
GOLD STANDARD VERIFICATION AND CERTIFICATION REPORT

PROJECT TITLE
UNIVANICH TOPI BIOGAS PROJECT

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

Verification Period:
1/10/2009 - 31/12/2010

Report No. : SQAS-GS-EU02350002
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Project title	Univanich TOPI Biogas Project		
Organisational Unit	SIRIM QAS International Sdn. Bhd.		
Client	Unvanich Palm Oil Public Co. Ltd.		

Summary:

Univanich Palm Oil Public Co. Ltd. had appointed SIRIM QAS International Sdn. Bhd. to perform the first verification and certification of the emission reductions reported for the 'Univanich TOPI Biogas Project' for the period from 1/10/2009 and 31/12/2010. The project was registered by the UNFCCC Executive Board on 24 August 2009. The verification was based on the validated project design document (PDD)^{/1/}, Validation Report^{/2/}, Monitoring Reports^{/6//43//48//65/}, the Registered Gold Standard Annex^{/74/}, the Gold Standard Monitoring Report Annex^{/75//76/} and other supporting documents made available to the verification team by the project participant.

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:

Monitoring period	01/10/2009 to 31/12/2009	01/1/2010 to 31/12/2010
Total Baseline Emissions	19,903.80 tCO ₂ e	71,183.93tCO ₂ e
Total Project Emissions	3,977.88 tCO ₂ e	11,917.59 tCO ₂ e
Emission Reductions	15,925.92 tCO ₂ e	59,266.34 tCO ₂ e

Subject : Gold Standard Verification

Work carried out by :

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Abbreviations

CAR	Corrective Action Request
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CH ₄	Methane
CIGAR	Covered In-Ground Anaerobic Reactor
CL	Clarification Request
DOE	Designated Operational Entity
EB	UNFCCC Executive Board
ER	Emission Reduction
FAR	Forward Action Request
FFB	Fresh Fruit Bunches
GHG	Greenhouse Gas(es)
GS	Gold Standard
HDPE	High-density Polyethylene
IPCC	Intergovernmental Panel on Climate Change
MP	Monitoring Plan
MR	Monitoring Report
PDD	Project Design Document
PEA	Provincial Electricity Authority
PP	Project Participant
POME	Palm Oil Mill Effluent
SIRIM QAS Intl.	SIRIM QAS International Sdn Bhd
UNFCCC	United Nations Framework Convention for Climate Change
Unvanich	Unvanich Palm Oil Public Co. Ltd.
VER	Voluntray Emission Reduction
VVM	Validation and Verification Manual version 1.2

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Annex 1: Verification Protocol

1. 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 project activity 'Univanich TOPI Biogas Project' (hereafter referred to as the project activity) for the period from 1/10/2009 and 31/12/2010. The emission reductions for the project activity for the monitoring period starting for the same monitoring period have already been verified (verification report ref number. SQAS-CDM-EU02350001 dated 13 January 2012) and issued by the CDM EB on 10 April 2012.

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 Manual /VVM/ of the UNFCCC. This report summarizes the findings and conclusions of this verification of the above mentioned UNFCCC registered project activity.

1.1 Objective

The objectives of this verification were:

- To verify that the actual monitoring system and procedures were in full compliance with the system and procedures described in the monitoring plan of registered PDD^{/1/}, the applicable methodology AMS III.H version 9^{/3/} and AMS I.D. version 13^{/4/}, and the Gold Standard v1 rules.
- To verify that the data reported was 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 the emission reductions reported for 'Univanich TOPI Biogas Project' for the period from 1/10/2009 to 31/12/2010

1.2 Scope

The scope of the verification is the independent and objective review and *ex-post* determination of the monitored reductions in GHG emissions from 'Univanich TOPI Biogas Project'. The verification is based on the validated and registered project design document and the monitoring report and the GS monitoring report annex and the Registered Gold Standard Annex^{/74/} for the project. These documents were reviewed against the requirements of the Gold Standard v1, the Kyoto Protocol, the CDM Modalities and Procedures and related rules and guidance.

The verification team has, based on the recommendations in the Validation and Verification Manual, employed a risk-based approach in the verification, focusing on the identification of significant risks and reliability of project monitoring and generations of VERs.

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 Parties	:i) Univanich Palm Oil Public Co.Limited ii) Carbon Bridge Pte Ltd
Title of project activity	:Univanich TOPI Biogas Project
GS reference no.	:GS 460
UNFCCC CDM reference no.	: 2661
Registered date by UNFCCC EB	: 24 August 2009
Project location	: Univanich TOPI Palm Oil Mill, Krabi Province, 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. 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 the biogas engines. Three units of gas engines of 952kW capacity each were installed to generate the electricity that 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.

2. METHODOLOGY

The project assessment was based on the methodology developed in the Validation and Verification Manual.

In order to ensure transparency, a verification protocol was customized for the project, according to the Validation and Verification Manual. 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 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.

Verification Team

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

Verification team leader : Aminah Ang
Verification team member : Azhar Abdul Raof
Trainee auditor : Hafriazhar Mohd. Mokhtar

Aminah Ang, the validation team leader is a qualified verification team leader in accordance with SIRIM QAS Intl.'s qualification criteria. She has been a lead auditor for environmental management systems (ISO 14001) for the past 14 years.

Azhar Abdul Raof is a Chemical Engineer by qualification. He has extensive experience in the area of wastewater treatment technology including the anaerobic waste treatment processes in the palm oil industries. He has been trained in the CDM validation and verification processes, and is a qualified verifier.

Hafriazhar Mohd. Mokhtar is a Chemical Engineer by qualification. He has several years of direct work experience in palm oil milling including the operation of wastewater treatment plants. Currently, he is an auditor under training.

Duration of verification

The verification of the project was carried out between April 2011 to April 2012, with details as follows:

On-site verification : 27 to 28 April 2011
Preparation of draft report : 5 to 13 May 2011
Preparation of GS final report: April 2012

2.1 Review of Documentation

The following documentation were reviewed and verified:

- Registered PDD^{/1/}, version 5.1, dated 4 June 2009;
- Validation Report CDM.VAL2195^{/2/} dated 9 June 2009;
- Monitoring Report^{/6/} version 1, dated April 2011
- ER spreadsheet^{/7/} version 1, dated April 2011
- Registered Gold Standard Annex, version 7.2 July 2010
- GS Monitoring Report Annex, version 1^{/75/}

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

2.2 Site Visits

An on-site audit of the project was carried out by the verification team from 27 to 28 April 2011. The on-site audit consisted of visits to the project site to verify project implementation, the location of the monitoring equipment, and the review of documents and data in the office. Interviews with relevant personnel were also carried out to confirm the method of recording the GHG data.

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

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

Coverage	Source of information/Persons interviewed
• GHG reporting and calculation • Information in the monitoring report	Phiphit Khlaisombat – Group Engineer Thongchai Posew - CDM Biogas Manager/QC Manager
• Assessment of project boundary • Review of physical components • Plant operation • Qualification and training • Roles and responsibilities • GHG raw data compilation • Reporting and reviewing of GHG data • CDM Monitoring and reporting • Collection of measurements • Data logging and reporting • Maintenance of monitoring equipment • Calibration of equipment	Bridget McIntosh – Carbon Bridge Watcharea Kongsan – TOPI Biogas Supervisor

2.3 Assessment

Means of verification used:

- Review of project documentation.
- On-site inspection, including review of performance records, interviews with plant engineer, supervisor and shift leader, collection of measurements and confirming all data sources and constants used in the monitoring report.
- Review of monitoring results and verification of the correct application of monitoring methodologies.
- Determination of the accuracy of the GHG emission reduction calculations.

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) and/or Forward Action Request (FAR).

A CAR may be raised if

- the verification is not able to obtain sufficient evidence for the reported emission reductions or part of the reported emission reductions. In this case these emission reductions shall not be verified and certified; or
- the verification has identified material misstatements in the reported emission reductions. Emission reductions with material misstatements shall be discounted based on the verifiers ex-post determination of the achieved emission reductions.

The verification process may be halted until corrective actions have been carried out and made available to the auditor's satisfaction.

A Forward Action Requests (FAR) should be issued, where:

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

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

3 VERIFICATION FINDINGS

During this periodic verification, 8 CARs, 4 CLs and 1 FAR were raised on the technicality of the project implementation as per the CDM requirements and additional 3 CLs against the GS Monitoring Criteria, after the on-site audit carried out on 27 to 28 April 2011. Details of the findings are in the verification protocol in Annex 1 of this report.

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

This is the first verification for the project activity. OneFAR (FAR#19) was raised during the validation stage by the validator to ensure that the verifying DOE interviews a few local villages

and at least one NGO interviewed through telephone. During this verification, the verification team had visited and interviewed several stakeholders who have been leaving in the nearby villages prior to the implementation of the project activity. There was no NGO identified during this visit as from the list of local stakeholders meeting, there were no representative from the NGOs present in the meeting although invitations were made. Hence, comment from the NGOs was not obtained.

3.2 Project Implementation

The project has been implemented as described in the PDD^{/1/} and monitored in accordance with the monitoring plan and methodology. The project activity involves construction of a covered lagoon anaerobic reactor with a biogas capture system. The digester lagoon is a 60,000 m³ lagoon covered with thick HDPE sheets. The biogas from the covered anaerobic reactor is captured, treated and used in three units of biogas engines (brand Guascor each of 952kW capacity). The first two biogas engines were commissioned in July 2009 while the third unit was installed and commissioned in October 2009. The generated electricity is sold to PEA and is used on-site when the existing biomass boiler is not in operation. The excess biogas is combusted in an open flare system.

The project was fully commissioned in August 2009 and the start date of the crediting period was changed to 1 October 2009 due to delay in the grid connections and installation of monitoring equipment

3.3 Completeness of Monitoring

Following are the parameters required to be monitored by the monitoring plan^{/1/} and the method of which the verification of the parameters was carried out by the verification team:

Data/parameter:	$Q_{\text{biogas, total, y}}$
Data unit:	Nm ³
Description:	Total amount of biogas recovered from the covered lagoon
Source of data used:	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 in Nm ³ . The supplier of the flow meter (ST Control Co. Ltd.) ^{/47/} , who set up the equipment provided a summary of the equipment setting and how flow computer algorithm calculates the 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, this parameter was not included in the monitoring report and the data in the ER spreadsheet was not using the data from the on –line flow meter. (i.e. it was based on the calculated total flow to each biogas engines and flare). A CAR (CAR 3) was raised on this issue. Details of the findings and the closure are as in Table 2 of Annex 1 of this report.
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Data/parameter:	$Q_{\text{biogas,engine,v}}$
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 (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 TI63 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.)^{/47/}, who set up the equipment provided a summary of the equipment setting and how flow computer algorithm calculates the 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 the Excel ER spreadsheet via a dedicated software. Verification of the data in the spreadsheet revealed no data transfer error.

