VERIFICATION REPORT

of

"WASTEWATER TREATMENT WITH BIOGAS SYSTEM IN PALM OIL MILL AT SAWI, CHUMPORN, THAILAND"

Document Prepared By: Germanischer Lloyd Certification GmbH

Project Title	Wastewater Treatment with Biogas System in Palm Oil Mill at Sawi, Chumporn, Thailand
Version	06

Report Title	Verification of "Wastewater Treatment with Biogas System in Palm Oil Mill at Sawi, Chumporn, Thailand"
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Summary:

Germanischer Lloyd Certification GmbH (GLC) has performed the VCS verification of the project "Wastewater Treatment with Biogas System in Palm Oil Mill at Sawi, Chumporn, Thailand" with regard to the relevant requirements for VCS project activities.

The project was validated and registered with reference no. 426 under VCS (Verified Carbon Standard) program on 18-05-2010. This is the 1st verification of the project which covers the period from 01-01-2009 to 31-05-2012 (both the days are included). The project is verified against the VCS Version 3/2/. The verification is based on the monitoring plan of registered VCS Project Description document (VCS PD)/1/, requirements of VCS (VCS Standard and VCS Program Guide of VCS Version 3)/2/ and CDM Validation and Verification Standard/3/. The project document is found at VCS registry under the Project ID 426 which can be accessible by below given link:

https://vcsprojectdatabase2.apx.com/myModule/Interactive.asp?Tab=Projects&a=2&i=426&la

The methodologies applied for the project to estimate the GHG emission reduction are **AMS III.H., version 13 – Methane Recovery in Wastewater Treatment** and **AMS I.D., version 14 – Grid connected renewable electricity generation /7/.**

Monitoring report (MR)/4/, Emission reduction calculation spread sheet (ER sheet)/5/, Project Description document (VCS PD)/3/ and other supporting documents have also been made available to the verification team by project participants.

The project activity involves treatment of wastewater generated from palm oil production process at The Natural Palm Group Co., Ltd. through CSTR (Complete Stirred Tank Reactor) and covered lagoon technology. The use

of CSTR and covered lagoon to treat the wastewater generated in the plant enables capturing of methane produced during the treatment as well as meets the effluent standards. The captured methane (or biogas) is utilized as fuel in onsite gas engines (electricity generators). Surplus biogas, if any, is either sent to boiler or flared in an open flare.

A risk based approach has been followed in this verification. In the course of verification, 7 Corrective Action Requests (CAR), 3 Clarification Request (CL) and 3 Forward Action Requests (FAR) have been raised. All the CARs and CLs have been closed out successfully.

As a result of the verification, the verifiers confirm that the GHG emission reduction in the verification period from 01-01-2009 to 31-05-2012, including both the days, is **91,121 tCO_2e.**

The emission reduction during each vintage of the monitoring period is as below:

Emission reductions in 2009:	22,609	t CO_2e
Emission reductions in 2010:	29,521	t CO_2e
Emission reductions in 2011:	28,523	t CO_2e
Emission reductions in 2012: (From 01-01-2012 to 31-05-2012)	10,468	t CO_2e
Total Emission Reductions during monitoring period:	**91,121**	**t CO_2e**

GLC does not assume any responsibility towards the issuance and utilization of VCUs hereby verified and certified. Request for issuance of VCUs shall be made by the project proponent to an approved VCS Program Registry based on the requirements set out under the most recent version of the VCS Program Guidelines clause on VCS Registration. The verification of reported emission reductions is based on the information made available to GLC and the engagement conditions detailed in this report. Hence, GLC cannot be held liable by any party for decisions made or not made based on this report.

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1 INTRODUCTION

South Pole Carbon Asset Management Ltd. has commissioned Germanischer Lloyd Certification GmbH (GLC) to carry out the 1st verification of the emission reductions reported for the VCS project activity "Wastewater Treatment with Biogas System in Palm Oil Mill at Sawi, Chumporn, Thailand" with regard to the relevant requirements for VCS program as per the VCS version 3/2/.

This verification report summarizes:

(i) The findings from the VCS verification for the current monitoring period from 01-01-2009 to 31-05-2012; and

(ii) VCU certification statement for the emission reductions.

1.1 Objective

VCS Verification is the independent review and ex post determination by a Verification Entity or Designated Operational Entity (DOE) (which is approved/registered as a verifier by VCSA) of the monitored reductions in GHG emissions that have occurred as a result of the registered VCS project activity during the defined verification period.

VCS Certification is the written assurance by a Certification Entity (which is approved/ registered as a certifier by VCSA) that, during a specific period in time, a project activity achieved the emission reductions as verified.

The objective of this verification was to verify and certify emission reductions reported for the "Wastewater Treatment with Biogas System in Palm Oil Mill at Sawi, Chumporn, Thailand" project for the monitoring period covering from 01-01-2009 to 31-05-2012 (both the days are included).

One of the objectives is also to confirm that the monitoring system is implemented and fully functional to generate Verified Carbon Units (VCUs) without any double counting.

1.2 Scope and Criteria

The scope of the verification is:

- To verify that the project activity has been implemented and operated as per the latest version of the VCS PD and that all physical features (technology, project equipment, and monitoring and metering equipment) of the project are in place.

- To verify that actual monitoring systems and procedures are in compliance with the monitoring systems and procedures described in the monitoring plan as per the latest version of the VCS PD.

- To evaluate the GHG emission reduction data and express a conclusion with a reasonable level of assurance about whether the reported GHG emission reduction data is free from significant misstatement.

- To verify that the reported GHG emission data is sufficiently supported by evidence.

The verification shall ensure that reported emission reductions are complete and accurate.

The project design, its eligibility as project activity under VCS guidelines and the correct application of the approved baseline and monitoring methodologies for small-scale CDM project activities; AMS III.H., version 13: Methane Recovery in Wastewater Treatment and AMS I.D., version 14: Grid connected renewable electricity generation[7] have already been validated by the DOE 'TUV NORD' (Validation Report issued on 18-11-2009)[6]. As stated in the validation report, the validation opinion of validating DOE was that the project activity as described in the registered VCS PD dated 15-11-2009 meets all VCS Program requirements as set out in the VCSA Rules (Voluntary Carbon Standard – 2007 and Voluntary Carbon Standard Program Guidelines 2007) and all relevant host country criteria.

The verification team has focused on the identification of significant reporting risks and verifying the mitigation measures for these risks based on the recommendations in the "Validation and Verification Standard"[3], "ISO 14064-3 Greenhouse gases – Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions and employed a risk-based approach" [10].

According to the requirements and guidance of VCS Version 3 [2], the criteria of this verification include the relevant applicable rules and steps for verification under the CDM excluding the following:

- The public availability of the VER/VCS Monitoring Report;
- Confirmation of contribution of the project activity towards sustainable development in the country where the project is located
- The public availability of the Verification Report and VCU Certification Statement.

1.3 Level of assurance

As the VCS Version 3 only recognizes verified emission reductions, GLC has focused on providing a reasonable level of assurance that the emission reduction calculation methodology used is appropriate and correctly applied, and that emission reductions have been accurately monitored.

In accordance with the recommendation in the Validation and Verification Standard, GLC may "discount verified emission reductions or requests a discount of these by using conservative assumptions for uncertainties in emission reduction calculations that cannot be fully quantified or that cannot give a desired level of assurance". For verifying/certifying VCUs, the desired level of assurance was based on the combined quantitative assessment of the accuracy of monitoring project performance and the identification of material risks. For this verification, GLC is able to give a reasonable level of assurance.

1.4 Summary Description of the Project

The project activity involves installation of an anaerobic wastewater treatment facility at The Natural Palm Group Co., Ltd., a palm oil production plant in Thailand. The palm oil factory has a capacity of processing 45 to 60 tons of fresh fruit bunches producing 200 tons of palm oil per day. The wastewater generation from the palm oil factory is approximately 450 m^3 per day as confirmed by the factory manager during the onsite verification.

Prior to project implementation, the wastewater was treated through an open lagoon based system with gravitational flow (cascading flow through 8 open lagoons). The minimum depth of these lagoons being more than 2 m and the average atmospheric temperature in the region about 27°C[1], these conditions resulted in anaerobic environment within the ponds resulting in methane generation from the organic content of the wastewater, characterized by its COD, which was released into the atmosphere.

The use of CSTR technology to treat wastewater enables not only the avoidance of methane into the atmosphere but also capturing of methane produced and meeting the effluent standards. The captured methane (or biogas) is utilized as fuel in existing gas engines of 2.48 MW to generate electricity. Any surplus biogas is either sent to onsite boiler or flared into the atmosphere through an open flare, thereby contributing to green house gas (GHG) emission reduction.

As per the registered VCS PD (VCS Ref No: 426) of the VCS project, baseline emissions are calculated as the sum of fugitive methane emissions from lagoons in the baseline case and CO_2 emissions due to electricity generation in gas engines which would replace equivalent energy from the electricity grid. Project emissions are calculated as the fugitive methane emissions from the project activity and the electricity consumption for the project activity. The emission reduction is calculated as the difference of baseline emissions and the project emissions as the leakage emissions are considered to be negligible for the project activity as per the applied methodologies.

The total emission reduction for the 1st verification period from 01-01-2009 to 31-05-2012 is 91,121 tCO_2e. The emission reduction is calculated conservatively as per the applied methodologies.

Further background information on the project activity can be found in the VCS Project Design document (VCS PD) as well as the Validation report which are available on the VCS website:

https://vcsprojectdatabase2.apx.com/myModule/Interactive.asp?Tab=Projects&a=2&i=426&lat=10%2E2927&lon=99%2E0908&bp=1

The project activity was implemented at Palm Oil factory of The Natural Palm Group Co., Ltd., which is located at 250 M. 12 Petchkasem Rd, Khron, Sawi, Chumporn, Thailand.

