84,960 mg/L
COD _{y,ww,treated}	1,030 mg/L	1,407 mg/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. i) Mdm.Rattanaporn – shopowner behind the biogas plant ii) Mdm. Thavvan – shopowner behind the biogas plant iii) Mdm. Ampa Rakwong – shop owner in front of the mill iv) Mr. Sarayut Sopapong – villager v) Mr. Withoon Peenthong – shop owner near the biogas plant vi) Mr. Pattanapong Jaiklieng – TOPI staff Following were among the questions asked during the interviews: i) How long have you stayed at this area? ii) Are you aware of the TOPI's biogas plant? iii) Do you encountered bad smell from the biogas plant? iv) Do you observed any other environmental pollution from the biogas plant? v) Do you observed any differences in the air quality before and after the installation of the biogas plant? vi) Do you feel any differences in the air quality before the recent years? All of the interviewed stakeholders have stayed in the areas for more than 5 years but not all of them were aware of the existence of the biogas plant. Although not all of them were aware of the biogas plant, they had confirmed that there were no bad smell from the factory in the recent years and they did not observed any other environmental pollution resulting from the factory. During the on-site 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 no desludging had been carried 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) Use of 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 of the integrity of the pipes was checked. The inspection was recorded in the Quarterly checklist and safety walk through (TBP009) ^{16/} . The filled checklists were checked and it was 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 a quarterly basis by the Biogas Supervisor. These criteria were included in the Quarterly checklist and safety walk through (TBP009) ^{16/} . The filled reports were sighted and it can be confirmed that the checks were carried out in 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 a learning centre about biogas plant.
Means of verification :	From the Visitor Record Log Book and records of photographs taken during the monitoring period, the following were noted: 15/6/2011 - visit by 15 students and 3 teachers from the primary school of Banbanghaen (located near to the mill) 16/3/2011 - visit by 17 villagers from village of Phattaharung 23/3/2011 - visit by villagers from village of Kanchanaburi. 14/7/2012 - visit by students and staff of the Hatyai Commercial College

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, 6 new vacancies have been created and filled (1 Biogas Supervisor, 4 technicians and 1 general worker) to operate and maintain the biogas plant. During this period, two new staffs were appointed following the resignation of previous staff: • one technician (Mr. Treepob – confirmation on 30/9/2012 and • one new general worker (Mr. Soontorn – confirmation on 20/9/2012.) The payroll for the employees for the period from Jan 2011 to December 2012 was provided which confirmed that there were 6 employees for the biogas plant. Training on the operation of the biogas plant was also provided. This was evident from the training records.

ID No. :	GS 9
Data/parameter:	New legislation mandating biogas plants.
Data unit:	-
Description:	Confirm there are no new legislations that mandate methane recovery from wastewater treatment plant in agro-processing plants through confirmation from relevant government authority.
Means of verification :	Confirmation from the Deputy Executive Director, Thailand Greenhouse Gas Management Organization dated 26 February 2013 ^{/71/} was obtained. It was confirmed that since March 2008 there has been no new legislation development that mandated methane recovery from wastewater treatment for agro-processing plants in Thailand.

ID No. :	GS 10		
Data/parameter:	Minimum 65% of biogas used for energy purposes		
Data unit:	%		
Description:	Continuously monitor biogas 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:		
		2011	2012
	Amount of biogas flared	1,653,359.6 Nm ³	1,207,109.7 Nm ³
	Amount of biogas combusted in gas engines	8,019,685.6 Nm ³	7,278,548.3 Nm ³
	Total flare + gas engines	9,673,045 Nm ³	8,485,658 Nm ³
	% of biogas sent to gas engine	83%	86%
	From the data above, it was confirmed that the percentage of biogas used for energy purpose was more than stipulated minimum of 65%.		

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 21 January 2013 ^{/72/} , confirmed that the sources of land for new oil palm in year 2010 – 2012 was due to the conversion of the rubber plantations, fruit

	orchards, empty land and former rice farms. No primary forests had been cleared for the expansion of oil palm. plantations.
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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 June 2013. The certificate no. is TNI-RSPO-F-1311 and is valid until 2 June 2018. The initial certification audit by the Tuv Nord's auditors was carried out in October 2012.

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 plant;
- Default values determined during the validation period;
- Data provided by internal and third party laboratory report;

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

$Q_{y,ww}$	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. 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_CH ₄	21	tCO ₂ /CH ₄	PDD page 24
$B_{0,ww}$	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^{/13/} - Third party laboratory report^{/14/}
COD _{y,ww,untreated}	As in Excel spreadsheet	Tonnes/ m ³	- Internal Wastewater Analysis Report^{/13/} - Third party laboratory report^{/14/}

Emission reductions calculations:

In accordance with paragraph 34 of AMS.III.H version 9^{/4/},

'... 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^{5/}.

'...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' (tCO₂e)

BE_y total baseline emission in year 'y'(tCO₂e)

PE_y total project activity emissions in the year 'y' (tCO₂e)

$MD_{y,combustion}$ Baseline methane emissions destroyed through combustion for energy production or flaring (tCO₂e)

$BE_{elec,y}$ Baseline emissions from displaced electricity from grid (tCO₂e)

PE_{flare} Project emissions from flaring (tCO₂e)

$PE_{wastewater}$ Project emissions from wastewater treatment (tCO₂e)

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 (Nm³)

F_{CH_4} Fraction of methane in the biogas

ρ_{CH_4} Density of methane at normal conditions (kg/Nm³)

GWP_{CH_4} Global warming potential for CH₄

The $MD_{y,combustion}$ for each vintage year was calculated as follow :

	01/1/2011 – 31/12/2011	01/1/2012 – 31/12/2012	Total
$MD_{y,combustion}$	84,170.25 tCO ₂ e	73,680.01 tCO ₂ e	157,850.26 tCO ₂ e

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 (kgCO₂e/kWh)

The $BE_{elec,y}$ for each vintage year is as follows:

	01/1/2011 – 31/12/2011	01/1/2012 – 31/12/2012
$BE_{elec,y}$	7,537.13 tCO ₂ e	6,847.00 tCO ₂ e

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' (tCO₂e). The electricity consumption of project has been accounted in baseline calculations of net electricity.

$PE_{y,ww,treated}$ Emissions from degradable organic carbon in treated wastewater in year 'y' (tCO₂e)

$PE_{y,s,final}$ Emissions from anaerobic decay of the final sludge produced in the year 'y' (tCO₂e).

$PE_{y,fugitive}$ Emissions from methane release in capture and flare systems in year 'y' (tCO₂e)

$PE_{y,dissolved}$ 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 (Nm³/year)

ρ_{CH_4} Density of methane at normal conditions (kg/Nm³)

η_{flare} flare efficiency

GWP_{CH_4} Global warming potential for CH₄

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, $PE_{y,ww,treated}$, $PE_{y,s,final}$, $PE_{y,fugitive}$, and $PE_{y,dissolved}$ 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:

	01/1/2011 – 31/12/2011	01/1/2012 – 31/12/2012
PE_{flare}	8,925.58 tCO ₂	7,234.12 tCO ₂
$PE_{y,ww,treated}$	2,643.27 tCO ₂ e	3,450.57 tCO ₂ e
$PE_{y,fugitive}$	9,018.63 tCO ₂ e	8,692.55 tCO ₂ e
$PE_{y,dissolved}$	611.32 tCO ₂ e	583.94 tCO ₂ e
PE_y	21,198.79 tCO₂e	19,961.17 tCO₂e

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	01/1/2012 – 31/12/2012
Baseline emissions (= $MD_{y,combustion}$)	84,170.00 tCO ₂ e	73,680.00 tCO ₂ e
Project emissions (= PE_y)	21,198.79 tCO ₂ e	19,961.17 tCO ₂ e
Emission reduction (rounded value)	62,971.00 tCO ₂ e	53,719.00 tCO ₂ e
Emissions reduction as per PDD	56,314.00 tCO ₂ e	

In 2011, the emissions reductions under AMS III.H had exceeded the small scale CDM project threshold value of 60,000tCO₂e. PP had provided the reasons for the increase which was mainly due to more FFB processed during that year. The mill capacity was confirmed to be the same as the baseline and the project design itself has not changed. Thus, in accordance with the revised PDD^{3/}, The emissions reduction under this methodology is capped at the PDD level of 56,314 tCO₂e. This approach has been accepted as it is considered as conservative.

Emissions reduction under AMS I.D

	01/1/2011 – 31/12/2011	01/1/2012 – 31/12/2012
Baseline emissions ($BE_{elec,y}$)	7,537.13 tCO ₂ e	6,847.00 tCO ₂ e
Project emissions	0 tCO ₂ e	0 tCO ₂ e
Emission reductions (rounded value)	7,537.00 tCO ₂ e	6,847.00 tCO ₂ e

Hence, the total emissions reduction is as follow:

	01/1/2011 – 31/12/2011	01/1/2012 – 31/12/2012
Emissions reduction AMS III.H	56,314.00 tCO ₂ e	53,719.00 tCO ₂ e
Emissions reduction I.D	7,537.00 tCO ₂ e	6,847.00 tCO ₂ e
Total emissions reduction for the project activity by year	63,851.00 tCO ₂ e	60,566.00 tCO ₂ e
Total emissions reduction for the whole monitoring period	124,417 tCO ₂ e	

The total emissions reduction for this monitoring period has been determined as 124,417 tCO₂e. The formulae in the spreadsheets^{/67/} 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 to measure $Q_{\text{biogas, total, y}}$	S/N 5814	28/2/2009 ^{/18/} , and 13/01/2011 ^{/19/}	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 to measure P_{biogas}	S/N 800238600 01	30/09/2009 ^{/62/} , 07/02/2011 ^{/62/} , and 07/03/2012 ^{/62/}	Every 2 years	- A Honeywell STD924 pressure transducer identified by PP as PI60 installed on line at the biogas pipeline next to the thermocouple. - This meter was installed on 11/8/2009. - The calibration frequency is as per manufacturer's recommendation.