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 (Nm^3) by the data logger. The supplier of the flow meter (ST Control Co. Ltd.)^{147/}, who set up the equipment provided a summary of the equipment setting and how flow computer algorithm calculates the 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 was downloaded to Excel ER spreadsheet via a dedicated software. Verification of the data in the spreadsheet revealed no data transfer error.

Data/parameter:	F_{CH_4}
Data unit:	%
Description:	Fraction of methane in biogas
Source of data used:	Measured using an 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/malfunctions. Digital display on the panel indicates the fraction in percentage (%) terms. The main methane gas analyser at the biogas plant is linked to data logger no. 2 that measures and records data on a minutely basis. This data is downloaded to the ER spreadsheet using a dedicated software. The backup analyser at the biogas engine is not linked to any data any logger. Data measured from this meter was manually recorded in 'Genset Data Report Checksheet'^{140/} on an hourly basis by the technician. These data were used when the main methane gas analyser was out of order. This has been clearly indicated in the ER spreadsheet and in the revised monitoring report. During the verification, CL 4 was raised as the reporting on the use of manually recorded data was not fully included 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:	°C
Description:	Temperature of biogas
Source of data used:	Measured continuously using a N type thermocouple
Means of verification :	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 T160 and installed next to the biogas flow meter FI60. The temperature measurement is used in the conversion of the biogas flow from m³/h to Nm³/h in the data logger. This parameter was not reported in the first version of the monitoring report. CAR 2 was raised on this issue. Details of the findings and the closure are as in Table 2 of Annex 1 of this report

Data/parameter:	P _{biogas}
Data unit:	kPa(g)
Description:	Pressure of biogas
Source of data used:	Measured continuously using a 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. The pressure measurement is used in the conversion of the biogas flow from m³/h to Nm³/h in the data logger. This parameter was not reported in the first version of the monitoring report. CAR 2 was raised on this issue. Details of the findings and the closure are as in Table 2 of Annex 1 of this report

Data/parameter:	Other flare operation parameters – Flame detector
Data unit:	-
Description:	Flame on or off detector
Source of data used:	Data logger
Means of verification :	Flame ionization detector (FID) was installed at the flare system to detect the flame. The FID is linked to data logger no. 2, where if no flare is detected, an alarm will be triggered. No calibration required for FID but the checking on the functionality of the detector is carried out by the Biogas Supervisor on a quarterly basis and the results recorded in TOPI Biogas quarterly checklist and safety walk through (TBP009)⁽³²⁾. The records revealed that the FID was functioning

	well during the monitoring period.
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Data/parameter:	Other flare operation parameters – pressure of biogas at flare
Data unit:	kPa(g)
Description:	Pressure of biogas
Source of data used:	Measured continuously using a pressure gauge
Means of verification :	In accordance with the monitoring plan, PP had carried out a quarterly check to ensure that the operating pressure of the flare system is as specified by the manufacturer (10 – 100mbar). The results of the check was recorded in the TOPI Biogas quarterly checklist and safety walk through^{/32/}. It was confirmed that during this monitoring period, the pressure transducer was operating within the manufacturer's specification. This parameter was not reported in the first version of the monitoring report. CAR 2 was raised on this issue. Details of the findings and the closure are as in Table 2 of Annex 1 of this report.

Data/parameter:	Other flare operation parameters – flowrate of biogas at flare
Data unit:	m 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. 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.)^{/47/}, who set up the equipment provided a summary of the equipment setting and how flow computer algorithm calculates the Nm³. The algorithm provided was confirmed to be in accordance with the standard formula used in the calculation for normalisation of gas volume. During the verification, this parameter was not reported in the monitoring report. CAR 2 was raised on this issue. To resolve the issue PP had included this parameter in the revised monitoring report. A FAR (FAR 1) was also raised to ensure that the unit of measurement in the monitoring plan could be revised to Nm³/h in the next monitoring period. Details of the findings and the closure are as in Table 2 of Annex 1 of this report.

Data/parameter:	ELgrid
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 • M1 - kWh from gas engine no.1 • M2 – kWh from gas engine no.2 • M3 – kWh from gas engine no. 3 • M8 – kWh usage in gas engine room from all sources • M9 – kWh usage for covered lagoon system from all sources • M7 – kWh total biogas use only from PEA The kWh cumulative readings from all the meters were recorded in the Daily Electricity Meter Record (TBP004_1)/37/ 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. No data transfer errors were found. PP had applied the requirements in the EB 52 Annex 60 'Guidelines for assessing compliance with the calibration frequency' for the data which was used in the spreadsheets. During the verification, PP had initially used the electricity generated at the gas engines (readings from M1, M2 and M3) minus the electricity consumed by the biogas plant (M8 and M9). Two CARs were raised on this issue. One related to the requirement of the monitoring plan where the electricity should be the amount sent to the grid rather than generated (CAR 3), and the second was on the use of data from M7 which was not included in the spreadsheet (CAR 4). One CAR (CAR 7) was also raised on data in which the meters were not calibrated in a timely manner. Details of the findings and the closure are as in Table 2 of Annex 1 of this report. In the revised ER spreadsheets, data from M5 minus the data from M8 and M9 or M7 was used to represent the ELgrid.

Data/parameter:	$Q_{y,ww}$
Data unit:	m ³ /year
Description:	Volume of Wastewater Treated in year
Source of data used:	Measured using a 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 F101. 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^{/46/}. 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 Checksheet (TBP005)^{/42/} on a daily basis by the biogas technician. There was no data transfer errors found in the ER spreadsheet.
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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. A standard operating procedure (SOP) was established to guide the laboratory technician to carry out the analysis. 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. The method was found to be in accordance with the SOP for COD sampling and analysis^{/10/}. The results of the analysis were recorded in Wastewater Analysis Report^{/38/}. Quarterly analysis of COD was carried out by Saint Envir Co. Ltd. (Bangkok), 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^{/41/} and the internal reports^{/38/} were checked against that in the ER spreadsheet. One data transfer error was found on 25/1/2010. CAR 1 was raised and PP had corrected the value which is now consistent with the value verified. Details of the findings and the closure are as in Table 2 of Annex 1 of this report.

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. A standard operating procedure (SOP) was established to guide the laboratory technician to carry out the analysis. The sampling point and method was verified 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 ^{/10/}. The results of the analysis were recorded in Wastewater Analysis Report ^{/38/}. Quarterly analysis of COD was carried out by Saint Envir Co. Ltd. (Bangkok), 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 ^{/41/} and the internal reports ^{/38/} were checked against that in the ER spreadsheet. No data transfer error was found.
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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:	SD 1 - Water quality improvement in wastewater released to 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) 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 ^{/10/}. The results of the analysis were recorded in Wastewater Analysis Report ^{/38/}. Quarterly analysis of COD was carried out by Saint Envir Co. Ltd. (Bangkok), an accredited laboratory. From the analysis, it can be concluded that the average COD inlet is 0.070 mg/L and the average COD outlet is 0.010 mg/L. This showed that the quality of the wastewater released to existing wastewater treatment system had improved.
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ID No. :	GS 2
Data/parameter:	SD2- Air quality. There is a reduction in odour from the plant.
Data unit:	Interview with surrounding stakeholders
Description:	-
Means of verification :	Interview with the following stakeholders were carried out during the on-site verification. i) Mr. Nirat - Plaipraya village (opposite the mill) ii) Mdm. Prajvab Thongduang _ Plaipraya village iii) Mr.Saijai Na.Songkram – Srisor village (near to the biogas plant) iv) Mr. Virat Nunkeon – Srisor village v) Mr. Satit Napayab*– Nasuan village (4km from the mill) The stakeholders have confirmed that since the implementation of the project , the odour from the palm oil mill had reduced. Note: * participated in the local stakeholder consultation process.

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 are followed during the transfer of wastewater to the new biogas digester. There was no spill reported during this process.

ID No. :	GS 5
Data/parameter:	SD5 – Biodiversity. Avoidance of POME spill during operation
Data unit:	-
Description:	(i) Used HDPE pipe to transfer POME and (ii) No POME spill from

	pipes during operation
Means of verification :	The purchase of HDPE pipe was checked against the receipt of purchasing the pipe. It was confirmed that HDPE pipe was purchased for the purpose of transferring of POME to the biogas plant. The monitoring of this parameter was also carried out through the quarterly safety walk through in which inspection on the pipes integrity was check. The inspection was recorded in the Quarterly checklist and safety walk through (TBP009)^{/32/}. The filled checklists were checked and found that no leaks or spill was recorded.

ID No. :	GS 6
Data/parameter:	SD6 – Employment Quality. Ensure safety of workers
Data unit:	-
Description:	Safety of biogas plant. Monitored and reported on quarterly basis
Means of verification :	Safety Review of biogas plant was carried out by the biogas plant supervisor on quarterly basis sighting at least the following: • Leaks or cracks in pipes and joints • Leaks or cracks in the CIGAR cover • Equipment that could potentially produce sparks in engine room • Sufficient ventilation in engine room • Potential for sparks at any of the pumps or blowers The inspection was recorded in the Quarterly checklist and safety walk through (TBP009)^{/32/}. The filled checklists were checked and it was found that the inspections had been carried out according to the requirements by the biogas plant supervisor.

ID No. :	GS7
Data/parameter:	SD9 – Human and Institutional Capacity. Raising environmental awareness amongst the community including school children.
Data unit:	-
Description:	Maintain visitors Logbook of site visits to TOPI Biogas Plant to show use of site as learning centre about biogas plant.
Means of verification :	From the Visitor Log Book ^{/71/} and photograph provided, it was noted that there were visits from the nearby schools to the project site on 13 August 2010 and 8 October 2009, and visit from the Suratani Industrial Provincial Department on 7 June

	2010. Hence, this criteria had been fulfilled.
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ID No. :	GS8
Data/parameter:	SD 10 – Employment numbers. Number of new jobs created for biogas project.
Data unit:	No. of staff
Description:	Test that at least 5 new jobs were created by showing payroll, payslips or other appropriate way to prove employment during the period.
Means of verification :	Since the beginning of the project, 5 new staff (1 Biogas Supervisor and 4 technicians) have been recruited to operate and maintain the biogas plant. This was verified from the appointment letter ^{/72/} , latest payroll ^{/73/} of the staff and through interview of the staff.