Main components of the project activity include Equalization pond, CSTR, Covered Lagoon, H_2S Scrubber, Gas holder, Gas engines, Boiler, Open flare and Cascading open lagoons system.

The project characteristics are as mentioned below:

Item	Data
Title of the project activity	Wastewater Treatment with Biogas System in Palm Oil Mill at Sawi, Chumporn, Thailand
Project Location (specific Address, Country)	Address: 250 M. 12 Petchkasem Rd, Khron, Sawi, Chumporn Country: Thailand Latitude: 10° 17'34"N (10.2928)

	Longitude: 99° 5' 27"E (99.0908)
Project proponents	The Natural Palm Group Co., Ltd.
	South Pole Carbon Asset Management Ltd.
Project Entities	The Natural Palm Group Co., Ltd. 250 M. 12 Petchkasem Road, Khron, Sawi, Chumporn Thailand
	South Pole Carbon Asset Management Ltd., Technoparkstrasse 1 Zurich -8005 Switzerland
Applied Methodologies	AMS III.H., version 13: Methane Recovery in Wastewater Treatment AMS I.D., version 14: Grid connected renewable electricity generation
Sectoral Scope	Sectoral Scope 13 : Waste handling and disposal Sectoral Scope 1: Energy Industries
Project crediting period	From 01-06-2006 to 31-05-2016
Period verified in this verification	From 01-01-2009 to 31-05-2012

2 VALIDATION PROCESS, FINDINGS AND CONCLUSION

2.1 Validation Process

NA

2.2 Validation Findings

2.2.1 Gap Validation

NA

2.2.2 Methodology Deviations

NA

2.2.3 New Project Activity Instances

Not applicable since this is not a grouped project

2.3 Validation Conclusion

NA

3 VERIFICATION PROCESS

3.1 Method and Criteria

The verification process was carried out inline with the requirements VCS Version3 /2/. In addition, the verification team followed the guidelines of the CDM Validation and Verification Standard /3/. Standard auditing techniques and GLC's CDM Procedures/11/ were also applied during the verification. The verification team performed first a desk review, followed by an on-site visit to review the project realization.

The verification process was based on assessment of the validated VCS Project Description document (VCS PD)/1/, the monitoring report/4/, emission reduction calculation spreadsheet (ER sheet)/5/, supporting documents made available to the verification team and information collected through performing interviews during the on-site assessment. Furthermore publicly available information was considered as far as available and required

The verification was carried out on the basis of the following requirements, applicable for this project activity:

- Requirements and guidance of VCS Version 3 /2/.
- Applicable CDM guidelines and requirements, including applicable relevant methodological decisions made by the CDM Executive Board.
- Other relevant rules, including the host country legislation,
- CDM Validation and Verification Standard /3/,
- Monitoring plan as given in the registered VCS PD /1/,
- Small-Scale CDM Methodologies; AMS III.H., version 13 – "Methane Recovery in Wastewater Treatment" and AMS I.D., version 14 – "Grid connected renewable electricity generation" /7/

3.2 Document Review

During the desk review all documents initially provided by the client and publicly available documents relevant for the verification were reviewed. The main documents are listed below:

- The validated VCS PD/1/, including the monitoring plan and the corresponding validation report/6/;

- Monitoring Report [4] and Emission reduction calculation sheet [5];
- The applied monitoring methodologies [7];
- Requirements and guidance of VCS [2] as well as applicable methodological relevant decisions, clarifications and guidance from the CDM Executive Board;
- Any other information and references relevant to the project activity's resulting emission reductions (e.g., IPCC reports[12], data on electricity generation in the national grid or laboratory analysis and national regulations).
- Addressing of FARs identified during the validation

3.3 Interviews

Representatives of The Natural Palm Group Co., Ltd including the operational staff of the biogas plant and South Pole Carbon Asset Management Ltd. (project consultant) were interviewed to confirm selected information and to resolve issues identified in the document review.

The main topics of the interviews are summarized in below table:

Interview Topic	Interviewed persons and source of information
• General aspects of the project • Project equipment operation and technical details • Changes since validation • Monitoring and measurement equipment • Remaining issues from validation and previous verification • Calibration procedures • Quality management system • Involved personnel and responsibilities • Training and practice of the operational personnel	Mr. Somchai Tunteeraphap, General Manager, The Natural Palm Group Co., Ltd. Mr. Paitoon Thangleleang, Power Plant Manager, The Natural Palm Group Co., Ltd. Mr. Vichar Chuvatiyara, Biogas Supervisor, The Natural Palm Group Co., Ltd. Mr. Kraisorn Keaw-on, Factory Manager, The Natural Palm Group Co., Ltd. Mr. Wisa Pen, QA & QC Supervisor, The Natural Palm Group Co., Ltd. Ms. Daranee Thammarat, Calibration in-charge, The Natural Palm Group Co., Ltd. Ms. Sirida Promkhunthong, Administrator, The Natural Palm Group Co., Ltd. Ms. Nattaya Lonawan, Project Manager,

Interview Topic	Interviewed persons and source of information
• Implementation of the monitoring plan • Monitoring data management • Data uncertainty and residual risks • GHG calculation • Procedural aspects of the verification • Maintenance • Environmental aspects	South Pole Carbon Asset Management Ltd. Ms. Narumon Tiangviriya, CDM Project Manager, South Pole Carbon Asset Management Ltd.

3.4 Site Inspections

From 23-07-2012 to 24-07-2012 GLC carried out an on-site verification of the project activity. During the visit, GLC's verification team verified that the actual implementation of the project was as described in the registered VCS PD.

On-site inspection included review of data and records, interviews with the plant manager, shift engineers, biogas supervisor, operations and maintenance personnel confirming all data sources used in the Monitoring Report.

The main tasks covered during the on-site visit included, but were not limited to:

- Verified whether the project was implemented as per the description in the VCS PD[/1/]
- Confirmation that all monitoring equipments have been installed and operated as per the monitoring plan in the VCS PD[/1/].
- The operating staff was interviewed and observed in order to check the risks of inappropriate operation and data collection procedures.
- Information processes for generating, aggregating and reporting the selected monitored parameters were reviewed.
- Calibration records of all metering equipment were checked and calibration procedure was verified.

- The monitored data was checked completely.

3.5 Resolution of Any Material Discrepancy

On the basis of the desk review, the on-site visit, follow-up interviews and further background investigation the verification report is completed.

Findings established during the verification may be that:

i) The verification is not able to obtain sufficient evidence for the reported emission reduction or part of the reported emission reduction. In this case these emission reduction shall not be verified and certified;

ii) The verification has identified significant misstatements in the reported emission reduction.

A detailed list of verification findings form the draft verification report, which is sent to the client for resolution of raised CARs and CLs.

Nonconformities raised during the verification can either be seen as a non-fulfilment of criteria ensuring the proper implementation of a project or where a risk to deliver high quality emission reduction is identified.

Corrective Action Requests (CARs) are issued, if:

- the project participants have made mistakes that will influence the ability of the project activity to achieve real, measurable additional emission reductions;
- the CDM or VCS requirements have not been met;
- there is a risk that emission reductions cannot be monitored or calculated.

Forward Action Requests (FAR) indicate essential risks for further periodic verifications. Forward Action Requests are issued, if:

- The actual status requires a special focus on this item for the next consecutive verification, or an adjustment of the monitoring plan is recommended.

The verification team uses the term Clarification Request (CL), which is issued if:

- Information is insufficient or not clear enough to determine whether the applicable CDM or VCS requirements have been met.

For a detailed list of all CARs, CLs and FARs raised in the course of the verification please refer to Annex 3.

4 VERIFICATION FINDINGS

4.1 Project Implementation Status

On the basis of the on-site visit and the reviewed project documentation, the verification team confirms that the project was implemented as described in the registered VCS PD. All the physical components and project boundary are in conformity with the description in registered VCS PD. The only difference is that an additional open lagoon i.e. Open lagoon no. 9 has been provided during the monitoring period /28/. However, it does not have any impact on the project activity. The site visit also revealed that an additional CSTR is under construction. When the Plant Manager was interviewed, he informed that the Management is planning to increase the production capacity of Palm Oil factory which would result in increased wastewater generation. In order to treat the additional wastewater generated from the factory, CSTR-3 is under implementation. However, it was informed that the increased emission reduction on account of capacity expansion and additional CSTR will not be accounted under the project activity. Nevertheless, a FAR has been issued to verify the same during the next verifications (please refer to FAR1 in Annex 3).

According to the validated VCS PD, the start date of the project activity was 15-05-2006 /1/. Though the implementation of the whole project activity was completed in 2008, due to insufficient monitoring equipment, the first monitoring period was started from 01-01-2009.

The project activity involves capturing of methane generated from the wastewater treatment through CSTR and covered lagoon technology. The captured methane (biogas) is utilized as fuel in onsite gas engines. Any excess biogas is utilized as fuel in onsite steam boiler replacing fossil fuel (HFO). However, the emission reduction on account of fossil fuel replacement in the boiler is not accounted in the emission reduction calculation. This is a conservative approach and is inline with the description in registered VCS PD. An open flare was also installed to flare out the biogas into atmosphere in case of any emergency.

GLC's verification team has also verified that all the parameters are monitored as described in the monitoring plan of the VCS PD in order to estimate the emission reduction.

As per the applied methodologies; AMS III.H., version 13 and AMS I.D., version 14 /8/, the project boundary is defined as below:

"The project boundary is the physical, geographical site where the wastewater and sludge treatment takes place in baseline and project situation. It covers all facilities affected by the project activity including sites where the processing, transportation and application or disposal of waste products as well as biogas takes place".

"The physical, geographical site of the renewable generation source delineates the project boundary".

Based on document review and onsite verification, it is confirmed that all the emission sources within the boundary have been considered appropriately.