3)	Thermocouple used to measure T_{biogas}	S/N N0185334	08/10/2010 ^{/63/} and 07/03/2012 ^{/63/}	Once a year	- N type thermocouple 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 08/10/2011 to 06/03/2012. However, since the data from FI60 is not in used in the calculation of the ER, the error application is not applicable.
2)	Biogas flow meter 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) S/N 5812 (for biogas engine no.3)	28/2/2009 ^{/20/} , 13/01/2011 ^{/21/} and 06/03/2012 ^{/22/} 28/2/2009 ^{/23/} , 13/01/2011 ^{/24/} and 06/03/2012 ^{/25/} 28/2/2009 ^{/26/} , 13/01/2011 ^{/27/} and 06/03/2012 ^{/28/}	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 - Recalibration was carried out by PTT Public Co Ltd
3)	Pressure transducers for normalisation of $Q_{\text{biogas, engine,y}}$	S/N.260TU TO (PI61) for biogas engine no. 1 S/N.206313 5 (PI62) for biogas engine no. 2 S/N.260SU OX (PI63) for biogas	07/10/2010 ^{/29/} and 07/03/2012 ^{/30/} 07/10/2010 ^{/29/} and 07/03/2012 ^{/30/} 07/10/2010 ^{/29/} and 07/03/2012 ^{/30/}	Every 2 years	- All of the pressure transducers are of Kobold brand, model SEN3251 - The calibration frequency is as defined by the manufacturer. - No delay in calibration was found.

		engine no. 3			
4)	Temperature sensors for normalisation of Q_{biogas} , engine,y	S/N.N0851.965110 (TI61) for biogas engine no. 1	07/10/2010 ^{/31/} and 07/03/2012 ^{/32/}	Once per 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 07/10/2011 to 07/03/2012. In accordance with para 273 of the VVS^{/1/} PP had applied the maximum permissible error (MPE) of the sensor to the measured values. The method used was also in accordance with the manufacturer's recommendation.
		S/N.N0851.965113 (TI62) for biogas engine no. 2	07/10/2010 ^{/31/} and 07/03/2012 ^{/32/}		
		S/N. N0851.965101 (TI63) for biogas engine no. 3	07/10/2010 ^{/31/} and 07/03/2012 ^{/32/}		
5)	Biogas flow meter to measure Q_{biogas} , flare,y	S/N 5815	28/2/2009 ^{/41/} , 04/11/2010 ^{/42/} and 06/03/2012 ^{/43/}	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.
6)	Pressure transducer for normalisation of Q_{biogas} , flare,y	S/N.260TU T1	08/10/2010 ^{/44/} and 07/03/2012 ^{/45/}	Every 2 years	- Pressure transmitter (PI64) is of brand Kobold SEN3251. - The calibration frequency is recommended calibration by Kobold - No delay in calibration during this monitoring period.
7)	Temperature sensor for normalisation of Q_{biogas} , flare,y	S/N. N0906.979554	07/10/2010 ^{/46/} and 06/03/2012 ^{/47/}	Once per year	- Temperature sensor is of brand Kobold TWD-B9410213T - Calibration frequency is as recommended by Kobold. - There was a delay in calibration during the period from 07/10/2011 to 06/03/2012. During

					this period, PP had applied the MPE of the sensor to the measured values. The method used was also in accordance with the manufacturer's recommendation. During the verification, CL 10 was raised on the application of the MPE. Details of the findings and the resolutions are as in Annex 1 of this report.
8)	Methane analyser to measure fraction of methane in biogas F _{CH4}	S/N.10034 A4-203 (analyser at the biogas plant)	24/11/2010 ^{/48/} , 30/11/2011 ^{/49/} and 19/12/2012 ^{/50/}	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 - Delay in calibration was observed during the period from 24/11/2011 to 29/11/2011 and from 30/11/2012 to 18/12/2012. During this period, PP had applied the maximum permissible error of the sensor as specified in the equipment specification. - CAR 4 was raised as the MPE applied was wrong. Details of the findings and the resolutions are as in Annex 1 of this report.

		S/N.29196 (at gas engine no. 1)	24/11/2010 ^{/51/} , 30/11/2011 ^{/52/} and 19/12/2012 ^{/53/}	Once a year	• Brand JE • Calibration frequency was defined by the PP as the supplier had not defined such requirement. • There was a delay in calibration from 24/11/2011 to 30/11/2011 and from 30/11/2012 to 18/12/2012. However, for November 2011, all of the CH₄ data were from the main analyser. For second delayed period, data from these analysers were used as there was problem in the main analyser. • During this period, PP had applied the maximum permissible error of the analyser which was based on the measured error. • CL 7 was raised on the issues relating to the application of the MPE. Details of the findings and the resolutions are as in Annex 1 of this report.
		S/N. 28961 (gas engine no. 2)	24/11/2010 ^{/51/} , 30/11/2011 ^{/52/} and 19/12/2012 ^{/53/}		
		S/N.27894 (gas engine no.3)	25/11/2010 ^{/54/} , 02/08/2011 ^{/55/} and 19/12/2012 ^{/56/}		
9)	COD meter to measure COD _{y,ww,treated,j} , COD _{y,ww,untreated}	S/N. 1275172	11/2/2010 ^{/57/} , 27/01/2011 ^{/57/} and 27/01/2012 ^{/57/}		• 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.
10)	Flowmeter to measure Q _{y,ww}	S/N 265044	18/02/2009 ^{/58/} , 12/01/2011 ^{/59/} and 07/03/2012 ^{/59/}	Every 2 years	• Magnetic flow meter Brand Kobold with accuracy class of is±0.3 • Calibration frequency is as recommended by

					Kobold Recalibration was carried out by Science Magic Grow Co. Ltd.
11)	Other flare operation parameters – flame detector	-	-	-	- Flame ionization detector (FID) was installed at the flare system to detect the flame. The FID was linked to data logger - No calibration required but the checking on the functionality of the detector was carried out by the Biogas Supervisor on a quarterly basis and the results were recorded in the Quarterly Parameter Report (LBP009).
12)	Flowmeter to measure sludge remove $S_{y,final}$	S/N265047	23/02/2009 ^{/60/} , 12/01/2011 ^{/61/} and 07/03/3012 ^{/61/}	Every 2 years	- Kobold magnetic flow meter with accuracy class of ± 0.3 - Calibration frequency is recommended by Kobold - Recalibration was carried out by Science Magic Grow Co.Ltd.
13)	Power meters to measure EL_{grid}	EDMI Genius S/N 206500246 (old meter)	08/05/2007 ^{/39/}	Every 3 years	- This power meter is owned by PEA, and was installed on 28/7/2009 and used until 30 March 2011 - There was a delay in calibration from 1/1/2011 to 30/03/2011 - During this period, PP had applied the maximum permissible error of the meter which was based on the equipment specification. - CL 8 was raised on the calibration frequency of this meter. Details of the findings are as in Annex 1 of this report.
		EDMI Genius S/N206500 216	03/09/2012 ^{/40/}		This is a temporary power meter installed by PEA after the flood. This meter was used

		(M5 temporary meter)			temporarily from 10 April 2011 to 31 May 2011. - During the verification, there was no information on the calibration of this power meter prior to its use. - Calibration was only provided by PEA on 03/09/2012. - CL 8 was raised on the application of maximum permissible error which was not evident during the on-site. Details of the findings and the resolutions are as in Annex 1 of this report.
		EDMI Genius S/N202008 352 (new meter)	11/05/2011 ^{/36/} , 14/12/2011 ^{/37/} and 28/11/2012 ^{/38/}	Every 3 years	- Installed on 1 June 2011 - Calibration was carried out by PEA
14)		S/N 4A9515d5 (M7)	07/01/2011 ^{/33/} , 14/12/2011 ^{/34/} and 27/11/2012 ^{/35/}	Once a year	- The power meter brand Schneider Electric PowerLogic was used during this monitoring period - 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 2011 and 31 December 2012. The crediting period for this project is from 1 October 2009 to 30 September 2016 (renewable).

The verification was based on the approved registered PDD^{/2/} and revised PDD^{/3/}, the approved methodology, AMS III.H.- Methane recovery in wastewater treatment, version 9^{/4/} and AMS I.D. – Grid connected renewable electricity generation version 13^{/5/}, the Monitoring Reports^{/7/}^{/66/}, the registered Gold Standard Annex^{/69/}, Gold Standard Monitoring Report Annex^{/70/}, emissions reduction calculation spreadsheets^{/8/}^{/67/}, 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 2011 and 31 December 2012 and on the calculation of GHG emission reductions from the project based on the verified emissions for the same period.