ID No. :	GS9
Data/parameter:	New legislation mandating biogas plants.
Data unit:	-
Description:	Confirm there is no new legislations that mandate methane recovery from wastewater treatment plant at Agro-processing plants through confirmation from relevant government authority.
Means of verification :	Confirmation from the Deputy Executive Director, Thailand Greenhouse Gas Management Organization dated 9 May 2011 has been 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 ^{/69/} .

ID No. :	GS10
Data/parameter:	Minimum 65% of biogas used for energy purposes
Data unit:	%
Description:	Monitor biogas continuously to engines and flare. On annual basis, calculate the % of biogas flow to engine is more than and equal to 65% of sum of biogas flow to engines and flare.
Means of verification :	From the ER spreadsheet and MR, the amount of biogas flared is 1,231,225 Nm ³ and the amount of biogas sent to the gas engine is 9,193,380 Nm ³ . Hence, the total amount of biogas captured is 10,424,605 Nm ³ . Therefore, the amount of biogas used for energy purpose = 88.2%, which is more than the stipulated target 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 28 March 2011^{70/}, confirmed that the sources of land for new oil palm in year 2009 to 2010 are from land that were previously planted with coffee, fruit orchards and coconut trees, and empty land (ex-paddy and prawn farms). No forest had been cleared for the expansion of oil palm plantations. This is in addition to documentation provided for 2008 (already uploaded to Gold Standard Registry from previous Verification) also from an official source i.e. Krabi Agricultural office, indicates that the source of land for new oil palm plantation is not increasing pressure on primary forests. During the verification, this letter was not made available to the verification team. Hence, CL7 was raised. Details of findings and resolutions is as in Table 2 of Annex 1 of this report.

ID No. :	GS12
Data/parameter:	Status of RSPO
Data unit:	-
Description:	Update on status of RSPO membership and action towards certification
Means of verification :	Confirmation from the RSPO Secretary General on the acceptance as a member in the RSPO was verified. The status is also reflected in the RSPO website. Interview with the Managing Director of Univanich confirmed that Univanich had participated in major meetings of the RSPO.

In addition to the GS monitoring parameters, PP had also included the 'changes to the key sustainable development indicators' in Section 5 of the Monitoring Report. The information for each indicator had been checked and verified. It can be confirmed that the information provided in the report correct and that there are 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:

- i) Data recorded from meters installed in the plant
- ii) Default values determined during the validation period
- iii) Data provided by internal and third party laboratory

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

Parameter	Equipment	Unit
$Q_{\text{biogas, total, y}}$	Biogas flow meter	Nm^3
$Q_{\text{biogas, engine, y}}$	Biogas flow meter	Nm^3
$Q_{\text{biogas, flare}}$	Biogas flow meter	Nm^3
F_{CH_4}	Methane gas analyser	%
T_{biogas}	N type thermocouple	$^{\circ}\text{C}$
P_{biogas}	Pressure transducer	kPa(g)
Flow rate of biogas at flare	Biogas flow meter	Nm^3/hr
EL_{grid}	kWh meters	kWh
$Q_{\text{y, ww}}$	Magnetic flow meter	m^3/year
Sludge removal	Magnetic flow meter	m^3/year

For the default values, the values determined during the validation were used. 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	$\text{kg CH}_4/\text{m}^3\text{CH}_4$	PDD page 33
GWP _{CH4}	21	tCO_2/CH_4	PDD page 30
$B_{0, \text{ww}}$	0.21	$\text{kg CH}_4/\text{kg COD}$	AMS III.H
DOC_F	0.5	-	AMS III.H
$\text{MCF}_{\text{ww, final}}$	0.2	-	Table III.H.I of AMS III.H
$\text{MCF}_{\text{ww, treatment}}$	1.0	-	Table III.H.I of AMS III.H
$\text{MCF}_{\text{s, final}}$	0.09	-	AMS III.G
$\text{DOC}_{\text{y, s final}}$	0.09	-	AMS III.H
F	0.5	-	AMS III.H
CFE_{ww}	0.9	-	AMS III.H
$[\text{CH}_4]_{\text{y, ww, treated}}$	0.0001	t/m^3	AMS III.H
$\text{EF}_{\text{project}}$	0.534	$\text{kg CO}_2\text{e/kWh}$	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 follows:

Parameter	Value	Unit	Remarks
COD _{y,ww,treated}	As in Excel spreadsheet	Tonnes/ m ³	• Internal Wastewater Analysis Report^{/38/} • Third party laboratory report^{/41/}
COD _{y,ww,untreated}	As in Excel spreadsheet	Tonnes/ m ³	• Internal Wastewater Analysis Report^{/38/} • Third party laboratory report^{/41/}

Emission reductions calculations:

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

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

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

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

Thus, the total emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y$$

Where:

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

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

ER _y	Emission reductions in the year ‘y’ (tCO ₂ e)
BE _y	total baseline emission in year ‘y’(tCO ₂ e)
PE _y	total project activity emissions in the year ‘y’ (tCO ₂ e)
MD _{y,combustion}	Baseline methane emissions destroyed through combustion for energy production or flaring (tCO ₂ e)
BE _{elec,y}	Baseline emissions from displaced electricity from grid (tCO ₂ e)
PE _{flare}	Project emissions from flaring (tCO ₂ e)
PE _{wastewater}	Project emissions from wastewater treatment (tCO ₂ e)

Baseline emissions calculation:

Baseline methane emissions destroyed through combustion for energy production or flaring ($MD_{y,combustion}$) was calculated based on the following formula:

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

Where:

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

The total $MD_{y,combustion}$ for the monitoring period was = 84,168.20tCO₂e

Baseline emissions from the displaced electricity from grid ($BE_{elec,y}$) was calculated based on the following formula:

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

Where:

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

The total $BE_{elec,y}$ for the monitoring period was =6,919.53tCO₂e.

Therefore, $BE_y = 84,168.20tCO_2e + 6,919.53tCO_2e = 91,087.73tCO_2e$

Project emissions calculations:

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

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

where:

$PE_{y,power}$	Emissions from electricity consumption in the year 'y'(tCO ₂ e). 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'(tCO ₂ e)
$PE_{y,s,final}$	Emissions from anaerobic decay of the final sludge produced in the year 'y'(tCO ₂ e).
$PE_{y,fugitive}$	Emissions from methane release in capture and flare systems in year 'y' (tCO ₂ e)

$PE_{y, \text{dissolved}}$ Emissions from dissolved methane in treated wastewater in year “y”.

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

$$PE_{\text{flare}} = V_{\text{CH}_4, \text{flare}} \times \rho_{\text{CH}_4} \times (1 - \eta_{\text{flare}}) \times 0.001 \times GWP_{\text{CH}_4}$$

where:

$V_{\text{CH}_4, \text{flare}}$ 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, $PE_{y, \text{ww, treated}}$, $PE_{y, \text{s, final}}$, $PE_{y, \text{fugitive}}$, and $PE_{y, \text{dissolved}}$ were accounted in the emissions reduction calculation. Based on the input values provided, the total PE_y for this monitoring period was determined as 15,895.48 tCO₂e.

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

Monitoring period	01/10/2009 to 31/12/2009	01/1/2010 to 31/12/2010
BE_y	9,903.80 tCO ₂ e	71,183.93 tCO ₂ e
PE_y	3,977.88 tCO ₂ e	11,917.59 tCO ₂ e
Emission reductions	15,925.92 tCO ₂ e	59,266.34 tCO ₂ e

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 EB 52 Annex 60 for the period of delay. Following are the calibration status of the equipment:

	Monitoring and measuring equipment	Equipment no.	Calibration date	Frequency of calibration	Remarks
1)	Biogas flow to meter measure	S/N 5814 (FI60)	28/2/2009 (Factory calibration)	Every 3 years	Oscillator flow meter (Kobold Technology) with accuracy class of 1.5% of measured volume (as per

	$Q_{\text{biogas, total, y}}$				equipment specs). • Installed on 11/8/2009 • Calibration frequency recommended by Kobold is 3 years. Clarification was raised on the re-calibration requirement. Refer to CL 1. In response to the CL, Kobold (Thailand) had provided a response that the recalibration cycle is based on the date of the installation of the equipment. Details of the findings and the closure are as in Table 2 of Annex 1 of this report.
2)	Biogas flow to meter measure $Q_{\text{biogas, engine, y}}$	S/N 5813 (FI61 for biogas engine no.1) S/N 5811 (FI62 for biogas engine no.2) S/N 5812 (FI63 for biogas engine no.3)	28/2/2009 (Factory calibration) 28/2/2009 (Factory calibration) 28/2/2009 (Factory calibration)	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 (as per equipment specs) • Flow meters for biogas engine no.1 and no. 2 were installed on 11/8/2009, and flow meter for biogas no. 3 was installed on 5/10/2009. • Calibration frequency recommended by Kobold is 3 years. Clarification was raised on the re-calibration requirement. Refer to CL 1. In response to the CL, Kobold (Thailand) had provided a response that the recalibration cycle is based on the date of the installation of the equipment. Details of the findings and the closure are as in Table 2 of Annex 1 of this report.

3)	Temperature sensors used for the normalization of $Q_{\text{biogas, engine, y}}$	S/N. N0851.965 110 (TI61 for biogas engine no, 1) S/N. N0851.965 113 (TI62 for biogas engine no, 2) S/N. N0851.965 101 (TI63 for biogas engine no, 3)	20/4/2009 & 7/10/2010 20/4/2009 & 7/10/2010 20/10/2009 (& 7/10/2010	Once year	a	- All temperature sensors are using Kobold TWD-B9410213T model. - Calibration frequency recommended by Kobold is once a year. - For all the temperature sensors recalibration was delayed from 20/4/2010 to 7/10/2010. During this period, PP had applied the maximum permissible error of each of the sensor as specified in the equipment specification to the data recorded from these sensors. This was found to be in accordance with EB52, Annex 60 requirements 'Guidelines for Assessing compliance with the calibration frequency requirements'. - The method of adjustment^{/60/} of the data was in accordance with the manufacturer's recommendation.
4)	Pressure transducer used for the normalization of $Q_{\text{biogas, engine, y}}$	S/N 260TUTO (PI61 for biogas engine no, 1) S/N 2063135 (PI62 for biogas engine no, 2) S/N : 260SUOX (PI63 for biogas engine no, 3)	23/7/2009 23/7/2009 9/1/2010 & 7/10/2010	Every years	2	- All the pressure transducers are Kobold brand. - The calibration was carried out by Thailand Promotion Association. - Calibration frequency as defined by the manufacturer. For PI63, there was no records of factory calibration and was only calibrated on 9 Jan 2010. Therefore, from the start of operation of the flowmeter until 8 Jan 2010, PP had applied the maximum permissible error to the data recorded from this gauge. The maximum permissible