Implementation status of the monitoring plan and the completeness of monitoring

The verification team has followed two steps to assess the completeness of the monitoring. The first step is document review and the second one is on-site interviews and observations. As a part of the step 1, the verification team has reviewed the submitted documents such as MR /4/, ER sheets /5/ and supporting documents stated in Annex 2. The monitoring parameters have been monitored with calibrated monitoring equipment as described in the monitoring plan of the registered VCS PD /3/. It is confirmed that the monitoring mechanism is effective and reliable. Wherever a parameter was not sufficiently monitored as per the monitoring plan of the VCS PD, a deviation was applied by the PPs and the emission reduction was calculated by a conservative approach.

Therefore, from the document review and onsite verification, it is confirmed that all the parameters were monitored in accordance with the registered monitoring plan during the monitoring period. Following are the details of monitoring in accordance with the monitoring plan of the registered VCS PD:

Monitored Parameter	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	$Q_{ww, y}$ Volume of wastewater treated in the year *y* (m^3)
Measuring frequency:	Continuously The parameter is measured on a continuous basis and recorded by the flow meters (FM1 and FM2). The flow meters, FM1 and FM2, were installed at the inlet of CSTR1 and CSTR2 respectively.
Reporting frequency:	Daily The parameter is recorded from the totaliser of the flow meters by the operators into log sheets once a day. The daily log sheets are submitted to Biogas Supervisor on a daily basis. The Biogas Supervisor checks the values and approves. The approved log sheets by the Supervisor are sent to Administrator. The Administrator transfers the data from operator log sheets into electronic files (i.e. excel sheets), calculates the daily flow, prepares daily reports and submits them to the Factory Manager. The original data sheets recorded by the operators and approved daily reports are stored in hard format. The soft copy of data sheets (excel sheets) are stored in Administrator's computer and also in Factory Manager's computer. The Administrator also sends the data to the project consultant i.e. South Pole Carbon Asset Management Ltd. on a monthly basis for calculating emission reduction. This information is confirmed based on the observations and interviews with the

<table>
<tr><td></td><td>operating team during the onsite verification.</td></tr>
<tr><td>Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)</td><td>Yes. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PD.

From the onsite interviews it is observed that the operating team is competent enough to monitor the data as required by the monitoring plan and monitoring methodology.

Therefore, it is the opinion of the verification team that the measuring and reporting frequencies represent good monitoring practice.</td></tr>
<tr><td>Type of monitoring equipment:</td><td><table>
<tr><td>Type of Meter</td><td colspan="2">Electro magnetic flow meter</td></tr>
<tr><td>Meter</td><td>FM1</td><td>FM2</td></tr>
<tr><td>Model</td><td>Promag 50W</td><td>Promag 50W</td></tr>
<tr><td>Serial number</td><td>79006020000</td><td>A2019020000</td></tr>
<tr><td>Accuracy</td><td>± 0.5% /13/</td><td>± 0.5% /13/</td></tr>
</table>
There are two CSTRs in parallel. FM1 is at the inlet of CSTR1 and FM2 is at the inlet of CSTR2. Sum of the flow indicated by FM1 and FM2 gives the total volume of wastewater treated.</td></tr>
<tr><td>Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?</td><td>Yes. Monitoring plan of the VCS PD specifies an accuracy of ±1% for flow meters. The installed meters have better accuracy (±0.5% as mentioned above) than required. Therefore, it is confirmed that the accuracy of monitoring equipment is in compliance with the monitoring plan which represents good monitoring practice.</td></tr>
<tr><td>Calibration frequency /interval:</td><td>The defined calibration frequency by the PPs is at least once every 3 years. The calibration dates of the flow meters is as below:
<table>
<tr><td>Meter</td><td>FM1</td><td>FM2</td></tr>
<tr><td>Calibration dates /14/</td><td>04-03-2011
29-08-2009
03-07-2007</td><td>24-09-2011
29-08-2009
03-07-2007</td></tr>
</table></td></tr>
<tr><td>Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration,</td><td>Yes. The monitoring plan specifies the calibration frequency as ‘once every 3 years’. From the verified calibration reports (dates mentioned above) it is</td></tr>
</table>

does the selected frequency represent good monitoring practice?	confirmed that the calibration frequency is less than 3 years and is, therefore, inline with the monitoring plan of the VCS PD.
Company performing the calibration:	The calibrations of the flow meters were carried out by: "Endress & Hauser (Thailand) Ltd." who is also the manufacturer of the flow meter /14/. "Miracle International Technology Co., Ltd.", a reputed calibration agency located in Bangkok /14/.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration reports were checked and the meters were found functioning properly.
Is (are) calibration(s) valid for the whole reporting period?	Yes. The calibrations are valid for the whole monitoring period.
If applicable, has the reported data been cross-checked with other available data?	Yes, the reported data was cross checked with the operator log sheets /15/ during the site visit.
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet were verified with the daily reports approved by the Factory Manager/16/ and crosschecked with the operator log sheets. It was learnt that while transferring the data from operator log sheets to excel files, daily flow of wastewater was calculated and inputted. However, when the reported values were crosschecked with the log sheets where totaliser values were recorded, on some of the days the daily flow could not match with the difference of the totaliser values. Therefore, a CAR has been raised (please refer to CAR4). In response to the CAR, the PPs have corrected the data reported in the draft MR and ER sheet inline with the operator log sheets.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description.

Monitored Parameter	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	$COD_{ww, untreated, y}$ COD of water entering the wastewater treatment system (mg/l)
Measuring frequency:	Daily.

	It is confirmed based on onsite verification that wastewater samples are collected by the operators daily from the wastewater at the inlet of CSTRs (separately for both CSTRs) and COD is determined by colorimetric method at onsite laboratory on a daily basis.
Reporting frequency:	Daily COD analysis is done by Lab Analyst. The Lab analyst enters the values into log sheets and submits to QA/QC Supervisor. The Supervisor checks the COD values and approves. The approved log sheets by the QA/QC Supervisor are submitted to Administrator. The Administrator transfers the data into electronic format (excel sheets), prepares daily reports and submits to the Factory Manager. The approved daily reports are stored in hard format in properly labeled files. The soft copy of data is stored in Administrator's computer and also in Factory Manager's computer. The Administrator also sends the data to the project consultant i.e. South Pole Carbon Asset Management Ltd. on a monthly basis for calculating emission reduction. This information is confirmed based on the observations and interviews with the operating team during the onsite verification.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. The monitoring plan specifies the measuring and reporting frequency as 'daily'. Therefore, from the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PD. From the onsite interviews it is observed that the operating team is competent enough to monitor the data as required by the monitoring plan and monitoring methodology. Therefore, it is of the opinion of the verification team that the measuring and reporting frequencies represent good monitoring practice.
Type of monitoring equipment:	Type of meter: Colorimeter / COD meter Model: C99 Serial number: H105199 Accuracy: 10 mg/l [13]
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not	VCS PD does not specify the accuracy of monitoring equipment. However, the method of

specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	analysis is specified as colorimetric method which is well documented and accepted by national and international standards. The verification team, based on onsite observations, confirms that the method of COD analysis is colorimetric method and therefore it is in compliance with the monitoring plan of the registered VCS PD.
Calibration frequency /interval:	The calibration frequency of COD meter is defined as 'at least once in 3 years'. The calibration dates of the colorimeter are: 02-12-2010 /14/ 10-10-2008 From the calibration reports, it is confirmed that the COD meter is calibrated within the defined period.
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Yes. The monitoring plan specifies the calibration frequency as 'once every 3 years'. From the verified calibration reports (dates mentioned above) it is confirmed that the calibration frequency is less than 3 years and is, therefore, inline with the monitoring plan of the VCS PD.
Company performing the calibration:	The calibration of the colorimeter was performed by "Hanna Instruments (Thailand) Ltd."
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration certificates were checked and the meter was found functioning properly.
Is (are) calibration(s) valid for the whole reporting period?	Yes, the calibration is valid for the whole reporting period.
If applicable, has the reported data been cross-checked with other available data?	Yes. Wastewater samples were also collected and COD was tested by an external laboratory once a year during the monitoring period to ensure accuracy. It was done by "Envi Lab and Consultant Co., Ltd." in 2009 and 2010/20/ and by "SGS (Thailand) Limited" in 2011 and 2012 /21/. The COD reports of external laboratories were also provided to the verification team. It is confirmed that the COD values are comparable to the average values of COD determined at onsite laboratory.
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet were verified with the daily reports approved by the Factory Manager/16/ and crosschecked with the operator log sheets/15/. It is confirmed that the reported values in the MR and ER sheet are correct.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC

processes in place?	procedures are in place. Please refer to sections 4.2 to 4.4 for further description

Monitored Parameter	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	$COD_{out, CSTR, y} = COD_{in, CL, y}$ COD of water exiting the CSTR system or COD entering the covered lagoon process (mg/l)
Measuring frequency:	Daily. It is confirmed based on onsite verification that wastewater samples are collected by the operators daily from the outlet of CSTRs (separately for both CSTRs) before entering the covered lagoon and COD is determined by colorimetric method at onsite laboratory on a daily basis.
Reporting frequency:	Daily COD analysis is done by Lab Analyst. The Lab analyst enters the values into log sheets and submits to QA/QC Supervisor. The Supervisor checks the COD values and approves. The approved log sheets by the QA/QC Supervisor are submitted to Administrator. The Administrator transfers the data into electronic format (excel sheets), prepares daily reports and submits to the Factory Manager. The approved daily reports are stored in hard format in properly labeled files. The soft copy of data is stored in Administrator's computer and also in Factory Manager's computer. The Administrator also sends the data to the project consultant i.e. South Pole Carbon Asset Management Ltd. on a monthly basis for calculating emission reduction. This information is confirmed based on the observations and interviews with the operating team during the onsite verification.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. The monitoring plan specifies the measuring and reporting frequency as 'daily'. Therefore, from the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PD. From the onsite interviews it is observed that the operating team is competent enough to monitor the

<table>
<tr><td></td><td>data as required by the monitoring plan and monitoring methodology.