The verification was carried out in accordance with the requirements of the Validation and Verification Standard^{/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^{/3/};

- 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^{/66/} (version 4, dated 20 May 2014) 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 2011 and 31 December 2012 stated in the latest revised monitoring report^{/66/} 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:

	01/1/2011 – 31/12/2011	01/1/2012 – 31/12/2012
Emissions reduction AMS III.H	56,314.00 tCO ₂ e	53,719.00 tCO ₂ e
Emissions reduction I.D	7,537.00 tCO ₂ e	6,847.00 tCO ₂ e
Total emissions reduction for the project activity by year	63,851.00 tCO ₂ e	60,566.00 tCO ₂ e
Total emissions reduction for monitoring period (rounded value)	124,417 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 6.0)
- /2/ Registered PDD, version 5.1, dated 4/6/09
- /3/ Revised PDD version 006, approved on 18/2/2014
- /4/ AMS III.H.- Methane recovery in wastewater treatment,version 9
- /5/ AMS I.D. – Grid connected renewable electricity generation version 13
- /6/ Verification Report (SQAS-CDM-EU02350001) Revision 4
- /7/ Monitoring Report version 1, October 2013
- /8/ UNIV TOPI ER Calculation version 1, October 2013
- /9/ UNIV TOPI Flare Tool spreadsheet version 1, October 2013
- /10/ Summary of flow meter setting and the mathematical setting for the normalisation for Kobold equipment, ST Control Co. Ltd.
- /11/ TOPI Biogas Project – Covered Lagoon Report (TBP005)
- /12/ SOP for COD sampling and analysis procedure
- /13/ Wastewater analysis reports TBP003
- /14/ COD report by Saint Envir Co.,Ltd
- /15/ Genset Data Report Checksheet
- /16/ TOPI Biogas quarterly checklist and safety walk through (TBP009)
- /17/ Daily Electricity Meter Record Form TBP004_1
- /18/ Calibration report for oscillator flow meter S/N 5814 (FI60) dated 28/2/2009 by PTT Public Company Limited
- /19/ Calibration report for oscillator flow meter S/N 5814 (FI60) dated 13/01/2011 by PTT Public Company Limited
- /20/ Calibration report for oscillator flow meter S/N 5813 (FI61) dated 28/2/2009 by PTT Public Company Limited
- /21/ Calibration report for oscillator flow meter S/N 5813 (FI61) dated 13/01/2011 by PTT Public Company Limited
- /22/ Calibration report for oscillator flow meter S/N 5813 (FI61) dated 06/03/2012 by PTT Public Company Limited
- /23/ Calibration report for oscillator flow meter S/N 5811 (FI62) dated 28/2/2009 by PTT Public Company Limited
- /24/ Calibration report for oscillator flow meter S/N 5811 (FI62) dated 13/01/2011 by PTT Public Company Limited
- /25/ Calibration report for oscillator flow meter S/N 5811 (FI62) dated 06/03/2012 by PTT Public Company Limited
- /26/ Calibration report for oscillator flow meter S/N 5812 (FI63) dated 28/2/2009 by PTT Public Company Limited
- /27/ Calibration report for oscillator flow meter S/N 5812 (FI63) dated 13/01/2011 by PTT Public Company Limited
- /28/ Calibration report for oscillator flow meter S/N 5812 (FI63) dated 06/03/2012 by PTT Public Company Limited
- /29/ Calibration reports for pressure transducers S/N.260TUTO (PI61), S/N.2063135 (PI62) and

- S/N.260SUOX (PI63) dated 07/10/2010 by Science Magic Grow Co. Ltd.
- /30/ 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.
- /31/ Calibration reports for temperature sensors S/N.N0851.965110 (TI61), S/N.N0851.965113 (TI62) and S/N. N0851.965101 (TI63) dated 14/10/2010 by Science Magic Grow Co. Ltd.
- /32/ 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.
- /33/ Field Inspection and Test Report by PEA for M7 power meter dated 07/01/2011
- /34/ Field Inspection and Test Report by PEA for M7 power meter dated 14/12/2011
- /35/ Field Inspection and Test Report by PEA for M7 power meter dated 27/11/2012
- /36/ PEA Tested Report Energy Meter for M5 power meter dated 11/05/2011
- /37/ PEA Tested Report Energy Meter by for M5 power meter dated 14/12/2011
- /38/ PEA Tested Report Energy Meter for M5 power meter dated 28/11/2012
- /39/ PEA Tested Report Energy Meter for S/N 206500246 power meter dated 08/05/200 7
- /40/ PEA Tested Report Energy Meter for S/N206500216 power meter dated 03/09/2012
- /41/ KOBOLD Calibration report for oscillator flow meter S/N 5815 (FI64) dated 28/2/2009
- /42/ Calibration report for oscillator flow meter S/N 5815 (FI64) dated 04/11/2010 by PTT Public Company Limited
- /43/ Calibration report for oscillator flow meter S/N 5815 (FI64) dated 06/03/2012 by PTT Public Company Limited
- /44/ Certificate of calibration for pressure transmitter S/N 260TUT1(PI64) dated 08/10/2010 by Science Magic Grow Co. Ltd.
- /45/ Certificate of calibration for pressure transmitter S/N 260TUT1(PI64) dated 14/03/2012 by Science Magic Grow Co. Ltd.
- /46/ Certificate of calibration for temperature transmitter with probe S/N N0906.979554 (TI64) dated 07/10/2010 by Science Magic Grow Co. Ltd.
- /47/ Certificate of calibration for temperature transmitter with probe S/N N0906.979554 (TI64) dated 14/03/2012 by Science Magic Grow Co. Ltd.
- /48/ Calibration certificate for CH4 gas analyser S/N 10034A4-203 dated 24/11/10 by Entech Associate Co. Ltd.
- /49/ Calibration certificate for CH4 gas analyser S/N 10034A4-203 dated 30/11/2011 by Entech Associate Co. Ltd.
- /50/ Calibration certificate for CH4 gas analyser S/N 10034A4-203 dated 19/12/2012 by Entech Associate Co. Ltd.
- /51/ Calibration certificates for CH4 gas analyser S/N.29196 & S/N. 28961 dated 24/11/2010 by Entech Associate Co. Ltd.
- /52/ Calibration certificates for CH4 gas analyser S/N.29196 & S/N. 28961 dated 30/11/2011 by Entech Associate Co. Ltd.
- /53/ Calibration certificate for CH4 gas analyser S/N.29196 & S/N. 28961 dated 19/12/2012 by Entech Associate Co. Ltd.
- /54/ Calibration certificate for CH4 gas analyser S/N.27894 dated 25/11/2010 by Entech Associate Co. Ltd.
- /55/ Calibration certificate for CH4 gas analyser S/N.27894 dated 02/08/2011 by Entech Associate Co. Ltd.
- /56/ Calibration certificate for CH4 gas analyser S/N.27894 dated 19/12/2012 by Entech Associate Co. Ltd.
- /57/ Certificates of calibration for HACH Meter 1275172,dated 11/2/2010, 27/01/2011 and 27/01/2012 by Bangkok Lab Co Ltd
- /58/ KOBOLD Calibration report for magnetic flow meter S/N 265044 (FI01) dated 18/2/2009

- /59/ Calibration reports by Science Magic Grow Co. Ltd. for magnetic flow meter S/N 265044 (FI01) dated 19/01/2011 & 19/03/2012
- /60/ KOBOLD Calibration report for magnetic flow meter S/N 265047 dated 23/02/2009
- /61/ Calibration reports by Science Magic Grow Co. Ltd. for magnetic flow meter S/N 265047 dated 19/01/2011 & 07/03/2012
- /62/ Honeywell STD924 S/N80023860001 calibration reports dated 30/09/2009, 21/02/2011 and 14/03/2012.
- /63/ Certificate of calibration for thermocouple S/N N0185334 dated 08/10/2010 and 14/03/2012 by Science Magic Grow Co. Ltd.
- /64/ Manufacturer specification for Oscillation Flow Meter for Gases
- /65/ PowerLogic meters specification (Digital Power Meter) by Schneider Electric
- /66/ Monitoring Report version 4 dated 20/05/2014
- /67/ UNV TOPI ER calculation version 3.2
- /68/ UNV TOPI flare tool Excel spreadsheet version 2
- /69/ Registered Gold Standard Annex
- /70/ Gold Standard Monitoring Report Annex Version 2.July 2014
- /71/ Letter from Thailand Greenhouse Gas Management Organization dated 26 February 2013
- /72/ Letter from Krabi Agriculture Office dated 21 January 2013
- /73/ RSPO certificate TNI-RSPO-F-1311 by TuV Nord (Indonesia)

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ANNEX 1
VERIFICATION PROTOCOL
REPORT NO: SQAS-GS-EU02350009

SIRIM QAS INTERNATIONAL SDN BHD

Verification checklist

Project name : Univanich TOPI Biogas Project
Monitoring Period No. 2 :1/01/2011 – 31/12/2012

TABLE 1: VERIFICATION REQUIREMENTS BASED ON CDM VALIDATION AND VERIFICATION STANDARD VERSION 5.0

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
1. Compliance of the project implementation with the registered project design document					
1.1 Was an on-site visit conducted for this verification? If no, please justify the rationale of the decision.	VVS	227	On-site audit to the project site was carried out by Aminah, on 30-31/10/2013	OK	OK
1.2 Are all physical features of the CDM project activity proposed in the registered PDD in place?	VVS	227	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	227 & 230	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.	OK	OK
1.4 For this monitoring period, what is the status of the implementation of the project? For project activities that consist of more than one site, the DOE shall describe the status of implementation and starting date of operation for each site.	VVS	228 (a)	The project is only at one site.i.e. at the Univanich TOPI Factory (a palm oil mill).	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	228 (a)	There is no phase implementation.	OK	OK
1.5 Describe the actual operation of the project activity.	VVS	228 (b)	Project activity consisted of one unit of covered lagoon CIGAR (60,000m ³), 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
Any information (data and variables) provided in the monitoring report that is different from that stated in the registered PDD or any approved revised PDD? (that has caused an increase in estimates of the emission reductions in the current monitoring period or is highly likely to increase the estimates of emission reductions in the future monitoring)	VVS	228 (c)	The amount of POME in the PDD was based on estimation from the FFB processed and the effluent conversion factor which was based on test carried out for one month at other Univanich palm oil mill. It was not continuously measured. In the project implementation, there is a flowmeter installed to measure the POME generation. The data recorded from this flowmeter showed higher amount of POME generated as compared to that in the ex-ante estimation. Hence, more biogas was produced and more electricity has been generated and sold to the grid. The amount of FFB processed and the mill operation hours was checked and found that the mill was operating under normal condition (i.e. no increase in production capacity). Due to the increase in POME discharge, more biogas was produced and more electricity was generated and sold to the grid. With this reason, the actual ER was higher than the ex-ante value. However, for year 2011, the amount of ER generated under the AMS III-H has exceeded the small scale CDM threshold value of 60ktonnes/year.	CAR 1	OK
2. Compliance of the monitoring plan with the monitoring methodology including applicable tool(s) The monitoring plan of the proposed CDM project activity shall comply with the applied methodology.					