					error was as specified by the equipment manufacturer. This was found to be in accordance with EB52, Annex 60 requirements 'Guidelines for Assessing compliance with the calibration frequency requirements'. The method of adjustment^{/61/} of the data was in accordance with the manufacturer's recommendation.
5)	Biogas flow to meter measure $Q_{\text{biogas, flare,y}}$	S/N 5815	28/2/2009 (Factory calibration)	Every 3 years	- Oscillator flowmeter (Kobold Technology) with accuracy class of 1.5% of measured volume (as per equipment specs) - The flow meter was installed on 11/8/2009. - Calibration frequency recommended by Kobold is 3 years. Clarification was raised on the re-calibration requirement. Refer to CL 1. In response to the CL, Kobold (Thailand) had provided a response that the recalibration cycle is based on the date of the installation of the equipment. Details of the findings and the closure are as in Table 2 of Annex 1 of this report.
6)	Temperature sensor used for the normalization of $Q_{\text{biogas, flare,y}}$	S/N. N0906.979 554	19/6/2009 & 7/10/2010	Once a year	- All temperature sensors are using Kobold TWD-B9410213T model. - Calibration frequency recommended by Kobold is once a year. - Re-calibration was delayed from 19/6/2010 to 7/10/2010. 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 was in accordance with the manufacturer's recommendation.
7)	Pressure gauge used for the normalization of $Q_{\text{biogas, flare, y}}$	S/N 260TUT1	23/7/2009 & 08/10/2010	Every 2 years	- Kobold pressure gauge identified by PP as PI64. - The meter was installed 11/8/2009. - The calibration was carried out by Thailand Promotion Association. - Calibration frequency as defined by the manufacturer.
8)	Methane analyser to measure fraction of methane biogas F_{CH_4}	S/N 29197 (analyser at the biogas plant) S/N 10034A4-203	17/8/2009 (Factory calibration) 24/11/2010	Once a year	- 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 or malfunctioned. - S/N 29197 analyser was installed on 8/10/2009 while S/N 10034A4-203 on 24/11/2010 - No recommendation made by the manufacturer on the calibration frequency. However, PP had decided to calibrate the analyser every once a year. - The analyser S/N 29197 was factory calibrated on 17/8/2009 and recalibrated on 24/11/2010. Therefore for period beyond the recalibration due date, the

					data from this analyser had been corrected as per EB 52 Annex 60 'Guidelines for Assessing compliance with the calibration frequency requirements'. Refer to CAR 5 in Table 2 of Annex 1 of this report.
9)	Thermocouple used to measure T_{biogas}	S/N N0185334	9/6/2009 (Factory calibration)	Once year a	- 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. - This meter was installed on 11/8/2009. - The calibration frequency is as per manufacturer recommendation. - Recalibration was carried out on 8/10/2010. 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.
10)	Pressure meter to measure P_{biogas}	S/N 800238600 01	17/7/2009 (Factory calibration)	Every years 2	- 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 recommendation.
11)	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

					the results recorded in Quarterly Checklist TBP009.
12)	Pressure gauge to measure pressure of biogas at flare	S/N 260TUT1	23/7/2009 & 08/10/2010	Every 2 years	- Kobold pressure gauge identified by PP as PI64. - The meter was installed 11/8/2009. - The calibration was carried out by Thailand Promotion Association. - Calibration frequency as defined by the manufacturer.
13)	Power meters	S/N 20650024 6(M5)	08/05/07	Every 3 years	- All power meters used were Schneider Electric PowerLogic except for M5 which is EDM I Genius with accuracy class of 0.5 - M5 power meter was installed on 28/7/2009 and is used to measure the kWh total sold to PEA. The calibration of this meter is controlled by PEA and the calibration status was indicated to be valid until 31/12/2015. - The location of the meter was verified and it was found that the meter was sealed to ensure only personnel from PEA are allowed to record the meter reading. - The calibration frequency was determined by PEA which is not consistent with the Annex 9 of EB 59 "General Guidelines to SSC CDM methodologies". Refer to CAR 6 in Table 2 of Annex 1 of this report. In response to the CAR, PP had decided to change the calibration frequency to once in every 3 years.

		S/N 48F703C3 (M8)	11/12/2009	Once year	a	• M8 was installed on 12/8/2009. • Calibration was carried out by PEA on 11/12/2009 and the error reported was -0.4%. The manufacturer's specification specify that the error of this meter is $\pm 1\%$. • Recalibration was carried out on 7/1/2011 and the calibration report indicated no error. • Since the calibration was only carried out on 11/12/2009, the data used prior to this date was corrected as per EB 52 Annex 60 'Guidelines for assessing compliance with the calibration frequency'. A 1% data error was added into the meter readings. Refer to CAR 7 in Table 2 of Annex 1 of this report. • The calibration frequency was initially stated as once in 2 years. CAR 7 was raised on this issue as there was no documented evidence to support this requirement. In response to the CAR, PP had decided to carry out the calibration once a year.
		S/N 3914587 (M9)	11/12/2009	Once year	a	• M9 was installed on 12/8/2009. • Calibration was carried out by PEA on 11/12/2009 and the error reported was -0.2%. • Recalibration was carried out on 7/1/2011 and the reported error was -0.2%.

					- The manufacturer's specification specify that the error of this meter is $\pm 0.5\%$. Therefore an error factor of 0.5% was added to the data used prior to the calibration date. This was found to be in accordance with EB 52 Annex 60 'Guidelines for assessing compliance with the calibration frequency'. Refer to CAR 7 in Table 2 of Annex 1 of this report. - The calibration frequency was initially stated as once in 2 years. CAR 7 was raised on this issue as there was no documented evidence to support this requirement. In response to the CAR, PP had decided to carry out the calibration once a year.
		S/N 4906841E (M7)	11/12/2009	Once a year	- During this monitoring period, 2 power meters were used to monitor electricity consumed by the project activity. The first meter S/N 4906841E was installed on 8/11/2009 to replace M8 and M9 meter readings. - This power meter was calibrated by PEA on 11/12/2009. - Since the calibration was only carried out on 11/12/2009, the data used prior to this date was corrected as per EB 52 Annex 60 'Guidelines for assessing compliance with the calibration frequency'. From the calibration report, it was reported that the error was -0.35% and according to the manufacturer's specification, the error is

					$\pm 1\%$. Therefore, error of 1% was added into the meter reading for data from 8/11/2009. PP had decided to apply this error until 31/12/2009. Refer to CAR 7 in Table 2 of Annex 1 of this report. The calibration frequency was initially stated as one in 2 years. CAR 7 was raised on this issue as there was no documented evidence to support this requirement. In response to the CAR, PP had decided to carry out the calibration once a year.
		S/N 4A9515d5 (M7)	7/1/2011	Once a year	- This meter was installed on 14/9/2010 and calibration was only carried out on 7/1/2011. - Since there was no calibration during the monitoring period, the data from this meter was corrected as per EB 52 Annex 60 'Guidelines for Assessing compliance with the calibration frequency requirements'. An error of 1% was added to the meter readings. Refer to CAR 7 in Table 2 of Annex 1 of this report. - The calibration frequency was initially stated as 2 years once. CAR 7 was raised on this issue as there was no documented evidence to support this requirement. In response to the CAR, PP had decided to carry out the calibration once a year.
14)	Flow meter to measure	S/N265044	18/2/2009(Factory)	Once in 2 years	Kobold magnetic flow meter identified as FI01

	volume of waste water treated $Q_{y,w}$		calibration)		was installed at POME inlet to the CIGAR on 11/8/2009. • Accuracy class of the flow meter is ± 0.3 • Calibration frequency recommended by Kobold is 2 years. Clarification was raised on the re-calibration requirement. Refer to CL 1. In response to the CL, Kobold (Thailand) had provided a response that the recalibration cycle is based on the date of the installation of the equipment. Details of the findings and the closure are as in Table 2 of Annex 1 of this report.
15)	COD meter to measure $COD_{y,ww,treated,j}$, $COD_{y,ww,untreated}$	S/N. 1275172	29/12/2008 (Factory calibration) & 11/2/2010	Once a year	• Calibration frequency of this spectrophotometer was not specified by the manufacturer, but PP had decided to calibrate once a year. • The equipment was in use since 14/10/2009.
16)	Flow meter to measure the volume of sludge generated	S/N. 265047	23/2/2009 (Factory calibration)	Once in 2 years	• Kobold magnetic flow meter identified by PP as FI02 was installed at the outlet of the settling pond. • Accuracy class of the flow meter is ± 0.3 • Calibration frequency recommended by Kobold is 2 years.

During this monitoring period, PP had applied the guideline provided in EB 52 Annex 60 'Guidelines for assessing compliance with the calibration frequency', for dealing with issues relating to the delay in calibration or where there was no evidence of calibration having been carried out, whereby for data used in the calculation of the project emissions, the maximum permissible error was added and for baseline emissions, the error was deducted from the measured values. With this application, the data measured by the meters have been corrected conservatively.

3.6 Management System and Quality Assurance

The roles and responsibilities for monitoring of emission reduction data have 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 GHG data records.

4 VERIFICATION AND CERTIFICATION STATEMENT

SIRIM QAS International Sdn Bhd was engaged by Univanich Palm Oil Public Co. Ltd. to carry out the verification of the greenhouse gas (GHG) emissions reduction reported from the CDM registered project activity 'Univanich TOPI Biogas Project' for the period from 1 October 2009 and 31 December 2010.

The verification was based on the CDM registered PDD^{/1/}, version 5.1 dated 4 June 2009, the approved methodology, AMS III.H.- Methane recovery in wastewater treatment, version 9^{/3/} and AMS I.D. – Grid connected renewable electricity generation version 13^{/14/}, the Monitoring Reports^{/6//43/48//65/}, the registered Gold Standard Annex^{/74/}, Gold Standard Monitoring Report Annex^{/75/}, emissions reduction calculation spreadsheets^{/7//44//49/} 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 October 2009 and 31 December 2010 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 Manual^{/45/}. As a result of the verification, the verification team confirms that for the reporting period:

- all operations of the project were implemented as described in the registered PDD, version 5.1 dated 4 June 2009,
- 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^{/65/} (version 7, dated December 2011) was correct and that the emission reductions achieved had been determined correctly. In our opinion, the GHG emission reductions for the period from 1 October 2009 and 31 December 2010 stated in the latest revised monitoring report^{/65//76/} are calculated without material misstatements in a conservative and appropriate manner.