Therefore, it is the opinion of the verification team that the measuring and reporting frequencies represent good monitoring practice.</td></tr>
<tr><td>Type of monitoring equipment:</td><td><table><tr><td>Type of meter</td><td>Colorimeter / COD meter</td></tr><tr><td>Model</td><td>C99</td></tr><tr><td>Serial number</td><td>H105199</td></tr><tr><td>Accuracy</td><td>10 mg/l /13/</td></tr></table></td></tr>
<tr><td>Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?</td><td>VCS PD does not specify the accuracy of monitoring equipment. However, the method of analysis is specified as colorimetric method which is well documented and accepted by national and international standards. The verification team, based on onsite observations, confirms that the method of COD analysis is colorimetric method and therefore it is in compliance with the monitoring plan of the registered VCS PD.</td></tr>
<tr><td>Calibration frequency /interval:</td><td>The calibration frequency of COD meter is defined as ‘at least once in 3 years’.

The calibration dates of the colorimeter are:

02-12-2010 /14/

10-10-2008

From the calibration reports, it is confirmed that the COD meter is calibrated within the defined period.</td></tr>
<tr><td>Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?</td><td>Yes. The monitoring plan specifies the calibration frequency as ‘once every 3 years’. From the verified calibration reports (dates mentioned above) it is confirmed that the calibration frequency is less than 3 years and is, therefore, inline with the monitoring plan of the VCS PD.</td></tr>
<tr><td>Company performing the calibration:</td><td>The calibration of the colorimeter was performed by “Hanna Instruments (Thailand) Ltd.”/14/</td></tr>
<tr><td>Did calibration confirm proper functioning of monitoring equipment? (Yes / No):</td><td>Yes. The calibration certificates were checked and the meter was found functioning properly.</td></tr>
<tr><td>Is (are) calibration(s) valid for the whole reporting period?</td><td>Yes, the calibration is valid for the whole reporting period.</td></tr>
<tr><td>If applicable, has the reported data been cross-checked with other available data?</td><td>Yes. Wastewater samples were also collected and COD was tested by an external laboratory once a year during the monitoring period to ensure</td></tr>
</table>

	accuracy. It was done by "Envi Lab and Consultant Co., Ltd." in 2009 and 2010 /20/ and by "SGS (Thailand) Limited" in 2011 and 2012 /21/. The COD reports of external laboratories were also provided to the verification team. It is confirmed that the COD values are comparable to the average values of COD determined at onsite laboratory.
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet were verified with the daily reports approved by the Factory Manager /16/ and crosschecked with the operator log sheets /15/. It is confirmed that the reported values in the MR and ER sheet are correct.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

Monitored Parameter	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	$COD_{y, out, CL}$ COD of water exiting the covered lagoon treatment process (mg/l)
Measuring frequency:	Daily. It is confirmed based on onsite verification that wastewater samples are collected by the operators daily from the outlet of covered lagoon (i.e. from the overflow of covered lagoon into open lagoon-1) and COD is determined by colorimetric method at onsite laboratory on a daily basis.
Reporting frequency:	Daily COD analysis is done by Lab Analyst. The Lab analyst enters the values into log sheets and submits to QA/QC Supervisor. The Supervisor checks the COD values and approves. The approved log sheets by the QA/QC Supervisor are submitted to Administrator. The Administrator transfers the data into electronic format (excel sheets), prepares daily reports and submits to the Factory Manager. The approved daily reports are stored in hard format in properly labeled files. The soft copy of data is stored in Administrator's computer and also in Factory

<table>
<tr><td></td><td>Manager's computer.

The Administrator also sends the data to the project consultant i.e. South Pole Carbon Asset Management Ltd. on a monthly basis for calculating emission reduction. This information is confirmed based on the observations and interviews with the operating team during the onsite verification.</td></tr>
<tr><td>Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)</td><td>Yes. The monitoring plan specifies the measuring and reporting frequency as 'daily'. Therefore, from the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PD.

From the onsite interviews it is observed that the operating team is competent enough to monitor the data as required by the monitoring plan and monitoring methodology.

Therefore, it is of the opinion of the verification team that the measuring and reporting frequencies represent good monitoring practice.</td></tr>
<tr><td>Type of monitoring equipment:</td><td><table><tr><td>Type of meter</td><td>Spectrometer / COD meter</td></tr><tr><td>Model</td><td>C99</td></tr><tr><td>Serial number</td><td>H105199</td></tr><tr><td>Accuracy</td><td>10 mg/l /13/</td></tr></table></td></tr>
<tr><td>Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?</td><td>VCS PD does not specify the accuracy of monitoring equipment. However, the method of analysis is specified as colorimetric method which is well documented and accepted by national and international standards. The verification team, based on onsite observations, confirms that the method of COD analysis is colorimetric method and therefore it is in compliance with the monitoring plan of the registered VCS PD.</td></tr>
<tr><td>Calibration frequency /interval:</td><td>The calibration frequency of COD meter is defined as 'at least once in 3 years'.

The calibration dates of the colorimeter are:

02-12-2010 /14/

10-10-2008

From the calibration reports, it is confirmed that the COD meter is calibrated within the defined period.</td></tr>
<tr><td>Is the calibration interval in line with the</td><td>Yes. The monitoring plan specifies the calibration</td></tr>
</table>

monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	frequency as 'once every 3 years'. From the verified calibration reports (dates mentioned above) it is confirmed that the calibration frequency is less than 3 years and is, therefore, inline with the monitoring plan of the VCS PD.
Company performing the calibration:	The calibration of the colorimeter was performed by "Hanna Instruments (Thailand) Ltd."/14/
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration certificates were checked and the meter was found functioning properly.
Is (are) calibration(s) valid for the whole reporting period?	Yes, the calibration is valid for the whole reporting period.
If applicable, has the reported data been cross-checked with other available data?	Yes. Wastewater samples were also collected and COD was tested by an external laboratory once a year during the monitoring period to ensure accuracy. It was done by "Envi Lab and Consultant Co., Ltd." in 2009 and 2010/20/ and by "SGS (Thailand) Limited" in 2011 and 2012 /21/. The COD reports of external laboratories were also provided to the verification team. It is confirmed that the COD values are comparable to the average values of COD determined at onsite laboratory.
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet were verified with the daily reports approved by the Factory Manager/16/ and crosschecked with the operator log sheets/15/. It is confirmed that the reported values in the MR and ER sheet are correct.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

Monitored Parameter	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	W_{CH4} Methane content in biogas in the year *y* (%)
Measuring frequency:	Daily The parameter is measured by the operators with the help of portable analyzer every 2 hours and recorded in log sheets. Since the parameter was

	monitored not continuously but periodically during the monitoring period, 95% confidence level was applied to the measured values. However, the parameter was measured once a day using gas detector with gas pump from 01-01-2009 to 18-08-2010 and during some of the days it was not at all monitored. Therefore, PPs have applied a deviation as described under Deviation-1 in section 2.2 of the MR and the values of methane content have been taken conservatively. The assessment of the deviation is provided at the end of the section. In response to a CAR (please refer to CAR3), the PPs have considered lowest of the measured values for baseline emission calculation and highest of the measured values for project emission calculation during 2009.
Reporting frequency:	Daily The operator log sheets are submitted to Biogas Supervisor on a daily basis. The Biogas Supervisor checks the values and approves. The approved log sheets by the Supervisor are sent to Administrator. The Administrator transfers the data from operator log sheets into electronic files (i.e. excel sheets), calculates daily average of methane content, prepares daily reports and submits them to the Factory Manager. The original data sheets recorded by the operators and approved daily reports are stored in hard format. The soft copy of data sheets (excel sheets) are stored in Administrator's computer and also in Factory Manager's computer. The Administrator also sends the data to the project consultant i.e. South Pole Carbon Asset Management Ltd. on a monthly basis for calculating emission reduction. This information is confirmed based on the observations and interviews with the operating team during the onsite verification.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Continuous measurement and daily recording of the parameter shall be carried out as per the monitoring plan of the VCS PD. From the onsite interviews with the PP it was understood that inline gas analyser was installed on biogas line to monitor methane content on a continuous basis. However, the purchased equipment was not functioning since it was not suitable for biogas. Therefore, methane content was measured using portable analyser. A deviation was made in this regard and the methane content values

<table>
<tr><td></td><td>have been considered conservatively by applying the 95% confidence level. The approach is inline with the applied methodology. The deviation is, therefore, accepted. Assessment of the deviation is provided at the end of the section.

However, in response to CAR7, PP states that new inline gas analyser would be installed by the end of year. Therefore, a FAR has been raised (please refer to FAR2 in Annex 3) to verify it during the next verification.</td></tr>
<tr><td>Type of monitoring equipment:</td><td><table>
<tr><td>Type of meter</td><td>Portable gas analyzer</td></tr>
<tr><td>Model</td><td>Biogas Check</td></tr>
<tr><td>Serial number</td><td>BM 12438</td></tr>
<tr><td>Accuracy</td><td>± 3.0% /13/</td></tr>
</table></td></tr>
<tr><td>Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?</td><td>VCS PD specifies an accuracy of ± 2%; whereas, the accuracy of gas analyser is ± 3% and the accuracy of the gas anaylser was mentioned as ±5% in the draft MR. Therefore, a clarification request (refer to CL1) was raised. In response to the CL, PP has corrected the MR and provided the technical specifications of the gas analyser and calibration reports.

Though the accuracy of the instrument is mentioned as ± 3%/13/ in the technical specifications, the calibration reports indicate that the maximum error observed during the calibration was 1.06%/14/ which is below the required accuracy of ± 2%.