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
2.1 For monitoring aspects that are not specified in the methodology, particularly in the case of small-scale methodologies (e.g. additional monitoring parameters, monitoring frequency and calibration frequency), these should be brought to the attention of the Board issues which may enhance the level of accuracy and completeness of the monitoring plan.	VVS	231	No such situation occurred.	OK	OK
2.1 Is the monitoring plan of the CDM project activity complying with the methodology applied by the registered CDM project activity or an approved revised PDD?	VVS	232	Yes, all of the requirement in AMS III.H version 9 and AMS I.D version 13.	OK	OK
3. Compliance of monitoring activities with the registered monitoring plan. Determine whether the monitoring of parameters related to the GHG emissions reductions in the project activity has been implemented in accordance with the monitoring plan contained in the registered PDD or any accepted revised monitoring plan.					
3.1 Has the monitoring plan been properly implemented and followed by the project participants?	VVS	234 (a)	Yes, the monitoring plan has been implemented and followed by the PP.	OK	OK
3.2 Have all parameters stated in the monitoring plan, and relevant CDM Executive Board decisions been sufficiently monitored and updated as applicable, including:	VVS	234 (b)			

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
i) project emission parameters			i) Volume of wastewater ($Q_{y,ww}$) - Measured continuously using magnetic flow meter identified as FI01 (S/N 265044) - The flow meter 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 - Verification of the data in the spreadsheet revealed that from 16 Jan 2011 until 18 Jan 2011, the total POME flow to CIGAR was 6976m³ which was too large amount for two days flow. From the data available, it can be seen that the normal total flowrate was less than 1000m³/day - Verification of data also revealed that during the period from 8/6/2012 (20:00) to 12/6/2012 (23:00) there was FFB processed, but there was no wastewater recorded.	CL-1	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.		

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			- 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 (TBP003). - External lab results were also included in the spreadsheets. - In the TOPI Biogas ER spreadsheet, this parameter was labelled as COD_{input} and not COD_{y,ww,untreated} - From the spreadsheet, it was found that for the month of March and April 2012 there were no internal COD data available and there was no remark provided. - For the data from external lab, the value for 1/10/2011 (0.037tCOD/m³) and 7/5/2012 (0.0172tCOD/m³) the values were considered abnormal as they were not within the typical POME concentration for COD.	CL2	OK
			iii) 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.		

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			- 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 (TBP003). - In the TOPI Biogas ER spreadsheet, the COD is labelled as COD_{output} instead of COD_{y,ww,treated} - In the spreadsheet, there was no COD data for the month of April 2012 and no remark provided. - For external results, no data transfer was found.	CL-3	OK
			iv) Sludge application - There was no sludge removed from the project activity during this monitoring period. - A flow meter (FI02) has been installed to monitor the amount of sludge remove. From the on-site visit it was confirmed that there is no flowmeter reading since there has been no desludging activities been carried out since the commissioning of the project activity. - Interview with the technician also confirmed no desludging was carried out. - A ‘sludge removal report’ template has been established to ensure that the information on desludging is recorded. - 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.	OK	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			v) Other flame operation parameters – flame detector - The open flare system is equipped with a flame ionization detector 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. - Verification of data from the data logger revealed that occasionally, there was voltage recorded >0 but <5 and was considered as flame 'on'. This needs to be clarified to whether during this situation, the flame is functioning or not.	OK	OK
				GL-4	OK
			vi) Other flame operation parameters – pressure biogas at flare - On-site visit to the flare system confirmed that there is a pressure gauge at the biogas pipeline going to the flare system. - At the site, the pressure gauge is label as PG64 instead of PGI01 (as in the Monitoring Report). The existence of the gauge also not included in the 'Diagram showing monitoring equipment' of the MR - The on-site visit also confirmed that there was a calibration tagging by Miracle International Technology to indicate that t calibration to the gauge was carried out on 18 July 2011. However, this has not been reflected in the MR (which only included the calibration of PI64). - The values of monitored parameter as reported in the MR were found not consistent with that recorded in the Quarterly Checklist TBP009.	CAR-2	OK
				CAR-2	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			vii) Other flame operation parameters – flowrate of biogas at flare - A continuous oscillator flow meter labelled as FI64 (maker – Kobold) was available at the flare inlet (this is the same flow meter used to monitor the amount of biogas recovered and flared). - The meter is recording the flowrate in m³/hr and converted to total quantity of biogas Nm³ in the data logger.	OK	OK
ii) baseline emission parameters			i) $Q_{\text{biogas, total, y}}$ - 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 an hourly basis. - At 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 a dedicated software. - From the spreadsheet, it was noted that there were some low readings e.g. <10m³/hr. PP to check the lowest detection limit of the flowmeter.	CL-5	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			ii) $Q_{\text{biogas,engine,y}}$ - Measured using oscillator biogas flow meters attached to individual biogas engines. The flow meter labelled as FI61 for biogas engine no. 1, FI62 for biogas engine no. 2, and FI63 for biogas engine no. 3. - The flow meters 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 Nm^3 automatically by the data logger. - The information in the data logger was downloaded to Excel ER spreadsheet via a dedicated software. - From the spreadsheet, it can be seen that occasionally, the amount of biogas was too low i.e. $<10\text{Nm}^3$. PP to provide the flow meter specification to confirm the lowest detection level of the equipment.	Refer to CL5	OK
			iii) $Q_{\text{biogas,flare,y}}$ - 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.		

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			- At the same pipeline, pressure transducer and temperature sensor were also installed (labelled as PI64 and TI64). With the P and T measurement of the biogas, the flow meter reading is converted to Nm³ automatically by the data logger. - The information in the data logger was downloaded to Excel ER spreadsheet via a dedicated software. - The flowmeter spec indicated that the maximum flow that can be detected is 3000m³/hr and flare spec indicated that the maximum flow is 1200m³/hr - From the data verification, explanation is required for data on 10/6/2011 (4507Nm³/hr), 29/7/2011(78,137Nm³/hr) and 7/12/2011(1230Nm³/hr).	CL-6	OK
			iv) 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 are 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 methane gas analyser at the biogas plant is linked to data logger no.2 that measured and recorded data on every minute.		

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			- The methane analysers at the gas engine are not linked to any data logger. Data measured from this meter was recorded in 'Genset Data Report Check-sheet' on an hourly basis by the technician. - In the MR, only one methane analyser at the gas engine was included. The other two analysers were not in the MR. - The methane concentration during the following time was giving very low methane concentration 7/1/2011 to 11/1/2011 8/3/2011 10pm to 11pm - The data from the back up methane analysers at the gas engine was in used during the following dates and it has been the practice that CH4 reading from S/N29196 is used first when the gas engine no.1 is in operation, followed with S/N28961 &S/N.27894: 18 Jan 2011 9 - 14 Mar 2011 18 Mar 2011 13 Apr 2011 9 Jun 2011 - 16 Jun 2011 17 Jun 2011 - 27 Jun 2011 27 Apr 2012 - 11 May 2012 23 Sep 2012 - 2 Nov 2012	CL7	OK
			The above dates were indicated in the ER spreadsheet. The use of CH4 reading from gas engine was verified against the Genset Data Report.		