Our opinion is based on the project's GHG emissions and resulting GHG emission reductions reported, and, to the valid and registered project baseline and monitoring documents. Based on the information we have seen and evaluated, we confirm the following:

Monitoring period	01/10/2009 to 31/12/2009	01/1/2010 to 31/12/2010
Total Baseline Emissions	19,903.80 tCO ₂ e	71,183.93 tCO ₂ e
Total Project Emissions	3,977.88 tCO ₂ e	11,917.59 tCO ₂ e
Emission Reductions	15,925.92 tCO ₂ e	59,266.34 tCO ₂ e

Prepared by :



(Aminah Ang)
Verification Team
Leader
3 May 2012

Approved by :



(Parama Iswara Subramaniam)
DOE Representative
3 May 2012

5 REFERENCES

- /1/ Registered PDD, version 5.1, dated 4/6/09
- /2/ Validation Report CDM.VAL2195^{/2/} dated 9 June 2009
- /3/ AMS III.H.- Methane recovery in wastewater treatment,version 9
- /4/ AMS I.D. – Grid connected renewable electricity generation version 13
- /5/ Tool to determine project emissions from flaring gases containing methane version 1
- /6/ Monitoring Report version 1, April 2011
- /7/ UNIV TOPI ER Calculation version 1, April 2011
- /8/ UNIV TOPI Flare Tool spreadsheet version 1, April 2011
- /9/ Certificate of conformance for HACH meter HAC1275172
- /10/ COD sampling and analysis procedure
- /11/ Certificate of calibration for HACH Meter 1275172,dated 12 February 2011
- /12/ Manufacturer specification for Oscillation Flow Meter for Gases Kobold
- /13/ PEA Electricity monthly meter reading report for VSPP
- /14/ PEA monthly electricity invoices
- /15/ PEA Calibration Reports for Digital Power Meter (M7) dated11/12/2009 & 7/1/2011
- /16/ PowerLogic meters specification (Digital Power Meter) by Schneider Electric
- /17/ PEA Calibration report for M5 dated 23 April 2007
- /18/ PEA Calibration report for M8 dated 11/12/2009 & 7/1/2011
- /19/ PEA Calibration report for M9 dated 11/12/2009 & 7/1/2011
- /20/ KOBOLD Calibration report for magnetic flow meter S/N 265044 (FI01) dated 18/2/2009
- /21/ KOBOLD Calibration report for oscillator flow meter S/N 5814 (FI60) dated 28/2/2009
- /22/ Recommended recalibration cycle for gas flow meter and magnetic flow meter from KOBOLD Instrument Ltd.(equipment manufacturer)
- /23/ KOBOLD Calibration report for oscillator flow meter S/N 5813 (FI61) dated 28/2/2009
- /24/ KOBOLD Calibration report for oscillator flow meter S/N 5811 (FI62) dated 28/2/2009
- /25/ KOBOLD Calibration report for oscillator flow meter S/N 5812 (FI63) dated 28/2/2009
- /26/ KOBOLD Calibration report for oscillator flow meter S/N 5811 (FI64) dated 28/2/2009
- /27/ Certificate of calibration for temperature transmitter with probe S/N N0185334 dated 9 June 2009 (TI60) by Thailand Promotion Association
- /28/ Honeywell ST3000 standard calibration report dated July 2009 S/N80023860001 (PI60)
- /29/ Certificate of calibration for temperature transmitter with probe S/N N0906.979554 dated 6 October 2009 (TI64) by Thailand Promotion Association
- /30/ Certificate of calibration for pressure transmitter S/N 260TUT1 dated 23 July 2009

- (TI64) by Thailand Promotion Association
- /31/ TOPI Decanter commissioning report dated 25/07/08
 - /32/ TOPI Biogas quarterly checklist and safety walk through (TBP009)
 - /33/ JE Certificate of calibration for CH4 analyser at gas engine no. 1, S/N2916 dated 5/8/09
 - /34/ JE Certificate of calibration for CH4 analyser at biogas plant, S/N29197 dated 17/8/09
 - /35/ Calibration certificate for CH4 gas analyser S/N 10034A4-203 dated 24/11/10 (at biogas plant replacing the old unit /34/)
 - /36/ Calibration certificate for CH4 gas analyser at gas engine no. 1, S/N2916 dated 24/11/10
 - /37/ Daily Electricity Meter Record Form TBP004_1
 - /38/ Wastewater analysis reports TBP003
 - /39/ CH4 analyser meter specification
 - /40/ TOPI Biogas Plant – genset data report – recording hourly the CH4 reading from genset no.1 monitored continuously and recorded hourly
 - /41/ Water analysis report by Saint Envir Co., Ltd. – COD analysis by external laboratory
 - /42/ TOPI Biogas Project – Covered Lagoon Report – record the daily meters reading
 - /43/ Monitoring Report version 5 dated August 2011
 - /44/ UNV TOPI ER calculation version 4.1, 20/7/2011
 - /45/ VVM version 1.2
 - /46/ UNV TOPI flare tool Excel spreadsheet version 2, dated 26/5/2011
 - /47/ Summary of flow meter setting and the mathematical setting for the normalisation from supplier of Kobold equipment, ST Control Co. Ltd.
 - /48/ Monitoring Report version 6 dated October 2011
 - /49/ UNV TOPI ER calculation version 5, 05/10/2011
 - /50/ Calibration certificate for pressure transmitter PI61, S/N. 260TUTO dated 24/07/2009
 - /51/ Calibration certificate for pressure transmitter PI62, S/N. 2063135 dated 24/07/2009
 - /52/ Calibration certificate for pressure transmitter PI63, S/N. 260SUOX, dated 9/01/2010
 - /53/ Calibration certificate for pressure transmitter PI64, S/N. 260TUT1, dated 24/07/2009
 - /54/ Calibration certificate for temperature sensor TI61, S/N.N0851.965110 dated 06/10/2009
 - /55/ Calibration certificate for temperature sensor TI62, S/N. N0851.965113, dated 06/10/2009
 - /56/ Calibration certificate for temperature sensor TI63, S/N. N0851.965101dated 06/10/2009
 - /57/ Calibration certificate for temperature sensor TI61, S/N.N0851.965110 dated 01/11/2010
 - /58/ Calibration certificate for temperature sensor TI62, S/N. N0851.965113, dated 01/11/2010
 - /59/ Calibration certificate for temperature sensor TI63, S/N. N0851.965101dated 01/11/2010
 - /60/ Calibration certificate for pressure transmitter PI61, S/N. 260TUTO dated 08/11/2010
 - /61/ Calibration certificate for pressure transmitter PI62, S/N. 2063135 dated 08/11/2010
 - /62/ Calibration certificate for pressure transmitter PI63, S/N. 260SUOX, dated 08/11/2010

- /63/ Calibration certificate for temperature sensor TI64,S/N.N0906.979554, dated 01/11/2010
- /64/ Calibration certificate for pressure transmitter PI64, S/N. 260TUT1, dated 08/11/2010
- /65/ Monitoring Report version 7 dated December 2011
- /66/ UNV TOPI Biogas ER Calculations v6
- /67/ Method for calculation Nm3 accounting T error v1.1
- /68/ Method for calculation Nm3 accounting P error v1.1
- /69/ Letter from the Deputy Executive Director,Thailand Greenhouse Gas Management Organization dated 9 May 2011
- /70/ Letter from Krabi Agriculture Office dated 28 March 2011
- /71/ Visitor Log Book
- /72/ Staffs appointment letter dated 18 May 2009
- /73/ Staffs payroll 2010
- /74/ Registered Gold Standard Annex, version 7.2 July 2010
- /75/ Gold Standard Monitoring Report Annex, version 1, 11 April 2011
- /76/ Gold Standard Monitoring Report Annex, version 3.1,0 dated April 2012

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ANNEX 1:
VERIFICATION PROTOCOL
SQAS-GS-EU02350002

SIRIM QAS INTERNATIONAL SDN BHD

Verification checklist

Project name : Univanich TOPI Biogas Project (Project no. 2661)

TABLE 1: VERIFICATION REQUIREMENTS BASED ON CDM VALIDATION AND VERIFICATION MANUAL VERSION 01.2

Checklist Questions	Ref.	§	Comments by verifier	Draft Concl	Final Concl
1. Project implementation in accordance with the registered PDD Any concern related to the conformity of the actual project activity and its operation with the registered PDD shall be identified.					
1.1 Was an on-site visit conducted for this verification? If no, please justify the rationale of the decision.	VVM	196	Yes, on-site verification was carried out by the verification team on 27 and 28 April 2011.	OK	OK
1.2 Are all physical features of the proposed CDM project activity proposed in the registered PDD in place?	VVM	196	Yes, all the physical features of the proposed CDM project activity as described in the registered PDD were implemented.	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?	VVM	196	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 Is there any implementation or operation of the CDM project activity not conforming with the description contained in the registered PDD? If yes, proceed to 1.5.	VVM	197	None.	OK	OK
1.5 Has an assessment been conducted on the potential impacts due to these changes following EB 48 report, paragraph 73 and its annex 67? If yes, proceed to 1.6.	VVM	197	Not applicable	OK	OK
1.6 Has a notification or a request for approval of changes been submitted from the project activity as described in the registered PDD prior to the conclusion of the verification/certification for the corresponding monitoring period based on the assessment above?	VVM	197	Not applicable	OK	OK

2. Compliance of the monitoring plan with the monitoring methodology The monitoring plan of the proposed CDM project activity shall comply with the applied methodology.					
2.1 Is the monitoring plan of the CDM project activity complying with the applied methodology?	VVM	200	Yes, the monitoring plan in the registered PDD is complying with the requirements for monitoring as specified in AMS III.H version 9 and AMS 1.D version 13.	OK	OK
2.2 If no, was a request for revision of the monitoring plan done? (Approval from EB for the revised monitoring plan shall be obtained prior to concluding the verification and certification decisions.)	VVM	201	Not applicable.	OK	OK
2.3 Are there any monitoring aspects of the project activity 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)?	VVM	202	No. All monitoring aspects related to the project have been included in the PDD. No additional monitoring parameters are required. The monitoring frequency is as in the methodology.	OK	OK
2.4 If yes, is the request for revision of the monitoring plan necessary? (This revision may contribute in enhancing the level of accuracy and completeness of the monitoring plan)	VVM	202	Not applicable.	OK	OK