Therefore, it can be confirmed that the accuracy of the gas analyser is in compliance with the monitoring plan of the registered VCS PD.</td></tr>
<tr><td>Calibration frequency /interval:</td><td>The calibration frequency was defined as once every 3 years. The calibration dates during the monitoring period are as below:

06-03-2012 /14/

07-04-2011

08-04-2010

Though the required calibration frequency as per the VCS PD is once every 3 years, the gas analyser was calibrated annually to ensure the accuracy.</td></tr>
<tr><td>Is the calibration interval in line with the</td><td>Yes. The VCS PD specifies the calibration</td></tr>
</table>

monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	frequency as 'once every 3 years'. Therefore, from the above mentioned calibration dates it can be confirmed that the calibration frequency is inline with the monitoring plan of the VCS PD. The plant's team has also developed annual calibration plan for the gas analyser which indicates a good monitoring practice in place to ensure the accuracy of gas anaylser.
Company performing the calibration:	The gas analyser was calibrated by "Geotechnical Instruments (UK) Ltd." /14/ in 2010 and 2011 and by "Entech Associate Co., Ltd." in 2012.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration certificates were checked and the meter was found functioning properly.
Is (are) calibration(s) valid for the whole reporting period?	Yes, the calibrations are valid for the whole reporting period.
If applicable, has the reported data been cross-checked with other available data?	Yes, the reported data was cross checked with the operator log sheets /15/ during the site visit. The data was found consistent.
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet were verified with the daily reports approved by the Factory Manager/16/ and crosschecked with the operator log sheets. The reported values in the MR and ER sheet were found to be correct and consistent with the operator log sheet information.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

Monitored Parameter	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	$BG_{combusted, y}$ Amount of biogas combusted for gainful use in the year *y* (Nm^3)
Measuring frequency:	Continuously The parameter is measured on a continuous basis and recorded by the gas flow meters (GM2, GM3 and GM4). GM2 measures the biogas combusted in 1 MW gas engine

<table>
<tr><td></td><td>GM3 measured the biogas combusted in 1.4 MW gas engine

GM4 measured the biogas combusted in boiler</td></tr>
<tr><td>Reporting frequency:</td><td>Daily

The parameter is recorded from the totaliser of the flow meters by the operators into log sheets once a day. The daily log sheets are submitted to Biogas Supervisor on a daily basis.

The Biogas Supervisor checks the values and approves. The approved log sheets by the Supervisor are sent to Administrator. The Administrator transfers the data from operator log sheets into electronic files (i.e. excel sheets), calculates the daily flow, prepares daily reports and submits them to the Factory Manager.

The original data sheets recorded by the operators and approved daily reports are stored in hard format. The soft copy of data sheets (excel sheets) are stored in Administrator's computer and also in Factory Manager's computer.

The Administrator also sends the data to the project consultant i.e. South Pole Carbon Asset Management Ltd. on a monthly basis for calculating emission reduction. This information is confirmed based on the observations and interviews with the operating team during the onsite verification.</td></tr>
<tr><td>Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)</td><td>Yes. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PD.

From the onsite interviews it is observed that the operating team is competent enough to monitor the data as required by the monitoring plan and monitoring methodology.

Therefore, it is the opinion of the verification team that the measuring and reporting frequencies represent good monitoring practice.</td></tr>
<tr><td>Type of monitoring equipment:</td><td><table>
<tr><td>Meter</td><td>GM2</td></tr>
<tr><td>Type of meter</td><td>Turbine gas meter</td></tr>
<tr><td>Model</td><td>TZ 100</td></tr>
<tr><td>Serial number</td><td>8759701001</td></tr>
<tr><td>Accuracy</td><td>± 1.0% [13]</td></tr>
</table></td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><td>Meter</td><td>GM3</td></tr>
<tr><td>Type of meter</td><td>Thermal Mass flow meter</td></tr>
<tr><td>Model</td><td>T-mass 65I</td></tr>
<tr><td>Serial number</td><td>A20B2B02000</td></tr>
<tr><td>Accuracy</td><td>± 1% OR + 0.5% FS /13/</td></tr>
</table>
<table>
<tr><td>Meter</td><td>GM4</td></tr>
<tr><td>Type of meter</td><td>Thermal Mass flow meter</td></tr>
<tr><td>Model</td><td>T-mass 65I</td></tr>
<tr><td>Serial number</td><td>9908A202000</td></tr>
<tr><td>Accuracy</td><td>± 1% OR + 0.5% FS /13/</td></tr>
</table>
</td></tr>
<tr><td>Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?</td><td>Yes. Monitoring plan of the VCS PD specifies an accuracy of ±1% for gas flow meters. Therefore, it is confirmed that the accuracy of monitoring equipment is in compliance with the monitoring plan which represents good monitoring practice.</td></tr>
<tr><td>Calibration frequency /interval:</td><td>The defined calibration frequency by the PPs is at least once every 3 years. The calibration dates of the flow meters is as below:
<table>
<tr><td>Meter</td><td>Calibration dates /14/</td></tr>
<tr><td>GM2</td><td>24-08-2009
12-07-2007</td></tr>
<tr><td>GM3</td><td>24-09-2010
29-02-2008</td></tr>
<tr><td>GM4</td><td>28-09-2010
23-09-2007</td></tr>
</table>
Though there was a delay in calibration by 5 days for GM4, there was no biogas consumption for boiler during September 2010. The calibration delay does not have any impact.</td></tr>
<tr><td>Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?</td><td>Yes. The monitoring plan specifies the calibration frequency as ‘once every 3 years’. From the verified calibration reports (dates mentioned above) it is confirmed that the calibration frequency is inline with the monitoring plan of the VCS PD/1/.</td></tr>
</table>

Company performing the calibration:	GM-2 was calibrated by "Miracle International Technology Co., Ltd." in 2007 and by "PTT Public Company Limited" in 2009 /14/ GM-3 was calibrated by "Endress & Hauser (Thailand) Ltd." in 2008 and by "Miracle International Technology Co., Ltd." in 2010 /14/. GM-4 was calibrated by "Miracle International Technology Co., Ltd." in 2007 and 2010 /14/
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration certificates were checked and the meters were found functioning properly.
Is (are) calibration(s) valid for the whole reporting period?	Yes. The calibrations are valid for the whole reporting period.
If applicable, has the reported data been cross-checked with other available data?	Yes, the reported data was cross checked with the operator log sheets /15/ during the site visit.
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet were verified with the daily reports approved by the Factory Manager/16/ and crosschecked with the operator log sheets. It was learnt that while transferring the data from operator log sheets to excel files, daily consumption was calculated and inputted. However, when the reported values were crosschecked with the log sheets where totaliser values were recorded, on some of the days the daily consumption could not match with the difference of the totaliser values. Therefore, a CAR has been raised (please refer to CAR4). In response to the CAR, the PPs have corrected the data reported in the draft MR and ER sheet inline with the operator log sheets.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

Monitored Parameter	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	$BG_{TOFlare, y}$ Amount of biogas flared in the year *y* (Nm^3)
Measuring frequency:	Continuously The parameter was monitored on a continuous

<table>
<tr><td></td><td>basis by means of gas flow meter (GM6).

However, GM6 was not there at flare during the onsite verification. When the plant's operating team was interviewed it was revealed that the flow meter was installed on 23-02-2010/32/ and removed on 11-06-2011. The reason for removing the meter is to avoid damage to the meter that may cause due to ongoing construction activity of CSTR-3. Moreover, the flare was never operated since any biogas over and above that is consumed in the gas engines is utilized in the boiler.</td></tr>
<tr><td>Reporting frequency:</td><td>Weekly

During the period from 23-02-2010 to 10-06-2011, the parameter was recorded weekly during weekly maintenance of the flare and reported to the Factory Manager. It is confirmed from weekly reports/36/ that the quantity of biogas flared was zero. The parameter was not monitored for the rest of the monitoring period. Therefore, a CAR was raised (CAR 5 may please be referred for details).</td></tr>
<tr><td>Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)</td><td>No. As per the monitoring plan of the VCS PD, the parameter shall be measured continuously and recorded daily.

Since the parameter was not monitored in accordance with the monitoring plan, a CAR was raised. Please refer to CAR5 in Annex 3 for detailed assessment of the issue.

In response to the CAR a deviation was applied by the PPs. The deviated approach was described by the PPs in section 2.2 (Deviation-3) and the assessment of the deviation is provided at the end of the section.</td></tr>
<tr><td>Type of monitoring equipment:</td><td>
<table>
<tr><td>Type of meter</td><td>Thermal Mass flow meter</td></tr>
<tr><td>Meter</td><td>GM6</td></tr>
<tr><td>Model</td><td>T-mass 65I</td></tr>
<tr><td>Serial number</td><td>E1059F02000</td></tr>
<tr><td>Accuracy</td><td>± 1% OR + 0.5% FS /13/</td></tr>
</table>

<table>
<tr><td>Type of meter</td><td>Thermal Mass flow meter</td></tr>
<tr><td>Meter</td><td>GM1</td></tr>
<tr><td>Model</td><td>T-mass 65I</td></tr>
<tr><td>Serial number</td><td>A30CEA02000</td></tr>
</table>
</td></tr>
</table>