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			• Inconsistency of data was seen between the spreadsheet provided and the Genset Data report for 18 Jan 2011, 13 Apr 2011, 9 Apr 2011, 12 Jun 2011, 17 Jun 2011 2011, 3 May 2012 • PP also needs to be clear at what level of CH4 concentration from the main analyser to be replaced (which provide an abnormal data) with Genset CH4 analyser reading. • On 18/1/2011 and 18/3/2011, there was no remark given why the value from column C was not in used in Column D, although in column C there were values. • During the period from 23 Sep 2012 -2 Nov 2012, data from S/N29196 and S/N28961 was used and due to the delay in calibration, maximum permissible error has been applied to the measured error from these analysers. However, the error was only deducted from the measured error which is only conservative if the data is used for baseline calculation.	GL-7	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			In accordance with AMS I.D., the following parameter is monitored for the baseline : i) EL_{grid} • In accordance with the monitoring plan in the registered PDD, 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 paper every month and transfer the amount to the electronic spreadsheet. PEA invoice records will be used for cross-checked. • The title of this parameter reflected in the Monitoring Report is $EL_{y,project}$. This needs to be made consistent with that in the Monitoring Plan • 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	~~CAR-3~~	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			• M5 recorded the total electricity sold to grid or PEA and M7 recorded electricity consumed by the project activity which were taken from the grid. • Meter reading from M5 and M7 are recorded in Daily Electricity Meter Record (TBP004_1) on daily basis by the biogas technician. Verification of the data in the spreadsheet revealed that for M5 (column I of the spreadsheet) the data is from the PEA invoice and not from TBP004_1 as required by the monitoring plan. Further to that, comparison between the PEA reading and the meter reading recorded in TBP004_1 indicated that the total kWh for year 2012 is lower as compared to that recorded in the PEA invoices.	~~CAR-3~~	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 (new) iii) Ms.Watcharee Kongsan – Biogas Supervisor iv) 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

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			Training records indicated that training on the Biogas safety and plant operations were provided by the KPSR (technology provider) and attended by Mr.Sakol, Ms. Wacharee, Mr.Thaweesak, Mr.Nuthapol, Mr.Songchai and Mr.Soonporn.. 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.		
3.3 Has the equipment used for monitoring is in accordance with section 4 below and is controlled and calibrated in accordance with the monitoring plan, the applied methodology, the Board guidance, local/national standards, or as per the manufacturer's specification?	VVS	234 (c)	The following equipment calibration was verified: i) Flow meter to measure volume of waste water treated $Q_{y,w}$ • Kobold magnetic flow meter with S/N265044 identified as FI01 was installed at POME inlet to the CI-GAR • Accuracy class of the flow meter is ± 0.3 • Calibration: 18/02/2009, 12/01/2011 and 07/03/2012 • Calibration frequency recommended by Kobold is 2 years. • Recalibration was carried out by Science Magic Grow Co.Ltd. ii) COD meter to measure $COD_{y,ww,treated,j}$, $COD_{y,ww,untreated}$ • Spectrophotometer with S/N. 1275172 • Calibration : 11/2/2010, 27/01/2011 and 27/01/2012 by Bangkok Lab Co Ltd • Calibration frequency was not specified by the manufacturer, but PP had decided to calibrate once a year.	OK	OK
				OK	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			iii) Flowmeter to measure sludge remove $S_{y,final}$ • Kobold magnectic flow meter with S/N265044 identified as FI01 was installed at POME inlet to the CI-GAR • Accuracy class of the flow meter is ± 0.3 • Calibration: 23/02/2009, 12/01/2011 and 07/03/3012 • Calibration frequency recommended by Kobold is 2 years. • Recalibration was carried out by Science Magic Grow Co.Ltd. iv) Power meters • Only power meters that were relevant to the project activity was reviewed (i.e. M5 and M7). • M5 power meter (total kWh sold to the grid) • 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 authorise personnel from PEA to take the reading. • Three power meters were used during this monitoring period. In the QA/QC procedures in the MR, it was mentioned that M5 was out of calibration from 1 Jan – 31 May 2011. It was unsure for this mentioned period is for which power meter.	OK	OK
				CL8	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			The first power meter was EDM1 Genius S/N 206500246 - installed on 28/7/2009 and used until 30 March 2011. The power meter was calibrated on 8 May 2007. It has to be made clear why the calibration frequency indicated in the MR for this power meter is 1/year but the validity is 3 years. According to the MR (under the additional comment), there was a delay in calibration from 1 Jan to 30 March 2011. During this period, PP had applied the maximum permissible error of the meter as specified in the equipment specification. This was found to be in accordance with EB52 Annex 60 requirements.	CL-8	OK
			- The second power meter was a temporary power meter from PEA which was installed after the flood. This meter was used temporarily from 10 April 2011 to 31 May 2011. There was no information on the calibration of this power meter. In the MR, the temporary power meter was indicated as borrowed. This needs to be clarified to ensure no confusion. Further to that, it was not seen in the spreadsheet that application of the error to the reading has been done. - A new power meter EDM1 Genius S/N202008352 was installed on 1 June 2011 to replace the temporary meter. The calibration was carried out on 11/05/2011, 14/12/2011 and 28/11/2012.	CL-8	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			- M7 power meter to measure the kWh total biogas use only from PEA - power meter Schneider Electric PowerLogic S/N 4A9515d5 was used during this monitoring period - Calibration was carried out by PEA on 07/01/2011,14/12/2011 and 27/11/2012. - The calibration frequency determined by PP is once a year. There was no calibration carried out prior to 07/01/2011. Hence, for the period from 01/01/2011 to 06/01/2011, PP had applied the maximum permissible error of the sensor as specified in the equipment specification. This was found to be in accordance with EB52 Annex 60 requirements. - However, PP needs to clarify the method of calculation M7 with error which was indicated in column H as “ $((G6*7/31) + ((G6*7/31)*0.01)) + (G6*(31-7)/31)$” - The end date of the penalty indicated in the MR was 07/01/2011 instead of 06/01/2011.	OK	OK
				~~CL-9~~	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			v) Biogas flow meter to measure $Q_{\text{biogas, engine},y}$ • Each biogas engine is equipped with one flow meter, FI61 for gas engine no.1, FI62 for gas engine no. 2 and FI63 for gas engine no.3. • All meters are oscillator flow meter (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 3 years. • All the flow meters were calibrated by PTT Public Co Ltd. on 28/02/2009, 13/01/2011 and 06/03/2012 • All the biogas flow meters are also equipped with pressure and temperature sensors which are used for normalizing the measured volume. • All the pressure transducers are of brand Kobold SEN-3251. The recommended calibration frequency by the supplier is 2 years. Calibration was carried out on 07/10/2010 and 07/03/2012. • All the temperature sensors are of brand Kobold TWD-B9410213T and the recommended calibration for the sensor is 1/year. Calibrations for the sensors were carried out on 07/10/2010 and 07/03/2012. • Recalibration was delayed for all the temperature sensors from 07/10/2011 to 07/03/2012. During this period, PP had applied the maximum permissible error of the sensor as specified in the equipment specification. This was found to be in accordance with EB52 Annex 60 requirements. The method of adjustment of the data is in accordance with the manufacturer's recommendation.	OK	OK
				OK	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			vi) Biogas flow meter to measure $Q_{\text{biogas, flare,y}}$ and flowrate of biogas at flare • Oscillator flow meter (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 on 28/2/2009, 04/11/2010 and 06/03/2012 • Calibration frequency recommended by Kobold is 3 years. • The biogas flow meter is equipped with pressure transducer (PI64) and temperature sensor(TI64) which are used for normalizing the measured volume. • Pressure transducer (PI64) is of brand Kobold SEN3251. The recommended calibration by Kobold is 2 years. Calibration was carried out on 08/10/2010 and 07/03/2012. • Temperature sensor (TI64) is of brand Kobold TWD-B9410213T and the recommended calibration for the sensor is 1/year. Calibration of the sensor was carried out on 07/10/2010 and 06/03/2012. Recalibration was delayed for all the temperature sensors from 07/10/2011 to 06/03/2012. During this period, PP had	OK	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			• applied the maximum permissible error of the sensor as specified in the equipment specification. This was found to be in accordance with EB52 Annex 60 requirements. The method of adjustment of the data is in accordance with the manufacturer's recommendation. • In the ER spreadsheet, PP had applied the error up to 07/03/2012 instead of 06/03/2012. Also in the Flare tool spreadsheet, it was not seen that the error has been added, as it is used for project emission.	~~CL-10~~	OK
			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 on 24/11/2010 30/11/2011 and 19/12/2012. No recommendation by the manufacturer on the calibration frequency. PP had adopted 1/year. Delay in calibration was observed during the period from 24/11/2011 to 29/11/2011 and from 30/11/2012 to 18/12/2012. During this period, PP had applied the maximum permissible error of the sensor as specified in the equipment specification. However, the error indicated in the equipment specification is 3% instead of that indicated in the MR 2.5%.	~~CAR-4~~	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			- This was found to be in accordance with EB52 Annex 60 requirements. However, in the PE flare spreadsheet, the error was deducted although it is used for project emission calculation. - Methane gas analyser at the biogas engine was used as back up whenever, the main methane analyser at the biogas plant is malfunction. - 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 a delay in calibration from 24/11/2011 to 30/11/2011 and from 30/11/2012 to 18/12/2012. However, during the November 2011, all of the CH4 data were from the main analyser. However, for the second delayed period, data from these analysers was used as there was problem in the main analyser. From the calibration certificate, indicated that the measured error for S/N29196 was -9.1% (spec, $\pm 2.5\%$) S/N28961 & S/N.27894 -2.7% (spec $\pm 2.5\%$). This measured error was higher than the equipment spec error. Hence, when data from this analyser was used an error of 9.1% was included in the data measured and used during the period. However, the error was only deducted from the measured error, and this method is not conservative for the calculation of the project emissions. - The delay in calibration during the period from 30/11/2012 to 18/12/2012 had not been reported in the MR.	CAR-4	OK
				Refer to CL-7	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			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 T160. The meter was installed next to the biogas flow meter FI60. This thermocouple is used for the normalization of the biogas volume. • Calibration of the thermocouple was carried out on 08/10/2010 and 07/03/2012. • No calibration frequency determined by the manufacturer, but PP had decided to carry out 1/year. Delay in calibration was observed from 08/10/2011 to 06/03/2012. • There was a delay in calibration, however, since the data from FI60 is not in used in the calculation of the ER, the error application is not applicable.	OK	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
			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 30/09/2009, 07/02/2011 and 07/03/2012. - The calibration frequency is as per manufacturer recommendation.	OK	OK
			xi) Pressure gauge to measure pressure of biogas at flare There was no calibration information on PG64 included in the monitoring report.	Refer to CAR-2	OK
			xii) Biogas flow meter to measure $Q_{\text{biogas, total,y}}$ - Oscillator flow meter (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 on 28/02/2009 and 13/01/2011 - Calibration frequency recommended by Kobold is 3 years.	OK	OK
3.4 Are monitoring results consistently recorded as per approved frequency?	VVS	234 (d)	Most of the monitoring results have been consistently recorded as per approved frequency except for the COD.	Refer to CL-2	OK
3.5 Have quality assurance and quality control procedures been applied in accordance with the monitoring plan or revised monitoring plan?	VVS	234 (e)	Yes, the QA and QC procedures have been implemented as planned.	OK	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
4. Compliance with the calibration frequency requirements for measuring instruments. Determine whether the calibration of those measuring equipments that have an impact on the claimed emission reductions is conducted by the project participants at a frequency specified in the applied monitoring methodology and/or the monitoring plan.					
4.1 Identify if there is any monitoring equipment not calibrated in accordance with the monitoring plan, the applied methodology, the Board guidance, local/national standards, or as per the manufacturer's specification?	VVS	238	The calibration of the measuring equipment was verified and as explained in section 3.3. of the protocol there were several occasions 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