3. Compliance of monitoring with the monitoring plan. Monitoring of reductions in GHG emissions to result from the proposed CDM project activity shall be implemented in accordance with the monitoring plan contained in the registered PDD or the accepted revised monitoring plan.					
3.1 Have the monitoring plan and the applied methodology been properly implemented and followed by the project participants?	VVM	205 (a)	Yes, the PP had implemented the monitoring requirements as required in the monitoring plan of the registered PDD and the methodologies.	OK	OK
3.2 Have all parameters stated in the monitoring plan, the applied methodology and relevant CDM Executive Board decisions been sufficiently monitored and updated as applicable, including:	VVM	205 (b)	In accordance with the monitoring plan of the registered PDD, the following parameters were monitored :		
i) project emission parameters			i) Volume of wastewater ($Q_{y,ww}$) • Measured continuously using magnetic flow meter identified as FI 01 (S/N 265044) • The flow meter is connected to data logger no. 3 that recorded 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 • No data transfer error was found.	OK	OK

			ii) $COD_{y,ww,untreated}$ • Sampling by the site technician and analyse by the laboratory supervisor on monthly basis and sent to external laboratory on quarterly basis. • Sampling point and method was verified and found appropriate as sample was taken after the screen at the bottom of the mixing tank by using a scope. • Quarterly samples were sent to external accredited laboratory – Saint Envir Co.,Ltd. • In house laboratory test method was established – “SOP for COD sampling and analysis procedure”. The method included the samples preparation and operation of the equipment. The method was in accordance with the HACH method. Results of the analysis were recorded in the Wastewater Analysis Report (TBP003). • External lab results were also included in the spreadsheets. • No data transfer error was found.	OK	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. • 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).	OK	OK

			- External lab results were also included in the spreadsheets. - One data transfer error was found for the internal lab result on 25/1/2010	~~CAR-1~~	OK
		iv) Sludge application	- There was no sludge removed from the project activity - A flow meter (FI02) has been installed to monitor the amount of sludge remove and linked to data logger no.3. Record from data logger showed no flow. - S_{y,untreated} was included in the Monitoring Report but not in the PDD	~~CL-2~~	OK
		v) Other flare 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.	OK	OK
		vi) Other flare operation parameters – pressure biogas at flare	- On-site visit to the flare system identified that a pressure gauge with S/N260TUT1 was installed together with a temperature transmitter with probe which has S/N N0906.979554 - The P and T readings are linked to data logger no.2 which is dedicated for the flare system. The data from this meter was used to calculate the volume of biogas in normalised value (Nm³). The conversion to Nm³ was programmed in the data logger, and the reading recorded in the logger gives normalised value. - This parameter was not reported in the Monitoring Report	~~CAR-2~~	OK

			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. • This parameter was not included in the Monitoring Report • The unit measurement in monitoring plan is m³/h. This need to be revised to Nm³/h	CAR-2 FAR 1	OK FAR 1
ii) baseline emission parameters			In accordance with para 34 of AMS III.H version 9 the ER shall be based on the amount of methane recovered and fuelled or flared. The following parameters were monitored : 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. • The reporting of $Q_{\text{biogas, total, y}}$ in the Monitoring Report and the Excel spreadsheet was not using the data from the on –line flow meter. (i.e. it was based on the calculated total flow to each biogas engines and flare)	CAR-3	OK

			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 gas 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 T63 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. - No data transfer error was found.	OK	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. - 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 Nm^3 automatically by the data logger. - The information in the data logger was downloaded to Excel ER spreadsheet via a dedicated software. - No data transfer error was found.	OK	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 engine. The methane gas analyser at the gas engines (is used as back up when the main methane gas analyser at the biogas plant is out of order/malfunction). • The methane gas analyser at the biogas plant is linked to a data logger that measured and recorded data on every minute. • The methane analyser at the gas engine is not linked to any data logger. Data measured from this meter was recorded in 'Genset Data Report Checksheet' on an hourly basis by the technician. • The data from the methane analyser at the gas engine was in used during the period from 1/10/2009 to 8/10/2009 (i.e. when the methane analyser at the biogas plant was yet to be installed), from 12/10 to 13/10/2009 and from 16/2/2010 until 27/5/2010. The methane concentration recorded during this period was found to be within the normal range of the methane concentration of biogas generated from POME. The values were also comparable with the average data from the data logger. • The used of data from the back up methane analyser at the biogas engine was reported in Section B.1 of the Monitoring Report except for the period from 1/10/2009 to 8/10/2009 and from 12/10 to 13/10/2009 • Data from the methane analyser at the biogas plant (i.e. from data logger 2) was downloaded to the ER spreadsheet using a dedicated software. • No data transfer error was found.	CL-3	OK
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			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 bio-gas collected in the anaerobic treatment facility sent to the grid, and to be measured continuously using electricity meter at the electricity grid. • In the spreadsheet, PP had used the electricity generated at the gas engines rather than that sold to the grid. i.e. using data from M1, M2 and M3. • 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 • M8 – kWh usage in gas engine room from all source • M9 – kWh usage for covered lagoon system from all source • M7 – kWh total biogas use only from PEA • M7-1 –kWh total to biogas plant and from any source (i.e. both the renewable energy and grid) • M5 power meter was installed on 28/7/09 • M8 power meter was installed on 12/8/09 • M9 power meter was installed on 12/8/09 • M7 power meter was installed on 8/11/09	 CAR-4	OK
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			- For electricity consumed by the power plant and biogas engines, initially two power meters were installed i.e M8 for the gas engines and M9 for the lagoon and bio-gas system. These 2 power meters measured total kWh meter supplied to the plants from any source. On 8/11/09 another power meter was installed (M7) to monitor and measure the amount of electricity only from PEA. The data from M8 and M9 have been included in the spreadsheet but M7 was not included. - The kWh cumulative readings from all the meters were recorded in the Daily Electricity Meter Record (TBP004_1) on an 24 hour basis, i.e. every 8am of the day by the technician.	CAR-4	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.Thongchai Posew – CDM Biogas Manager /QC Manager iii) Ms.Watcharee Kongsan – Biogas Supervisor iv) Ms. Bridget McIntosh – CDM Consultant.	OK	OK

			There were total 5 staffs fully in-charge of the biogas plant (1 biogas supervisor and 4 field technician). The following trainings were attended : i) Series of training on biogas plant operation by the technology provider /consultant, ii) Training on gas engine operation by the biogas engine supplier. The list of training and the related dates were as reported in Section B.1 of the Monitoring Report.		
3.3 Is the accuracy of equipment used for monitoring is in accordance with the relevant guidance provided by the CDM Executive Board and is controlled and calibrated in accordance with the monitoring plan?	VVM	205 (c)	All monitoring equipment was calibrated in accordance with the frequency described in the Monitoring Plan of the registered PDD or in accordance with the manufacturer's recommendation. The calibration of the following equipment was verified : i) 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) • Installed on 11/8/2009 • Manufacturer's calibration 28/2/2009 • Calibration frequency recommended by Kobold is 3 years but it was not sure whether the validity of the calibration is from the installation date or calibration date. ii) Biogas flow meter to measure $Q_{\text{biogas, engine,y}}$ • Each biogas engine is equipped with one flow meter. • 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 but it was not sure whether the validity of the calibration is from the installation date or calibration date.	CL-1	OK
				CL-1	OK

			• Biogas engine no.1 equipped with flow meter S/N/5813 identified by PP as FI61. FI61 was installed on 11/8/2009. Manufacturer calibration 28/2/2009. • Biogas engine no.2 equipped with flow meter S/N/5811 identified by PP as FI62. FI62 was installed on 11/8/2009. Manufacturer calibration 28/2/2009. • Biogas engine no.3 equipped with flow meter S/N/5812 identified by PP as FI63. FI63 was installed on 1/10/2009. Manufacturer calibration 28/2/2009.	OK	OK
			iii) 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) • Installed on 11/8/2009 • Manufacturer's calibration 28/2/2009 • Calibration frequency recommended by Kobold is 3 years but it was not sure whether the validity of the calibration is from the installation date or calibration date.	OK	OK
			iv) 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 methane gas analyser at the biogas plant is linked to data logger no.2 that measured and recorded data every minute.	CL-1	OK
				OK	OK

			• The methane analyser at the gas engine is not linked to any data logger. Data measured from this meter was recorded in the 'Genset Data Report Checksheet' on an hourly basis by the technician • Methane gas analyser at the biogas plant with S/N 29197 was installed on 8/10/2009. Manufacturer's calibration was carried out on 17/8/2009. No recommendation from manufacturer on the calibration frequency and PP had decided to calibrate once a year. The methane gas analyser was changed to a new unit on 24/11/2010 (OLCT IR with S/N.10034A4-203, which was calibrated on 24/11/2010). The new meter was not included in the Monitoring Report. • The meter S/N 29197 was not calibrated in accordance with the frequency (i.e. no calibration before 8/10/2010)	CAR-5	OK
		v) Thermocouple used to measure T_{biogas} • N type thermocouple (S/N. 0185334) installed on line at the biogas pipeline identified by PP as TI60. The meter was installed next to the biogas flow meter FI60. • First calibration was on 2/6/2009 by the supplier. The thermocouple was installed on 11/8/2009. • This meter was not reported in the monitoring report and the frequency of calibration was not determined.	CAR-2		
			vi) Pressure meter to measure P_{biogas} • A Honeywell ST3000 pressure transducer (S/N 80023860001) identified by PP as PI60 installed on line at the biogas pipeline next to the thermocouple. • First calibration was carried out by Honeywell on 17/7/2009. The meter was installed on 11/8/2009. • This meter was not reported in the monitoring report and the frequency of calibration was not determined.	CAR-2	OK

			vii) 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 TOPI Biogas quarterly checklist and safety walk through TBP009.	OK	OK
			viii) Pressure gauge to measure pressure of biogas at flare - Kobold pressure gauge S/N 260TUT1 identified by PP as PI64. The meter was installed 11/8/2009 next to FI64. - Calibrated on 24/6/2009 by Thailand Promotion Association - This meter was not reported in the monitoring report and the frequency of calibration was not determined.	CAR-2	OK
			ix) Thermocouple used to measure temperature of biogas at flare - Temperature transmitter with probe (Kobold S/N. N0906.979554) was installed on 11/8/2009 at the flare system - The transmitter and the probe was calibrated on 22/6/2009.	OK	OK
			x) Power meters Only power meters that were relevant to the project activity was reviewed (i.e. M5, M7, M8 and M9). M1, M2 and M3 which were included in the monitoring report were not relevant.		