	<table><tr><td>Accuracy</td><td>± 1% OR + 0.5% FS /13/</td></tr></table> <table><tr><td>Type of meter</td><td>Thermal Mass flow meter</td></tr><tr><td>Meter</td><td>GM5</td></tr><tr><td>Model</td><td>T-mass 65I</td></tr><tr><td>Serial number</td><td>AC0A3602000</td></tr><tr><td>Accuracy</td><td>± 1% OR + 0.5% FS /13/</td></tr></table> GM-1 has been installed at the outlet of CSTR system and therefore it measures the gas produced from CSTRs. GM-5 has been provided between covered lagoon and gas holders (gas storage balloons).
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Yes. Monitoring plan of the VCS PD specifies an accuracy of ±1% for gas flow meters. Therefore, it is confirmed that the accuracy of monitoring equipment is in compliance with the monitoring plan which represents good monitoring practice.
Calibration frequency /interval:	The defined calibration frequency by the PPs is 'once every 3 years'. GM-6 was calibrated on 17-02-2011 /14/ GM-1 was calibrated on 24-09-2010 and 03-04-2008 /14/ GM-5 was calibrated on 25-08-2010 and 21-10-2008 /14/
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Yes. The monitoring plan specifies the calibration frequency as 'once every 3 years'. It is confirmed that the calibration frequency of the meter is inline with the monitoring plan of the VCS PD.
Company performing the calibration:	The calibration of the gas flow meter, GM-6, was conducted by Endress & Hauser (Thailand) Ltd. /14/ GM-1 and GM-5 were calibrated by "Endress & Hauser (Thailand) Ltd." in 2008 and by "Miracle International Technology Co., Ltd." in 2010 /14/.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration certificate was checked and the meter was found functioning properly.
Is (are) calibration(s) valid for the whole reporting period?	Yes. Calibration is valid for the whole reporting period.
If applicable, has the reported data been cross-	It is confirmed from the onsite interviews with the

checked with other available data?	operating team that the flare was never operated. However, a conservative approach was taken for the period for which flow meter was not available. Please refer to CAR5 and the assessment of Deviation-3 for further assessment.
How were the values in the monitoring report verified?	Please refer to CAR5 and the assessment of Deviation-3 for detailed assessment.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

Monitored Parameter	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	EG_y Net electricity generated by gas engines operated on biogas from wastewater treatment plant during the year y
Measuring frequency:	Continuously The parameter is measured continuously by electricity meter of PEA (Provincial Electricity Authority) located at the point of export to electricity grid.
Reporting frequency:	Monthly / Daily The meter is owned by the electricity provider i.e. PEA. The electricity export is recorded by the PEA representatives every month and monthly reports (or power sale invoices) are sent to the PP. The parameter is also recorded by the operators from the electricity meters available at generators on a daily basis into log sheets and reported to the Biogas Supervisor.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. The VCS PD states, “Electricity transmission meter provided at point of power generation sets or power sale invoices based on net electricity sold to PEA grid”. Net electricity export to the grid based on monthly sale invoices has been considered in the emission reduction calculation which is conservative and more authentic. Therefore, from the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with

	the monitoring plan of the registered VCS PD and monitoring methodology.
Type of monitoring equipment:	Type of Meter: Electricity meter (EM1) PEA number: 20963231
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	VCS PD specifies an accuracy of ±2% for electricity meter. However, the accuracy of the meter could not be checked during the site visit since it was sealed by PEA. Besides, the meter is under the purview of PEA and the verification team understands that it is the responsibility of PEA to maintain the accuracy of electricity meter at appropriate level.
Calibration frequency /interval:	Since the meter is owned by the PEA, the calibration is carried out by the PEA. It is also confirmed from the onsite verification that the meter is well secured and sealed by the PEA. The PP is not authorised to touch the meter.
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	The calibration frequency in the VCS PD has been stated as, "Generally once every three years. Otherwise, the PEA is responsible for calibrate meter in order to buy the right quantity of electricity from project owner." The verification team confirms that the calibration of electricity meter is beyond the control of PP and it is the responsibility of PEA to maintain the accuracy of meter at appropriate level in order to purchase right quantity of electricity.
Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is (are) calibration(s) valid for the whole reporting period?	NA
If applicable, has the reported data been cross-checked with other available data?	The reported data has been crosschecked with the daily log sheets of the plant's operating team[/15/]. It is confirmed that the reported data is appropriate and correct.
How were the values in the monitoring report verified?	The values in the MR and ER sheet have been verified with the monthly power sale invoices sent by the PEA[/17/] which are more authentic. The reported values have been found correct.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place.

	Please refer to sections 4.2 to 4.4 for further description

Monitored Parameter	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	EC_y Electricity consumption by wastewater treatment system and biogas plant in a year "y" (MWh / year)
Measuring frequency:	Continuously The parameter is measured continuously by electricity meter (EM2) located at the inlet of wastewater treatment plant. A monitoring diagram with a clear identification of monitoring points has been provided in section 5 under 'Additional Information' of the MR.
Reporting frequency:	Daily The parameter is recorded from the totaliser of the electricity meter by the operators into log sheets and reported to Biogas Supervisor on a daily basis. The Biogas Supervisor checks the values and approves. The approved log sheets by the Supervisor are sent to Administrator. The Administrator transfers the data from operator log sheets into electronic files (i.e. excel sheets), calculates the consumption, prepares daily reports and submits them to the Factory Manager. The original data sheets recorded by the operators and approved daily reports are stored in hard format. The soft copy of data sheets (excel sheets) are stored in Administrator's computer and also in Factory Manager's computer. The Administrator also sends the data to the project consultant i.e. South Pole Carbon Asset Management Ltd. on a monthly basis for calculating emission reduction. This information is confirmed based on the observations and interviews with the operating team during the onsite verification.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PD and monitoring methodology. From the onsite interviews it is observed that the

	operating team is competent enough to monitor the data as required by the monitoring plan and monitoring methodology. Therefore, it is of the opinion of the verification team that the measuring and reporting frequencies represent good monitoring practice.
Type of monitoring equipment:	Type of Meter: Electricity meter Model: PM700 Accuracy: ± 1% /13/
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	VCS PD does not specify the accuracy of monitoring equipment. However, based on the experience of verifying similar other projects GLC confirms that the accuracy of electricity meter is at good level.
Calibration frequency /interval:	Since the calibration was not defined in the VCS PD, the PPs have defined a calibration frequency of 'at least once every 2 years' in the MR. The calibration dates of the flow meters is as below: 26-09-2010 /14/ 18-10-2008
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	The VCS PD does not specify the calibration interval. However, it is of the opinion of verification team that the chosen calibration interval is appropriate for the electricity meter. Based on the experience of verifying similar other projects GLC confirms that the selected calibration represents good monitoring practice.
Company performing the calibration:	The electricity meter was calibrated by "Schneider Electric" /14/.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration certificates were checked and the meters were found functioning properly.
Is (are) calibration(s) valid for the whole reporting period?	Yes. The calibrations are valid for the whole reporting period.
If applicable, has the reported data been cross-checked with other available data?	Yes, the reported data was cross checked with the operator log sheets /15/ during the site visit.
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet were verified with the daily reports approved by the Factory Manager/16/ and crosschecked with the operator log sheets. It is confirmed that the reported values in the MR and ER sheet are correct.
Does the data management (from monitoring equipment to emission reduction calculation)	Yes, it is confirmed from document review and onsite verification that the data management

ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

Monitored Parameter	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	Sludge removed and its application (Tonnes)
Measuring frequency:	Whenever the sludge is removed from the CSTRs and covered lagoon, it is weighed through weighing machine available at the factory. The quantity of sludge and its application is recorded in the log books. However, no sludge was removed during the monitoring period. This is confirmed through onsite interviews.
Reporting frequency:	Not applicable for this monitoring period
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	NA
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	NA
Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	NA
Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is (are) calibration(s) valid for the whole reporting period?	NA
If applicable, has the reported data been cross-checked with other available data?	NA

How were the values in the monitoring report verified?	NA
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	NA

Monitored Parameter	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	$Q_{biogas, flare, y}$ Biogas sent to flare during a particular hour h (Nm^3 / hr)
Measuring frequency:	Continuously The parameter was monitored on a continuous basis by means of gas flow meter (GM6). Monitoring of this parameter is same as that of $BG_{TOFlare, y}$ (Amount of biogas flared in the year *y*) as described above. Therefore, please refer to $BG_{TOFlare, y}$ for further assessment.
Reporting frequency:	Weekly During the period from 23-02-2010 to 10-06-2011, the parameter was recorded weekly during weekly maintenance of the flare and reported to the Factory Manager. It is confirmed from weekly reports/36/ that the quantity of biogas flared was zero. The parameter was not monitored for the rest of the monitoring period. Therefore, a CAR was raised (CAR 5 may please be referred for details).
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	No. As per the monitoring plan of the VCS PD, the parameter shall be measured continuously and recorded daily. Since the parameter was not monitored in accordance with the monitoring plan, a CAR was raised. Please refer to CAR5 in Annex 3 for detailed assessment of the issue. In response to the CAR a deviation was applied by the PPs. The deviated approach was described by the PPs in section 2.2 (Deviation-3) and the assessment of the deviation is provided at the end of the section.