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
4.2 If there is delayed and the calibration has been implemented after the monitoring period in consideration (i.e.the results of delayed calibration are available), has the following conservative approach adopted in the calculation of emission reductions: (a) Applying the maximum permissible error of the instrument to the measured values taken during the period between the scheduled date of calibration and the actual date of calibration, if the results of the delayed calibration do not show any errors in the measuring equipment, or if the error is smaller than the maximum permissible error; or (b) Applying the error identified in the delayed calibration test, if the error is beyond the maximum permissible error of the measuring equipment.	VVS	238	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) Power meter M5 and M7 iii) Temperature sensor for measurement of biogas to flare TI64 iv) Methane analyser OLCTR IR During the application of the errors, there were some clarifications raised on these issues.	Refer to CAP 4, CL7, 8, 9, and 10	OK
4.3 Confirm that the error has been applied: (a) In a conservative manner, such that the adjusted measured values of the delayed calibration shall result in fewer claimed emission reductions; (b) For all measured values taken during the period between the scheduled date of calibration and the actual date of calibration.	VVS	239	Yes, it can be confirmed that the error has been applied. However, there were some clarifications raised on these issues.	Refer to CAP 4, CL7, 8, 9, and 10	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
4.4 In cases where the results of the delayed calibration are not available, or the calibration has not been conducted at the time of verification, the verification team, prior to finalizing verification, shall request the project participants to conduct the required calibration and shall determine whether the project participants have calculated the emission reductions conservatively using the approach mentioned in paragraph 4.3 above.	VVS	240	No such situation found.	OK	
4.5 In cases where the verification team determines that it is not possible for the project participants to conduct the calibration at a frequency specified by either the applied methodology, guidance provided by the Board, and/or the registered monitoring plan due to reasons beyond the control of project participants (For example, due to the contractual terms between the project participant and purchasing/selling entities), the verification team, shall follow the requirements for post registration changes in section of E of the VVS.	VVS	241	No such situation found.	OK	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
4.6 In cases where neither the monitoring methodology nor the monitoring plan specify any requirements for calibration frequency for measuring equipments, the verification team shall determine whether the equipments are calibrated either in accordance with the specifications of the local/national standards, or as per the manufacturer's specification. If neither local/national standards nor the manufacturer's specification are available, international standards may be used. Refer to appendix 1 of the VVS for an illustrative example to apply the above requirements.	VVS	242	Calibration frequency is mainly following the recommendation by the supplier. 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 approved methodology.					
5.1 Is a complete set of data for the specified monitoring period is available?	VVS	245 (a)	Yes, all data as required by the methodology and PDD were available.	OK	OK

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
5.2 If only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, the verification team shall raise a CAR for the project participants to comply with the requirements of Appendix 1 of the Project Standard or submit a request for deviation prior to submitting the request for issuance, if appropriate;	VVS	245 (a)	No such situation was found.		
5.3 Has information provided in the monitoring report been crosschecked with other sources such as plant log books, inventories, purchase records, laboratory analysis?	VVS	245 (b)	Yes, the information in the monitoring report has been crosschecked with the various log sheets and reports. The following were verified: • Waste water 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

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
5.4 Have calculations of baseline emissions, proposed CDM project activity emissions and leakage, as appropriate, been carried out in accordance with the formulae and methods described in the monitoring plan and the applied methodology document?	VVS	245 (c)	The formulae for calculations of baseline emissions and project emissions as in the ER spreadsheet were found to be correct accept for the following: • The calculation of PE flare (as indicated in the 'Univ TOPI Flare tool' spreadsheet found error in the formula set in column J from 21/07/2011 to 06/01/2012 which resulted the values for PE flare considered as zero. • It has to be made clear in the spreadsheet that the PEy,fugitive,s is not applicable to this project activity	~~CAR-5~~ ~~CL-11~~	OK OK
5.5 Any assumptions used in emission calculations? If yes, they been justified?	VVS	245 (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	245 (e)	The parameters determined during the validation (i.e. ex-ante) have included the emissions factors, IPCC values and default values as defined in the methodology. These parameters have been included in Section D.1 in the Monitoring Report.	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) Mdm.Rattanaporn – shopowner behind the biogas plant ii) Mdm. Thavvan – shopowner behind the biogas plant - iii)Mdm. Ampa Rakwong – shop owner in front of the mill - iv)Mr. Sarayut Sopapong – villager v) Mr.Withoon Peenthong – shop owner at near to the biogas plant - vi)Mr.Pattanapong Jaiklieng – TOPI staff All of the interviewed stakeholders have been staying in the areas for more than 5 years. Hence, they were able to observe any change before and after the installation of the biogas. Although not all of the stakeholders were aware of the biogas plant in the factory, all of them confirmed that was 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 carry 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. No leak was detected.
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 Throughreport. 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	From the Visitor Record Log Book and the photographs indicated that during the monitoring period the following were recorded: i) 15/6/2011 - visit by 15 students and 3 teachers from the primary school of Banbanghaien (located near to the mill) ii) 16/3/2011 – visit by the 17 villages from village of Phattaharung iii) 23/3/2011 – visit by the villages from village of Kanchanaburi. iv) 14/7/2012 – visit by the Hatyai Commercial College v) 13/8/2013 – visit by the Bann Banghein Primary School
GS8	SD10 – Employment Numbers Number of new jobs created for Biogas Project.	Since the beginning of the project, 6 new staffs (1 Biogas Supervisor, 4 technicians and 1 general worker) have been recruited to operate and

		maintain the biogas plant. During this period, new staffs were appointed as a result of the resignation of previous staffs: • one technicians (Mr. Treepob – confirmation on 30/9/2012 and • one new general worker (Mr. Soontorn – confirmation on 20/9/2012.) The payrolls for the staffs were provided from Jan 2011 to December 2012 which confirmed that there were 6 staffs for the biogas plant. Training on the biogas plant has also been provided. This is 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 12).
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 13).
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 14)
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. The audit by the Tuv Nord's auditors was carried out in October 2012.

TABLE 3: 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 For year 2011, the amount of ER generated under AMS III H has exceeded the small scale CDM project threshold value of 60ktonnes/year.		Since the AMSIIIH ER exceed the small scale CDM project threshold value of 60kt/y, to be conservative rather than capping it at 60kt/y; the amount of ER claimed for AMSIIIH in 2011 is capped at the amount estimated in the PDD 56,315 tCO₂e (i.e, total 62,871-6,556 ER from AMSI.D)) as per statement of page 32 of the Revised PDD approved 18th February 2014, "When inputs to the project causes the project activity to exceed the small scale limit (for example in year of abnormal crop yield), the CERs issued will be capped at the value in the PDD for that methodology component". 2011 was an unusually high crop year.	Comments on responses: It was confirmed from the annual report that TOPI factory had processed FFB in year 2011 (44,763.04 tonnes) higher than that in 2010 (42,506.42 tonnes) and 2009 (43,201.96 tonnes). The factory had also previously processed 61,164.06 tonnes of FFB in year 2008 and 56,242.15 tonnes in 2006. This confirmed that in 2011, there was no change in the design capacity of the factory (60t/hr) which was also confirmed at on-site visit. The capping of the ER for AMS III H at the PDD level in case when the actual ER more than the SSC threshold value is defined in the revised PDD. Hence, the corrective action is accepted. Conclusion; CAR 1 closed.
CAR 2 Other flame operation parameters – pressure biogas at flare At the project site, the pressure gauge is label as PG64 instead of PGI01 (as in the		A PRC has been approved on 18th February 2014 which changed the Monitoring Plan to use the more accurate pressure reading of the in-line pressure transmitter at the flare (PI64), rather than the more rudi-	Comments on responses: The reference to PI60 had been reflected in the revised MR. Data reflected in the revised MR had also