			• All power meters were using Schneider Electric Power-Logic except for M5 which is EDM I Genius with accuracy class of 0.5 • Power meter M5 (total kWh sold to the grid) – was supplied and controlled by the Provincial electricity Authority (PEA). The meter labelled as PEA 20963428 was installed on 28/7/2009. The location of the meter was verified and found that the meter was sealed to ensure only authorised personnel from PEA to take the reading. The calibration certificate for M5 was made available to the verification team. Calibration sticker indicated the calibration validity from 08/05/07 to 31/12/15. The calibration frequency was determined by PEA which is not consistent with the Annex 9 of EB 59 “General Guidelines to SSC CDM methodologies”	CAR-6	OK
			• M8 power meter with S/N.48F703C3 was installed on 12/8/2009 and was calibrated on 11/12/2009 (error - 0.4%) and 7/1/2011 (no error) by PEA. Frequency of calibration was indicated as 2 years. According to PP 2 years was as defined by PEA. Evidence of such requirements was not provided to the verification team. The calibration was only carried out on 11/12/2009 but the data used from this meter started from 1/10/2009.	CAR-7	OK
			• M9 power meter with S/N.3914587 was installed on 12/8/2009 and was calibrated on 11/12/2009 (error - 0.2%) and 7/1/2011(error -0.2%) by PEA. Frequency of calibration was indicated as 2 years. The calibration was only carried out on 11/12/2009 but the data used from this meter started from 1/10/2009.	CAR-7	OK

			M7 power meter – 2 units were used. The first one with S/N. 4906841E was calibrated on 11/12/2009, was replaced with new power meter with S/N 4A9515d5 which was calibrated by PEA on 7/1/2011 (error -0.09%). The data from the M7 old meter was used from 8/11/2009	CAR-7	OK
			xi) Flow meter to measure volume of waste water treated $Q_{y,w}$ - Kobold magnectic flow meter with S/N265044 identified as FI01 was installed at POME inlet to the CIGAR - Accuracy class of the flow meter is ± 0.3 - Manufacturer's calibration : 18/2/2009 and installation date : 11/8/2009 - Calibration frequency recommended by Kobold is 2 years but it was not sure whether the validity of the calibration is from the installation date or calibration date.	CL-1	OK
			xii) COD meter to measure $COD_{y,ww,treated,j}$, $COD_{y,ww,untreated}$ - Spectrophotometer with S/N. 1275172 - Manufacturer's calibration : 29/12/2008 - Equipment started to be used on 14/10/2009 - Re-calibration : 11/2/2010 - Calibration frequency was not specified by the manufacturer, but PP had decided to calibrate once a year.	OK	OK
3.4 Are monitoring results consistently recorded as per approved frequency?	VVM	205 (c)	Yes, the monitoring was carried out in accordance with the approved frequency. The following parameters were monitored : i) Total amount of biogas recovered ($Q_{biogas,total,y}$), amount of biogas recovered and combusted for energy production($Q_{biogas,engine,y}$), amount of biogas recovered and flared ($Q_{biogas,flare,y}$) continuously measured using on-line flow meters	OK	OK

			ii) Fraction of methane in biogas - continuously measured using on-line flow meter iii) Temperature, pressure of biogas and pressure of biogas at flare iv) - Continuously measured using on-line temperature and pressure meters. v) Net electricity generated from biogas collected in the anaerobic treatment facility sent to the grid - Although data was wrongly reported, on-line power meters with cumulative reading were available to measure the data. vi) Volume of wastewater treated - Measured using an on-line magnetic flow meters vii) COD treated and COD entering biogas - Analysis carried out monthly by the in house laboratory and quarterly by external laboratory. <td>OK</td> <td>OK</td>	OK	OK	
				OK	OK	
				Refer to CAR 4	OK	
				OK	OK	
				OK	OK	
3.5	Have quality assurance and quality control procedures been applied in accordance with the monitoring plan monitoring plan?	VVM	205 (c)	QA/QC requirements in accordance with the monitoring plan have been implemented by the PP.	OK	OK
4.	Assessment of data and calculation of greenhouse gas emission reductions. GHG emission reduction achieved by/resulting from the proposed CDM project activity calculated applying the selected methodology.					

4.1	Is a complete set of data for the specified monitoring period is available? (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 DOE shall opt to either make the most conservative assumption theoretically possible in finalizing the verification report, or raise a request for deviation prior to submitting request for issuance if appropriate).	VVM	208 (a)	Yes, all data as required by the methodology and PDD were available although for 'Net electricity generated from biogas collected in the anaerobic treatment facility sent to the grid' data from different meters were used.	Refer to CAR-4	OK
4.2	Has information provided in the monitoring report been crosschecked with other sources such as plant log books, inventories, purchase records, laboratory analysis?	VVM	208 (b)	Yes, the information in the monitoring report has been cross-checked 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

			The following were found not correctly reported in the Monitoring Report: i) The end date of the monitoring period as indicated in the Monitoring Report should be 31/12/2010 instead of 30/12/2010 ii) The reporting on the progress of the project activity in Section B.1 have not included the following: • Change in M7 power meter and methane gas analyser • Plant shut down in April 2010 iii) Not all parameters reported in Section D.1 were applicable in the calculation during this monitoring period.	~~CAR-8~~	OK
4.3 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?	VVM	208 (c)	Yes, the calculation of baseline emissions and project activity emissions were carried out in accordance with the formula and methods described in the monitoring plan and the applied methodologies. For the spreadsheet, the following need clarification: i) In Table 2 of 'Input Variable' sheet, the emissions factor of electricity used in the project (EF_{project}) was indicated as '0'. This is only applicable if electricity from biogas engine or biomass plant from the mill is used. What happen if electricity from PEA was used? ii) At 'AMS III.H' sheet, under the ER from methane combustion for energy production or flaring, the methane density and GWP_CH4 (Row G54 and G 55) was sum up.	~~CL-4~~	OK
4.4 Any assumptions used in emission calculations? If yes, they been justified?	VVM	208 (d)	There were no assumptions used in emission calculations.	OK	OK

4.5 Have appropriate emission factors, IPCC default values and other reference values been correctly applied?	VVM	208 (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 were as indicated in Table 2 of the spreadsheet and Section D.1 in the Monitoring Report.	OK	OK
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TABLE 2 : RESOLUTION OF CORRECTIVE ACTION AND CLARIFICATION REQUESTS

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 2	Summary of project owner response	Verification team conclusion
<u>CAR 1</u> COD_{y,ww,treated} from internal laboratory result for 25 Jan 2010 was 0.001435 t/m³ instead of 0.0010 as indicated in the spreadsheet.	205(b)	COD_{y,ww,treated} was corrected for 25 Jan 2010 to read 0.001435 t/m³ in the ER spreadsheet, which adjusts the overall value for COD_{y,ww,treated}	Data has been amended in accordance with the verified value. Conclusion: CAR 1 closed.
<u>CAR 2 :</u> The following were not included in the Monitoring Report : i) Other flame operation parameters – pressure biogas ii) Other flame operation parameters – flowrate of biogas at flare iii) Thermocouple used to measure T_{biogas} iv) Pressure meter to measure P_{biogas} v) Pressure transmitter to measure pressure of biogas at flare .	205 (b)	<u>Response no. 1:</u> Section D.2 of the Monitoring Report has been updated to include the following parameters: • Other flame operation parameters – pressure biogas measured using pressure transmitter • Other flame operation parameters – flowrate of biogas at flare • Thermocouple used to measure T_{bio-gas} • Pressure meter to measure P_{biogas} <u>Response no. 2:</u> The MR has been updated to include the instrumentation, calibration frequency for T_{biogas} and P_{biogas}	<u>Comments no. 1:</u> All the highlighted parameters have been included in the Monitoring Report. • pressure transmitter and thermocouple – please provide calibration certificate for 2010. No mentioned in the monitoring report on the calibration carried out for these meters. • We need confirmation from supplier on the calibration frequency. <u>Comments no. 2:</u> Information on the calibration of pressure transmitter and thermocouple has been in-

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
		There was a period when the instrument was out of calibration 8 June 2010 – 8 October 2010, therefore as per EB 52 Annex 60 'Guidelines for Assessing compliance with the calibration frequency requirements' error should be deducted. However, as TI60 is not actually used for ER calculation, the error application is not relevant.	cluded in the revised Monitoring Report. Confirmation from Kobold Instrument Ltd. on the calibration frequency of pressure transmitter (2 year once) and thermocouple (once a year) was provided. It is agreed that this parameter was not in used in the calculation of the ER. Therefore, the issue on the late calibration was not relevant. Conclusion: CAR 2 closed.
<u>CAR 3</u> The $Q_{\text{biogas, total, y}}$ was not included in the Monitoring Report and the Excel spreadsheet was not using the data from the on –line flow meter. (i.e. it was based on the calculated total flow to each biogas engines and flare)	205 (b)	<u>Response no. 1:</u> Section D.2 of the Monitoring Report has been updated to include $Q_{\text{biogas, total, y}}$ The Excel spreadsheet has been updated to include a datasheet reporting this data from the in–line flow meter. However, the $Q_{\text{biogas, total, y}}$ has not been used to calculate total biogas combusted because the $Q_{\text{biogas, total, y}}$ is higher than the sum of the biogas measured at $Q_{\text{biogas, engine, y}}$ and $Q_{\text{biogas, flare, y}}$ and therefore the lower value has been used for conservativeness. <u>Response no. 2:</u> The ER spreadsheet has been checked to ensure consistency with the MR.	<u>Comments on response no. 1:</u> Data from the data logger has been included in the spreadsheet. The values in the spreadsheet and that in the monitoring report for (F160) not consistent. Please ensure the figures are consistent. <u>Comments on response no. 2:</u> The values in the MR and spreadsheet are consistent now.