Type of monitoring equipment:	<table><tr><td>Type of meter</td><td>Thermal Mass flow meter</td></tr><tr><td>Meter</td><td>GM6</td></tr><tr><td>Model</td><td>T-mass 65I</td></tr><tr><td>Serial number</td><td>E1059F02000</td></tr><tr><td>Accuracy</td><td>± 1% OR + 0.5% FS /13/</td></tr></table>
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Yes. Monitoring plan of the VCS PD specifies an accuracy of ±1% for gas flow meters. Therefore, it is confirmed that the accuracy of monitoring equipment is in compliance with the monitoring plan which represents good monitoring practice.
Calibration frequency /interval:	The defined calibration frequency by the PPs is 'once every 3 years'. GM-6 was calibrated on 17-02-2011 /14/
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Yes. The monitoring plan specifies the calibration frequency as 'once every 3 years'. It is confirmed that the calibration frequency of the meter is inline with the monitoring plan of the VCS PD.
Company performing the calibration:	The calibration of the gas flow meter, GM-6, was conducted by Endress & Hauser (Thailand) Ltd. /14/
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration certificate was checked and the meter was found functioning properly.
Is (are) calibration(s) valid for the whole reporting period?	Yes. Calibration is valid for the whole reporting period.
If applicable, has the reported data been cross-checked with other available data?	It is confirmed from the onsite interviews with the operating team that the flare was never operated. Please refer to $BG_{TOFlare,\ y}$ for further assessment.
How were the values in the monitoring report verified?	Please refer to $BG_{TOFlare,\ y}$ for further assessment.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

Monitored Parameter	Assessment/ Observation

Data / Parameter: (as in monitoring plan of the VCS PD):	$\eta_{flare-h}$ Flare efficiency (%)
Measuring frequency:	Default value for open flares as per "Tool to determine project emissions from flaring gases containing methane"
Reporting frequency:	NA
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	The flare efficiency shall be determined based on the flame detection period. According to the monitoring plan of the VCS PD, "The default factor of 50% might be only applied if a flame is detected at the flare for more than 20 minutes in hour h, whenever biogas is sent to the flare system. If the biogas is sent to the flare for a period shorter than one hour, the flare detection signal shall be available for at least 1/3 of this period, following the same logic of the flaring tool (20 minutes out of 1 hour). If these conditions are not met, 0% default value should be used for this period". Flare was never operated during the monitoring period. However, in response to CAR5 (please refer to Annex 3), the quantity of biogas flared was calculated through a conservative approach since it was not monitored sufficiently inline with the monitoring plan of the VCS PD. The project emissions due to flaring were calculated by considering the flare efficiency as 0% by the PPs. Assuming the flare efficiency as 0% is more conservative according to "Tool to determine project emissions from flaring gases containing methane"[8]. Therefore, it can be confirmed that the monitoring approach for the parameter is in accordance with the monitoring plan of the VCS PD.
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	NA
Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	NA

Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is (are) calibration(s) valid for the whole reporting period?	NA
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	The flare efficiency has been considered as 0% which is inline with the "Tool to determine project emissions from flaring gases containing methane"/8/.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

Thus GLC confirms that

- The monitoring complies with the monitoring plan of the VCS PD.
- All parameters such as baseline, project and leakage emission parameters are monitored as described in the monitoring plan.
- The monitoring and reporting frequencies are in line with the monitoring plan.
- The accuracy and the calibration frequency of the measurement equipments are appropriate.

Remaining Issues from Validation or Previous Verification

The verification team has also reviewed validation report available on VCS database at

https://vcsprojectdatabase2.apx.com/myModule/Interactive.asp?Tab=Projects&a=2&i=426&lat=10%2E2927&lon=99%2E0908&bp=1

This is the 1st verification of the project activity. From the validation report issued on 18-11-2009 by validating DOE/6/, the verification team identified two FARs which were recommended to be verified during the 1st verification. One of the FARs is closed and the other is carried forward to the next verification. The issues in detail, PP's response and the assessment of the verification team is provided under CAR6 and CAR7 in the enclosed Annex 3.

Deviations from the Monitoring Plan

Three deviations from the monitoring plan have been applied by the PPs during the monitoring period. Description of the deviations and the assessment on conservativeness of the deviation is provided below:

Description of deviation	Assessment by verification team
Deviation-1 Although the inline gas analyzer has been installed but the performance of this analyzer was not stable. The readings were not consistent and accurate. The readings from the portable gas analyser are more reliable. Hence, the source of methane data is from following sources. Before 19-Aug-2010: the methane data was measured at the biogas supply line to generator by Gastec detector with RAE gas pump, measured once a day. 19-Aug-2010 onwards: the methane data has been measured at the biogas supply line to generator by portable gas analyser, every 2 hours or 12 times per day. The deviated approach is adopted for this monitoring period in accordance with the methodology for application of 95% confidential level and in line with conservativeness principle. This approach results in lower methane content which also affects the lowers baseline emission and achieved emission reduction.	As per the monitoring plan of the VCS PD, it is required to monitor the methane content on a continuous basis using an online gas analyser. It has also been stated in the VCS PD, "In the case non-availability of the monitoring data (e.g. breakdown of equipment), lowest reported value of the third party reports will be used for estimation of baseline emissions." It is confirmed from the onsite interviews with the operating team that an inline gas analyser to monitor the methane content continuously was purchased during the monitoring period. However, the readings were not stable and accurate since the procured meter is not suitable for biogas. In response to CAR7, the PPs have mentioned that a new inline gas analyser would be installed during the 2nd monitoring period (by the end of 2012). Therefore, a FAR (FAR2) is raised to verify it during the 2nd verification. Till 19-08-2010, methane content was monitored using a gas detector once a day. However, it was not monitored regularly on all days. From 19-08-2010 onwards, the parameter was monitored using a portable gas analyser every 2 hours. In response to CAR3, PPs have taken a conservative approach to determine the methane content. For 2009, lowest of the measured values has been considered for baseline emissions and average value has been considered for project emissions. 95% conservativeness has also been applied to these values for further conservative estimate of emission reduction. For the rest of the years during the monitoring period i.e. 2010, 2011 and 2012, 95% confidence level has been applied for the measured values since it was periodically

	measured. Lower bound value has been considered for baseline emissions and higher bound value for project emissions in order to calculate the emission reduction conservatively. This is inline with Para 36 of AMS III.H., version 13. Therefore, the verification team is of the opinion that the approach followed by the PPs results in more conservative estimation of emission reduction. Besides, the emission reduction is also estimated using COD approach to check the conservativeness. Therefore, the deviation is accepted.
Deviation-2 The biogas flow meter installed at generator no.1 (GM2) is turbine type, without the temperature and pressure compensation. The flow is presented in m^3 unit. Hence, the unit conversion using a conservative factor for adjusting the temperature to normal conditions and project conditions is applied. P1 X V1 / T1 = P2 X V2 / T2 where, 1 represents parameters at measured conditions and 2 refers to parameters at normal conditions P1 would always be higher than 1 atm pressure so that there is a positive gauge pressure and gas can flow from gas storage to boiler and gas engines. Therefore, P1 = (1+x) atm and P2 = 1 atm at normal conditions Since the gas is generated, stored and sent to boiler and gas engines at ambient conditions T1=29^oC (average temperature) and T2 as 0^oC at normal conditions. If V1 represents volume in m^3 and V2 represents volume in Nm^3, V2 = (1+x) x V1 x 273 / (273 + 29) If x = 0, a factor of 0.904 shall be multiplied to gas in m^3 to obtain gas in Nm^3.	As per the monitoring plan of the VCS PD, 'the amount of biogas combusted for gainful use' ($BG_{combusted, y}$) shall be monitored continuously using gas flow meter in Nm^3. It is confirmed from the onsite verification that the parameter was monitored continuously using gas flow meter. However, the meter (GM2) is of turbine type which measured the gas flow in m^3. Therefore, the value has been converted into Nm^3 using standard gas equation by assuming the pressure at 1 atm and ambient temperature of 29^oC. The approach is considered to be appropriate since it results in conservative value of the biogas combusted for gainful use. Therefore, the deviation is accepted.

Deviation-3 BG $_{TOFlare, y}$ (Amount of biogas flared in the year *y*) is estimated conservatively for the period when the gas flow meter for flare was not installed. The biogas flow meter has been installed on 23-Feb-2010. But this meter was removed on 11-Jun-11. During the meter was in place, the inspection and totalized recording was carried out on weekly basis because the flare is not supposed to operate. The biogas production rate is less than the consumption rate. This is the safety factor for preventing the biogas loss to flare when maintenance or shutdown of biogas using machines. From the monitored data, the boiler can use biogas only 91 days maximum in year 2011. It shows that this boiler mainly use the fuel oil because the biogas production is not sufficient. It can be concluded that the chance that there is the excess biogas sent to flare is very low. Additionally, the biogas operating team has the instruction for managing the biogas production to optimize between biogas demand and supply. In order to serve the over-demand and shortage supply, two biogas storage balloons are installed to ensure that no biogas loss when producing rate is higher than consuming rate and smooth running of generators and boiler. Thus, the flare should not operate. The installed flow meter always shows zero reading since no biogas sent to flare. However, since the biogas flow meter for flare is not monitored properly before 23-Feb-10 and after 11-Jun-11. The un-balance between the amount of biogas production and consumption is considered as flare volume. The project emission calculation is based on 0% of flare efficiency. This approach increases the project emission from flare. The reduction of the final emission reductions is	The biogas flow meter to flare could not be found at site during the physical inspection. When the plant's team was interviewed it was revealed that the flow meter was installed on 23-02-2010 and removed on 11-06-2011 due to construction activity of CSTR-3. During the period, the parameter, BG $_{TOFlare, y}$, was recorded weekly during the weekly maintenance of the flare. The weekly reports indicate the parameter as zero. The operating team of the plant informed that the flare was never operated since any excess biogas over and above that is consumed for gas engines is utilised in the onsite boiler. However, in response to CAR5, for the period from 01-01-2009 to 22-02-2010 and from 12-06-2011 to 31-05-2012 the parameter was calculated as the difference of biogas production and biogas combustion for gainful use. Total biogas production is the sum of biogas production from CSTRs and biogas production from covered lagoon. It can be seen from the monitoring diagram in section 5 that the gas flow meter GM1 measures the biogas production from CSTRs and GM5 measures the biogas production from covered lagoon. It can also be observed that GM5 is located between covered lagoon and gas holders (gas storage balloons). Therefore, biogas flows bi-directionally based on the pressure difference between covered lagoon and gas holders. GM5 records in both the directions. This is the primary reason for the difference between gas generation and gas consumption for gainful use. However, the PPs have accounted the positive difference as biogas flared and calculated the project emissions by assuming zero flare efficiency. This is a more conservative way of calculating emission reduction. Therefore, the deviation can be accepted.

according to conservative principle	

4.2 Accuracy of GHG Emission Reduction or Removal Calculations

GHG emissions reductions for the project and the baseline scenario were correctly calculated using the formulae described in the applied methodologies for this project. The verification team has reviewed the emission reduction (ER) spread sheet and checked all the formulae and found they are correct and inline with the monitoring plan of the registered VCS PD and the applied monitoring methodologies.