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
Monitoring Report). - The existence of the gauge also not included in the 'Diagram showing monitoring equipment' of the MR. - The on-site visit also confirmed that there was a calibration tagging by Miracle International Technology to indicate that calibration to the gauge was carried out on 18 July 2011. However, this has not been reflected in the MR (which only included the calibration of PI64). - The values of monitored parameter as reported in the MR were found not consistent with that recorded in the Quarterly Checklist TBP009.		mentary pressure gauge. This means the gauge is not used and calibration records are not relevant. The reference to the pressure gauge in the MR has been removed. The pressure values reported in the MR are based on the values read from the inline pressure reading and not the values in the Quarterly log sheet. A screenshot of the raw data for these value are provided with this Verification Protocol.	been revised to include those from the PI60, which was recorded in the data logger. Since the revised PDD had used the pressure transmitter PI64, the deletion of the information is acceptable. Conclusion: CAR 2 closed
CAR 3 EL_{grid} - The title of this parameter reflected in the Monitoring Report is EL_{y,project}. This needs to be made consistent with that in the Monitoring Plan - In accordance with the monitoring plan of the PDD, the electricity meter reading recorded by the biogas technician is to be used to in the spreadsheet. Verification of the data in the spreadsheet revealed that for M5 (column I of the spreadsheet) the data is from the PEA invoice and not from TBP004_1. Further to that, comparison between the PEA reading and the meter reading recorded		- The title of this parameter has been corrected in the Monitoring Report to EL_{grid} from EL_{y,project}. - As per the Monitoring Plan, the MWh should be based on meter reading logged manually and then cross checked from PEA. The spreadsheets has been updated to include the kWh from both the PEA reading and the manual log TBP004 for cross checking. In December 2011 and November 2012 the PEA invoice is higher (and thereby less conservative) than the manual log reading. This is because PEA calibrat-	Comments on responses: - MR had been corrected to indicate EL_{grid} - The spreadsheet had been revised to include the kWh from both sources. It was confirmed that for ER calculations, data from TBP004, which was verified during the on-site was used. Conclusion: CAR 3 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
in TBP004_1 indicated that the total kWh for year 2011 and 2012 were slightly lower as compared to that recorded in the PEA invoices.		ed the meter during this time - they took out the meter and replaced it with their own temporary meter to log MWh while it was being calibrated. Therefore the PP meter does not include the KWh logged by the temporary meter and therefore is lower. The ER sheet has been adjusted to only use the value from the meter read logged manually, which is more conservative as it excludes the MWh sold to the grid during PEA's calibration.	
CAR 4 : Calibration of Methane analyser to measure fraction of methane in biogas FCH4 • Delay in calibration from 24/11/2011 to 29/11/2011. In the PE flare spreadsheet, the error was deducted although it is used for project emission calculation. • The maximum permissible error applied to the measured value was found not as per the equipment specification.		The application of the error for the methane analyser in PE flare spreadsheet has been added, and not deducted as it's used for project emissions. The equipment specification for OLCT IR main CH4 analyser error is 3%. Therefore the error applied for the delay in calibration has been corrected to be 3% and not 2.5% as originally erroneously applied.	Comments on responses: From the flare tool spreadsheet, it can be confirmed that a 3% of error had been added to the measured error for the period from 24/11/2011 to 29/11/2011. The 3% was confirmed to be based on the equipment specification. The measured error was confirmed to be lower than that specified in the equipment specification. Conclusion: CAR 4 closed
CAR 5 • The calculation of PE flare (as indicated in	245 (c)	The error in the formula in column J has been corrected and the values for PE flare	Comments on responses: It can be confirmed that the formula in the

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 2	Summary of project owner response	Verification team conclusion
the 'Univ TOPI Flare tool' spreadsheet) found error in the formula set in column J from 21/07/2011 to 06/01/2012 which resulted the values for PE flare considered as zero.		are not zero as per 'Univ TOPI Flare tool v2'.	Flare tool spreadsheet had been corrected accordingly. Conclusion: CAR 5 closed.
CL1 : The following needs to be clarified for volume of wastewater ($Q_{y,ww}$) • Verification of the data in the spreadsheet revealed that from 16 Jan 2011 until 18 Jan 2011, the total POME flow to CIGAR was 6976m³ which was too large amount for two days flow. From the data available, it can be seen that the normal total flowrate was less than 1000m³/day. • Verification of data also revealed that during the period from 8/6/2012 (20:00) to 12/6/2012 (23:00) there was FFB processed, but there was no wastewater recorded during this period.	234 (b)	This flow rate data is a meter reading error. At that time the TOPI plant was shutdown on 4-17 Jan 2011 and when the meter was reinstalled there was an error found on 16-18 Jan 2011. After the error was found, the vendor was called there to check the flow meter and fix the problem and normal operation resumed. For this period a temporary deviation from the monitoring plan has been applied – as per para 3 of Appendix 1 of the CDM Project Standard, the maximum capacity is applied for $Q_{y,ww}$ for the full period of the missing data as the data is used to calculate project GHG emissions. The maximum capacity as stated by KOBOLD is 282.744 m³/hr as per specification sheet supplied with this verification statement. A note has been included next to the data in the spreadsheet. From period 8/6/2012 (20:00) to 12/6/2012 (10:00) flowmeter FI01 was under repair due to a broken fuse and therefore there is no reading for $Q_{y,ww}$. For this period, a temporary deviation from the monitoring plan has been applied – as per para 3 of Appen-	Response to comment no. 1: Since this parameter is used for the calculation of the project emissions, the use of the maximum flow based on design is considered to be conservative. This approach is in accordance with Appendix 1 of the Project Standard, hence, a non-prior approval post registration changes (PRC) on this deviation is also submitted together with the request for the issuance. It was also confirmed through the flowmeter specification that the maximum capacity of the flowmeter is 282.744 m³/hr. 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
		dix 1 of the CDM Project Standard, the maximum capacity is applied for $Q_{y,ww}$ for the full period of the missing data as the data is used to calculate project GHG emissions. The maximum capacity as stated by KOBOLD is 282.744 m³/hr as per specification sheet supplied with this verification statement. A note has been included in the spreadsheet to summarise this action.	
CL 2: $COD_{y,ww,untreated}$ • In the TOPI Biogas ER spreadsheet, this parameter was labelled as COD_{input} and not $COD_{y,ww,untreated}$ • From the spreadsheet, it was found that for the month of March and April 2012 there were no internal COD data available and there was no remark provided. • For the data from external lab, the value for 1/10/2011 (0.037tCOD/m³) and 7/5/2012 (0.0172tCOD/m³) the values were considered abnormal as they were not within the typical POME concentration for COD .	234 (b)	The ER spreadsheet has been edited as follows: • The TOPI Biogas ER spreadsheet, has corrected the label from COD_{input} to $COD_{y,ww,untreated}$ • The ER sheet has been edited to include a remark for March and April 2012 – there was no measurement as the biogas plant was shut down for long maintenance. The values from the external lab for 1/10/2011 (0.037tCOD/m³) and 7/5/2012 (0.0172tCOD/m³) were not within the typical POME concentration for COD and the values have been removed for conservativeness as they lower the COD input concentration and therefore removing them raises project emissions. For future (after this site visit in Nov 2013), Univanich have established a procedure to de-	Comments on response no. 1; • The legend in the MR had been corrected accordingly. • Remarks had been provided in the spreadsheet. • Removal of the abnormal data had resulted in higher average $COD_{untreated}$ and hence higher $PE_{y,ww,treated}$. Hence, the approach was found to be conservative. Conclusion: CL 2 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
		termine the typical range of COD values at the mill (based on 90/10 CI); where if the result is outside of the range; then they will re-sample. This will be applied for both internal and external. If the result from the review the results compared will be send another sample and send it back.	
CL 3 $COD_{y,ww,treated}$ - In the TOPI Biogas ER spreadsheet, the COD is labelled as COD_{output} instead of $COD_{y,ww,treated}$ - In the spreadsheet, there was no COD data for the month of April 2012 and no remark provided.	234 (b)	The ER spreadsheet has been edited: COD_{output} has been edited to correctly state $COD_{y,ww,treated}$ - A remark for why April 2012 is not there has been included as the plant was not operating as it was under long shut down for maintenance.	Comments on response no. 1: - The legend in the MR had been corrected accordingly. - Remarks had been provided in the spreadsheet. Conclusion: CL 3 closed.
CL 4 The following needs to be clarified for the flame detector : Accordingly the flame is indicated as 'on' if the signal indicated 5 volt and 'off' if it is 0 volt. However, from the raw data spreadsheet, it was found that occasionally, there were some reading with 4 volt and counted as flame 'on'.		The spreadsheet and filtering system has been corrected so that when the voltage signal is less than 5; it should be recorded as 0% efficiency, which addresses the issue of the flare ramping up.	The filtering in the spreadsheet had been carried out accordingly. Samples of 6 months hourly flare tool spreadsheets were checked and found adequately addressed. Conclusion: CL 4 closed
CL 5: $Q_{biogas,total,y}$ and $Q_{biogas,engine,y}$		The spreadsheet has been updated to exclude data that is outside the monitoring range as per the specification provided on-	Comments on response no. 1: The revised spreadsheet had excluded the