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 : CAR 3 closed.
<u>CAR 4</u> The data reflected in the ER spreadsheet for the electricity baseline was based on the electricity generation from the 3 biogas engine rather than that sold to the grid. (i.e. not based on kWh readings at M5) The power meters M1, M2 and M3 included in the monitoring report were found not relevant to the calculation of the emission reduction in this project activity. The power meters such as M5 and M7 were not included.	205 (b)	<u>Response no. 1:</u> The ER spreadsheet has been corrected to show the net electricity sold to the grid. Initially, this was measured by M5 (total distributed to the grid, after electricity is taken off for the oil palm factory and to operate the biogas plant) and subtracting M8 & M9 (all electricity used to operate the biogas plant). Later, M7 was installed to measure only electricity imported from PEA to operate the biogas plant, and this replaced the need for monitoring M8&M9 which remain in place only as backup. The Monitoring Report has been updated to only include the relevant power meters in the electricity metering diagram. Section D.2 has been updated to include information relating to M5, M7, M8 & M9 and deleted reference to M1, M2, M3. <u>Response no. 2:</u> The data from M1, M2, M3 has been removed from the Excel spreadsheet to avoid confusion.	<u>Comments on response no. 1:</u> Power meter readings from M5 and M7 have been used in the spreadsheet. The values are as verified during the on-site verification. M1, M2 and M3 meters which were not relevant have been removed from the monitoring report. However, in the Excel spreadsheet, the values were still indicated as the total kWh generation. This may create confusion as the actual readings are taken from M5 (i.e. not the total of M1, M2 and M3) <u>Comments on response no. 2:</u> The spreadsheet has been updated to only include the relevant data. Conclusion: CAR 4 closed.
<u>CAR 5</u>	205 (c)	Section D.2 of the Monitoring Report has been updated to include methane gas ana-	i) The information o the gas analyser S/N.10034A4-203 has been included in

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
i) The methane gas analyser which was installed on 24/11/2010 (OLCT IR with S/N.10034A4-203, was not included in the monitoring report. ii) The methane analyser S/N 29197 was first calibrated on 17/8/2009, installed on 8/10/2009 but was not recalibrated until it was changed. According to PP's procedure, the calibration frequency is once a year.		lyser OLCT IR S/N.10034A4-203. This methane analyser was installed because it is more reliable than the JE sensor. Methane analyser 29197 was calibrated on 17/8/2009. It was recalibrated on 24/11/2010 and therefore there was a period where it was out of calibration. The values from this analyser during this period have been corrected as per EB 52 Annex 60 'Guidelines for Assessing compliance with the calibration frequency requirements' and the MR and ER calculation sheet have been updated. The backup inline methane analyser 29196 was also out of calibration during this period, however as the data from this analyser was not used in that period, there is no data to deduct the error. The heading in the spreadsheet is corrected as biogas methane concentration.	the Monitoring Report. ii) In the Monitoring Report, stated that last calibration 17 Aug 2009. PP had corrected the value for the period where the delay in calibration occurred. Conclusion : CAR 5 closed.
CAR 6 The calibration frequency for M5 was not consistent with the Annex 9 of EB 59 "General Guidelines to SSC CDM methodologies". It was stated at the meter that the calibration validity from 08/05/07 to 31/12/15	205 (c)	The date of installation of M5 was 28 July 2009 as discussed during site visit. The General Guidelines to SSC CDM methodologies state it must be earlier of 3 years or manufacturers specifications. As the manufacturers specifications is valid for 8 years (up to 31/12/2015) and it is the CDM that specifies 3 years, then 3 years have been applied since the date of instal-	In line with the General Guidelines to SSC CDM Methodologies, PP had adopted the maximum of 3 years for calibration of this power meter despite that PEA had indicated a 5 year validity. Since the installation date was on 28/7/09, the calibration is still valid until 27/7/12.

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
		lation of 28/07/2009 and there for valid until 27/07/2012 Table D.2 has been updated to reflect this.	Conclusion : CAR 6 closed.
<u>CAR 7</u> i) The calibration of the power meters M8 and M9 was indicated as 2 years and according to PP was in accordance with PEA practices. PP need to provide evidence of such practices. ii) The calibration for M8 and M9 was only carried out on 11/12/2009 but the data used from this meter started from 1/10/2009. iii) M7 power meter with S/N. 4906841E was only calibrated on 11/12/2009 but the data started to be used from 8/11/2009. For new power meter with S/N 4A9515d5 calibration was only carried out on 7/1/2011 (error - 0.09%).	205 (c)	The Provincial Electricity Authority of Thailand calibrate the meters annually. PEA have not provided evidence of the requirement for this frequency however annually is considered applicable. Meters M7, M8 M9 were delayed in calibration. Therefore the values from these meters during this period that have been corrected as per EB 52 Annex 60 'Guidelines for Assessing compliance with the calibration frequency requirements' as follows: - For M7 the measured error was -0.35% and the specifications for error is +/-1%. Therefore error was added at 1% from 8-11-2009 until 31-12-2009 as calibration was only on 11-12-2009. This meter replaced M8 and M9 on 8-11-2009. - For M8 the measured error was -0.4% and the specifications for error is +/-1%. Therefore error was added at 1%. This meter was replaced by M7 on 8-11-2009. - For M9 the measured error was -0.2% and the specifications for error is +/-	i) Since PP could not provide confirmation from PEA on the calibration frequency, changing the frequency to once a year considered as appropriate. ii) The application of error as required in the Guidelines have been applied for readings from M8 and M9. The maximum permissible errors of the meters as provided in the equipment specification were used. iii) M7 old meter, calibration was only carried out on 11/12/09, therefore the reading with error should be up to 10/12/09. However, PP had decided to apply the error for readings up to 31/12/2009. For new M7 meter, since the calibration was not carried out during the monitoring period, maximum error was also added into the readings. This is found to be conservative. Conclusion : CAR 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
		0.5%. Therefore error added at 0.5%. This meter was replaced by M7 on 8-11-2009.	
CAR 8 The following were found not correctly reported in the Monitoring Report: i) The end date of the monitoring period as indicated in the Monitoring Report should be 31/12/2010 instead of 30/12/2010 ii) The reporting on the progress of the project activity in Section B.1 have not included the following: • Change in M7 power meter and methane gas analyser • Plant shut down in April 2010 iii) Not all parameters reported in Section D.1 were applicable in the calculation during this monitoring period.	208(b)	The Monitoring Report has been corrected as follows: Date corrected to 31/12/2010 Section B.1 has been updated to include change in power meter M7, change in CH4 meter OLCT IR, and plant shod down in January and annual Water Festival holidays in April 2010 Parameters in Section D.1 that were not applicable in the monitoring period were deleted.	i) The end date has been amended to 31/12/2010. ii) Plant shutdown in April 2010 has been included. iii) Section D.1 has been updated accordingly. Conclusion : CAR 8 closed.
CL 1 The calibration frequency for the magnetic flow meter and the biogas flow meter was recommended by Kobold. However, it was unclear to whether the validity of the calibration is from the installation date or calibration date.	205 (c)	Kobold supplier have provided information that the validity of the calibration is after manufactured or after installation.	Confirmation from Kobold Instrument Ltd. had been obtained which confirmed that the recalibration cycle is from the installation date. Conclusion : CL 1 closed.
CL 2		This was an error by cut-paste from another Monitoring Report. This parameter has	This parameter has been removed from the Monitoring Report.

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
Please explain why $S_{y,untreated}$ was included in the Monitoring Report which was not specified in the PDD.	205 (b)	been deleted.	Conclusion: CL 2 closed.
CL 3 The used of data from the back up methane analyser at the biogas engine was reported in Section B.1 of the Monitoring Report except for the period from 1/10/2009 to 8/10/2009 and from 12/10 to 13/10/2009	205 (b)	Section B.1 has been updated to include the additional periods when the backup methane analysers was used (ie 1/10/2009 to 8/10/2009 and from 12/10 to 13/10/2009). This backup inline analyser monitors the CH₄ continuously and used in case there is a problem with the main methane analyser.	Monitoring Report has been updated accordingly. Conclusion: CL 3 closed
CL 4 i) In Table 2 of 'Input Variable' sheet, the emissions factor of electricity used in the project ($EF_{project}$) was indicated as '0'. This is only applicable if electricity from biogas engine or biomass plant from the mill is used. What happen if electricity from PEA was used? ii) At 'AMS III.H' sheet, under the ER from methane combustion for energy production or flaring, the methane density and GWP_CH₄ (Row G54 and G 55) was sum up.	208 (c)	The monitoring parameter in the PDD is 'Net Electricity generated ... sent to the grid' and in other sections of the PDD the ER claimed relates to electricity sold to the grid. Originally the ER Sheet calculated net electricity sent to the grid as (gross generation – auxiliary load). However, this was not considered sufficiently accurate by the DOE, and therefore (electricity sold to the grid – minus the auxiliary load) was applied. This means that the $EF_{project}$ was not applied as it has been subtracted from amount distributed from the grid; thereby technically apply 0 EF and thereby effectively revising the EF from 0 to 0.534. (Row G54 and G 55) was corrected as it should not have been summed up. This does not affect the ER values calculated.	i) The EF in Table 2 has been corrected from 0 to 0.534. ii) The cell has been revised. In the spreadsheet, EF is still referred to as CEF. Please amend. Conclusion: CL 4 closed.

Draft report clarifications and corrective action requests by validation team	Ref. to checklist question in table 2	Summary of project owner response	Verification team conclusion
<u>FAR 1</u> The unit for flowrate of biogas at flare need to be changed from m3/h to Nm³/h as required by the 'Tool to determine project emissions from flaring gases containing methane'. It was noted that in actual implementation the m3/h reading from the meter is directly converted into Nm3/h in the data logger.	205 (b)	A Request for Revision of the Monitoring Plan will be submitted prior to submission for next Issuance.	Conclusion : FAR 1 open.

Findings on compliance to Gold Standard requirements:

Findings	Summary of project owner response	Verification team conclusion
<u>CL 5</u> Appointment letter for 5 new staffs to support the compliance to GS8 requirement need to be provided.	Please see attached file 'TOPI Staffs Appointment' provided with this Verification Protocol. This documentation shows the staff that were either hired new or transferred to the Biogas project. Staffs that were transferred to the Biogas project were then replaced, as per the 'Personnel Requisition Form'. <u>Round 2</u> Although 2 staff were transferred to the Mill, 2 new staff were hired to replace them at the Mill. Additional documentation was provided as proof of the hiring of these 2 new staff. Therefore a total of 5 new jobs were created.	Appointment letter dated 18 September 2009 has been provided. 2 staffs were transferred from the mill, can this be considered as new? Comments on response no.2 : Supporting document was provided for the replacement of the 2 personnel in the mill. Therefore it can be concluded a total of 5 new staffs were recruited. Conclusion : CL 1 closed.

<u>CL 6</u> Statement provided by Thailand Greenhouse Gas Office confirming no new legislation has been introduced in Thailand was not provided.	Please see confirmation from Dr Chaiwat, Deputy Executive Director, of the Thailand Greenhouse Gas Office which confirms there was no new legislation introduced into Thailand relating to the requirement for biogas plants (file 'RE TGO confirmation of legislation mandating methane recovery from ww agro-processing plants in Thailand'.	Confirmation from the Deputy Executive Director, Thailand Greenhouse Gas Management Organization dated 9 May 2011 has been obtained. It was confirmed that since March 2008 there is no new legislation development that mandate methane recovery from wastewater treatment for Agro-processing plants in Thailand. Conclusion : CL 2 closed.
<u>CL 7</u> Letter from Krabi Agriculture Extension Office summarising source of new oil palm for 2008 – 2010 was not provided.	Please see Letter 'Krabi land for oil palm 2009_10' provided by Krabi Agriculture Extension Office which summarises the source of land for new oil palm and demonstrates that no forests were cleared for the expansion of oil palm in that period.	Letter from Krabi Agriculture Office dated 28 March 2011 confirmed that the sources of land for new oil palm are from land that is used to replace the coffee, fruit orchards and coconut areas, and empty land (ex-paddy and prawn farms). There was no forests cleared for the expansion of oil palm. Conclusion : CL 3 closed.