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 2	Summary of project owner response	Verification team conclusion
From the spreadsheet, it was noted that there were some low readings e.g. $<10\text{m}^3/\text{hr}$. PP to check the lowest detection limit of the flowmeter.		site. - KOBOLD DOG1121 measuring range (from the Equipment specification) is only for reading between $10\text{-}1000\text{m}^3/\text{hr}$. (FI63, FI62, FI61); - KOBOLD DOG 1327 $30\text{-}3000\text{m}^3/\text{hr}$ (FI64) - KOBOLD DOG 1335 $50\text{-}5,000\text{ m}^3/\text{hr}$ (FI60)	data which is below the detection limit of the flowmeters. Conclusion : CL 5 closed
CL 6 : $Q_{\text{biogas,flare,y}}$ From the data verification, explanation is required for data on 10/6/2011 ($4507\text{Nm}^3/\text{hr}$), 29/7/2011($78,137\text{Nm}^3/\text{hr}$) and 7/12/2011($1230\text{Nm}^3/\text{hr}$).		These values are anomaly from the Fuji data logger – the signal has become blocked and the values are accumulated while it is blocked and the high values for the hour reflect the cumulative of the flow during that period where it was blocked. The ER spreadsheet has been updated to include remarks which clarifies the abnormal data where the signal has been blocked. To be conservative, when the signal to the data logger has jammed and the values before the abnormal data is not zero, these values have been deleted. This is conservative as these values from the Fuji data logger are used for baseline emission calculations (there is a separate data logger for the flare logging 1 minute intervals and it did not have this anomaly therefore doesn't affect flare emission calculations).	Comments on response no. 1: On 10/6/2011, data had been set to zero as the accumulation was before the logger was jammed. Data on 29/7/2011 and 7/12/2011 were maintained as they are accumulated after no reading for several hours. The approach accepted as it is logical and conservative. Remarks had been included for the clarification. Conclusions: CL 6 closed
CL 7		During this time the main inline me-	Comments on responses:

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
Fraction of methane in the biogas The methane concentration during the following time was giving very low methane concentration • 7/1/2011 to 11/1/2011 • 8/3/2011 10pm to 11pm • Inconsistency of data was seen between the spreadsheet provided and the Genset Data report for 18 Jan 2011, 13 Apr 2011, 9 Apr 2011, 12 Jun 2011, 17 Jun 2011, 3 May 2012 • PP needs to be made clear what level of the CH₄ concentration from the main analyser (abnormal data) to be replaced with Genset CH₄ analyser. • On 18/1/2011 and 18/3/2011, there was no remark given why the value from column C was not in used in Column D, although in column C there were values. • There has been a delay in calibration for the JE analysers for the period from 30/11/2012 to 18/12/2012 and this had not been reported in the MR. • During the period from 23 Sep 2012 - 2 Nov 2012, data from S/N29196 and S/N28961 was used and due to the delay in calibration, maximum permissible error has been applied to the measured error from these analysers. However, the error was only deducted from the measured error which is only conserva-		thane analyser was not reading correctly. Therefore the data from the back up inline methane analysers at the gensets was used. • The data from the spreadsheet has been corrected to correspond to the Genset Data report for 18 Jan 2011, 13 Apr 2011, 9 Apr 2011, 12 Jun 2011, 17 Jun 2011, 3 May 2012 as checked on site during verification. • The backup data from the genset CH₄ analysers is used when the CH₄ concentration is below 40%, which is the minimum level the gensets can operate (as per genset manufacturers specification provided onsite during verification). • The spreadsheet with the backup methane data from Gen1, Gen2 and Gen3 has been corrected with an algorithm that ensures data is used first from Gen1, then Gen2 if there is no value in Gen1 and then Gen3 if there is no value from Gen1; and zero if there is no value from any of the backup inline methane analysers. • The delay in calibration for the JE analysers for the period from 30/11/2012 to 18/12/2012 has now been reported in the MR. • During the period from 23 Sep 2012 - 2	• The use of the back up on-line analyser which is available at the gas engines is acceptable as the analyser was also on-line and calibrated. Data used was as verified during the on-site. • Data inconsistency had been corrected and confirmed to be as verified during the on-site audit. • The approach taken is acceptable as 40% is the concentration of methane specified in the gas engine specification. • The delay in calibration for JE analyser had been included in the revised Monitoring Report. • The ER spreadsheet had been revised to ensure that for baseline emission, the measured data was deducted with the error and for project emissions, the measured data was added with the error. This approach is in line with the VVS requirements. Conclusions: CL 7 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
tive if the data is used for baseline calculation.		Nov 2012, data from S/N29196 and S/N28961 was used and due to the delay in calibration, maximum permissible error was deducted for baseline calculation and added for project emission calculations.	
CL 8 Calibration of power meter M5 : - In the QA/QC procedures in the MR, it was mentioned that M5 was out of calibration from 1 Jan – 31 May 2011. It was unsure for this mentioned period is for which power meter. - In the MR, the calibration frequency for the power meter EDM I Genius S/N 206500246 was indicated as 1/year but under the validity column indicated as 3 years. - In the MR, the 'temporary' power meter was indicated as 'borrowed' which is not appropriate as the replacement was done by PEA and not by PP. - The application of error in the readings from the 'temporary' power meter was not seen in the spreadsheet.	234 (c)	- In the QA/QC procedures in the Monitoring Report, it has been clarified that M5 ~~old~~ was out of calibration from the beginning of the monitoring period until 31 May 2011 when the new M5 was installed. - The calibration frequency for the power meter EDM I Genius S/N206500246 has been corrected to be 3 years. As verified in previous Monitoring period, the Manufactures specification for PEA meter M5 state validity of 8 years. However Annex 9 of EB 59 "General Guidelines to SSC CDM methodologies" require calibration earlier of 3 years, therefore the meter is calibrated every 3years from the date of installation. - The Monitoring Report has been edited to read to the meter as 'Temporary' as it is provided by PEA and not borrowed by the PP. - The application of error for the 'temporary' power meter has been applied in	Comments on responses: - The revised MR had clearly indicated that the M5 old meter was the one with delay in calibration, and the calibration frequency is once in every 3 years. This was in line with the previous monitoring period. - The used of the 'temporary' meter had been indicated in the MR - The application of the error for 'temporary' M5 meter is evident in the revised spreadsheet. Conclusion: CL 8 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
		the spreadsheet – this is because PEA did not provide the original calibration certificate and so the equipment was calibrated only after it was used (calibration certificate supplied with this Verification Protocol), and therefore this error was deducted. The formula for the total replacement to the grid has been corrected.	
CL 9: Calibration of power meter M7 - PP needs to clarify the method of calculation which M7 with error was indicated as “$((G6*7/31) + ((G6*7/31)*0.01)) + (G6*(31-7)/31)$” - The end date of the penalty indicated in the MR was 07/01/2011 instead of 06/01/2011.	234 (c)	- The method of calculation indicated as “$((G6*7/31) + ((G6*7/31)*0.01)) + (G6*(31-7)/31)$” is to add the error for being out of calibration for the days of January 2011 with the error of 0.01. However, as the error applies to 6 days, and not 7, this calculation has been corrected. - The MR has been updated to state the end date of the penalty is 06/01/2011.	Comments on responses : - Clarification provided is adequate. - The MR had been corrected to 06/01/2011 Conclusion: CL 9 closed.
CL 10 : Calibration of biogas flow meter to measure $Q_{\text{biogas, flare,y}}$ and flowrate of biogas at flare - In the ER spreadsheet, PP had applied the error up to 07/03/2012 instead of 06/03/2012. - In the Flare tool spreadsheet, it was not seen that the error has been added, as it is used for project emission.		- In the ER spreadsheet, the error has been corrected to be applied up to 06/03/2012 by subtracting .002 (ie multiply by 0.998). This is derived from the maximum permissible error as shown in the spreadsheet “Method for calculation Nm3 accounting T error.xls” provided with this Verification Protocol. - In the Flare tool spreadsheet, the error has been added, please see tab “Data for efficiency and flow” column	Comments on responses: - ER spreadsheet had been revised to only include the adjustment of data up to 06/03/2012. - The method used to determine the error coefficient was provided to the verification team, and it can be confirmed that the coefficient was derived based on the maximum permissible error (MPE) of the sensor which was based on the equipment specification.

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
		D which is adjusted for the error by adding 0.002. This is derived from the maximum permissible error as shown in the spreadsheet "Method for calculation Nm3 accounting T error.xls" provided with this Verification Protocol. This value is used in the calculation sheet.	It was also confirmed that the measured error was less than the error specified by the equipment specification, Based on this MPE the coefficient error of 0.998 was determined when the data is used for baseline emissions and 1.002 for project emissions. This approach was found to be conservative. Conclusion: CL 10 closed
CL 11 : It has to be made clear in the spreadsheet that the $PE_{y,fugitive,s}$ is not applicable to this project activity		The spreadsheet has been edited to remove $PE_{y,fugitive,s}$ as it is not applicable to this project activity as there is no anaerobic sludge treatment system in the project design, as stated in the Registered PDD.	Comments on responses: The explanation of why the $PE_{y,fugitive,s}$ not applicable to the project activity had been included in the spreadsheet. Conclusion ; CL 11 closed.
Findings on compliance to Gold Standard requirements:			
CL 12: Confirmation from Thailand Greenhouse Gas Office (TGO) during this period has yet to be provided to the verification team.		please see attached confirmation from TGO dated 26/2/2013	Comments on responses: Confirmation from TGO had been obtained on 26/2/2013 which confirmed that there are no new regulations in Thailand during the period.

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
			Conclusion : CL12 closed
CL 13 : 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%.	Comments on responses: From the ER spreadsheet, it can be confirmed that the amount of biogas used for energy purpose is more than 80%, which is more than the stipulated target of 65%. Conclusion: CL 13 closed
CL 14: Letter from Krabi Agriculture Extension Office has yet to be provided to the verification team.		Letter from Krabi Agriculture Office dated 21/01/2013	Comments on responses: Letter from the Krabi Agriculture Office, dated 21/1/2013 had been provided which confirmed that the changes of the increase in planted areas during 2010 – 2012 was due to the conversion of the rubber plantation, fruit orchards, empty land, former rice farm which were own by farmers. There was no forests cleared for the expansion of oil palm. Conclusion: CL 14 closed