The emission reduction due to methane capturing and utilisation in onsite gas engines and boiler was estimated by measuring the required parameters using appropriate monitoring equipment and using the formulae described in the methodologies; AMS III.H., version 13 and AMS I.D., version 14 and the VCS PD except the deviations described in the above section. All the monitored parameters are described above in section 4.1. All the ex-ante parameters which are used in the calculation of emission reduction are presented in section 3.1 of the MR transparently. It is confirmed that all the ex-ante parameters have been correctly used in the emission reduction calculation.

The following are the ex-ante parameters used in the ER calculation which are in compliance with registered VCS PD:

Parameter	Description	Value	Unit
GWP_{CH4}	Global Warning Potential for methane	21	-
$B_{o, ww}$	Methane generating capacity of COD in wastewater	0.21	kg CH_4 / kg COD
$MCF_{ww, treatment, BL, lagoon}$	Methane correction factor for the existing anaerobic wastewater treatment systems	0.8	-
$MCF_{ww, treatment, PJ, lagoon}$	Methane correction factor for project wastewater treatment system not equipped with biogas recovery.	0.8	-
$MCF_{ww, treatment, PJ, CSTR}$	Methane correction factor for project wastewater treatment system CSTR equipped with biogas recovery	0.8	-
UF_{BL}	Model correction factor to account for model uncertainties	0.94	-
UF_{PJ}	Model correction factor to account for model uncertainties	1.06	-
COD removal	Chemical oxygen demand removal	87.5	%

efficiency - baseline	efficiency of baseline treatment system		
CFE_{ww}	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems	0.9	-
$EF_{FF,CO2}$	Emission factor of fossil fuel replaced – Residual Fuel oil	77.4	tCO_2/TJ
EF_y	CO_2 emission factor for grid electricity	0.5057	t CO_2/MWh
D_{CH4}	Density of methane at normal conditions	0.716	kg/m^3
FE	Flare efficiency	50	%
DE	Destruction efficiency of the electricity generator	100	%

According to the applied methodologies, the conservativeness of the achieved emission reduction was checked and the calculation has been transparently provided in the ER sheet. The emission reduction on account of methane avoidance is calculated using both COD approach and MD approach as specified by the applied methodology, AMS III.H., version 13. Conservative value of both for the year y has been considered for the final emission reduction to be claimed. Below table indicates the emission reduction calculated by both approaches.

Year	2009	2010	2011	2012
Unit	tCO_2e	tCO_2e	tCO_2e	tCO_2e
ER by COD approach	19,378	26,458	26,579	9,359
ER by MD_y approach	28,405	33,608	33,589	14,045
ER considered in the MR	**19,378**	**26,458**	**26,579**	**9,359**

Note: The above mentioned emission reduction does not include the emission reduction on account of electricity export to grid i.e. AMS I.D. component of the project activity. Total emission reduction achieved by the project activity is provided in below table and in section 5 of the report.

The detailed emission reduction calculation is presented in the ER spread sheet. All the formulae and the calculation procedure were checked by the verification team. It was observed that the emission reduction was determined in a conservative manner. The emission reduction being claimed during the period from 01-01-2009 to 31-05-2012 is 12.8% lower than the estimated emission reductions in the registered VCS PD, as given in the table below.

Table: Emission Reductions

Period	Estimated VCUs as per VCS PD	Achieved VCUs as per Monitoring Report
Emission Reductions	104,540*	91,121
% Deviation (+/-)	0	(-) 12.8 %

* The estimated emission reduction as per the VCS PD is 30,597 tCO_2e per annum. Therefore, for the total monitoring period of 3 years and 5 months, the value is calculated to be 104,540 tCO_2e.

The reduction in achieved emission reduction is considered appropriate due to various conservative approaches in the emission reduction calculation and variation in process parameters. However, no justification is required since the achieved emission reduction is lower than the estimated value in the VCS PD.

4.3 Quality of Evidence to Determine GHG Emission Reductions or Removals

During the verification site visit, all relevant documents were checked to assess the correctness and quality of data submitted by the project participants, which are used to determine emission reductions.

COD at inlet and outlet CSTR, COD at outlet of covered lagoon, quantity of wastewater treated, biogas combusted for gainful use, amount of biogas flared, methane concentration of biogas, quantity of electricity consumption for the treatment system, etc. were verified with the daily reports/16/ approved by the Factory Manager and the consistency and correctness of data was also crosschecked with the operator log sheets/15/ to ensure that there is no over estimation of the VCUs. Quantity of net electricity generation (i.e. electricity export to the grid) was verified with the monthly reports provided by PEA/17/. The provided data was found to be of adequate quality.

All records needed for monitoring are archived in line with the requirements of the registered monitoring plan. No significant, lack of evidence and missing data were detected during onsite verification. Hence, the verification team confirms that the monitoring system ensures required quality to ensure the quality of the monitored data. All internal data are subjected to QA/QC measures.

The plant was certified for ISO 9001:2008/29/. It is confirmed from the onsite interviews that the best practices of ISO have been implemented for the monitoring system. The documented procedures/33/, work instructions/30/ and forms have been established and implemented in accordance with ISO 9001. Monitoring of parameters, data recording and data archiving are required to be well managed as per the ISO 9001 requirements. The ISO system also outlines proper monitoring plan in terms of monitoring frequency as well as accuracy.

All the meters (wastewater flow meters, biogas flow meters, electricity meter, COD meter, and gas analyzer) were calibrated at appropriate calibration frequency (described in section 4.1) to ensure the quality of the data. Hence the verification team confirms that the quality of data is reasonably good and the emission reductions have been calculated conservatively. The plant's team has also developed an annual calibration plan/19/ for gas analyser in order to ensure proper accuracy in measuring methane content. It is confirmed from the onsite interviews that the meters have been scheduled for re-calibration as per the monitoring plan.

It was verified through onsite interviews that the plant's team involved in the monitoring of project activity is well experienced. Hence, the verification team concludes that competent staff is employed by the project proponent to carry out the relevant tasks with sufficient accuracy. Furthermore, it was learnt from the onsite interviews with the operating team that internal training programmes[/22/] are conducted on annual basis as per ISO requirements. Annual training plan, Personal training records, etc. were verified during the site visit. The training programmes would be in the areas of Quality control, Maintenance, Safety and Operation of biogas plant.

GLC is of the opinion that this method of estimation is accurate and results in conservative estimation of emission reduction and is in line with the applicable VCS requirements.

4.4 Management and Operational System

GLC was able to verify that authorities and responsibilities[/30/31/] for monitoring and reporting of all data related to the emission reductions were clearly defined for the monitoring period from 01-01-2009 to 31-05-2012. Moreover, all project related equipments were confirmed to be operated by qualified and trained staff[/22/23/]. The frequency of monitoring measurement, as well as applicable calibrations and reporting details were conducted as outlined in the monitoring plan available in the registered VCS PD.

The allocation of the responsibilities is documented in a written form and is followed as described in the registered VCS PD. Routines for the archiving of data are defined and documented. During the site visit all the required plant records were verified and found that the data is consistent with the provided in the final MR[/4/] and ER sheets[/5/].

The monitoring plan described in section 3.3 of the MR is confirmed to be correct. All the parameters of the monitoring plan are monitored using appropriate metering system. The parameters related to wastewater flow, biogas flow, electricity generation and electricity consumption are measured continuously and the cumulative value is displayed in the totaliser of the meters. The totaliser readings are recorded daily by the operators in the log sheets. In case of methane content, the parameter is measured once every 2 hours with the help of a portable gas analyser and in case of COD, the wastewater samples are collected and the COD is analysed once a day. The values are recorded by the operators in the log sheets.

The log sheets are submitted to the Biogas Supervisor and QA/QC Supervisor in case of COD on a daily basis. The Supervisor checks the values and approves the log sheets. The approved log sheets are submitted to Administrator. The Administrator transfers the data into electronic format (excel sheets), prepares daily reports and submits to the Factory Manager. The reported data in the MR and ER sheet was verified with the daily reports and crosschecked with operator log sheets during the onsite verification. The data was found to be consistent. However, in case of wastewater flow and biogas consumption, some inconsistency between the log sheets and the reported data in ER sheet was observed. Therefore, a CAR (CAR4 in Annex 3) was raised. The data was corrected in response to the CAR.

The Administrator also sends the data to the project consultant i.e. South Pole Carbon Asset Management Ltd. on a monthly basis for calculating emission reduction.

The operator log sheets and approved daily reports are stored in hard format in properly labeled files for easy identification. The soft copy of data sheets (excel sheets) are stored in Administrator's computer and also in Factory Manager's computer as a back up. The data is also backed up into factory server once every 6 months. The data is also available at South Pole's server on a monthly basis. It is therefore confirmed that the data monitoring and data storage represents good monitoring practice.

The verification team has interviewed the plant personnel who are involved in the monitoring of the parameters that are used to determine the emission reductions of the VER project. It is confirmed based on the interviews that the plant's team is competent enough to monitor the parameters as described in the monitoring plan.

As discussed above, the verification team concludes that management and operational system of the project is implemented and operated well. Thus it ensures the quality of data which is required in calculating the emission reductions. Description of the monitoring plan including organisation structure and data management system provided in section 3.3 of the MR is confirmed to be correct.

5 VERIFICATION CONCLUSION

Germanischer Lloyd Certification GmbH (GLC) has performed the 1st verification of the project: "**Wastewater Treatment with Biogas System in Palm Oil Mill at Sawi, Chumporn, Thailand**" with regard to the applicable relevant requirements for VCS project activity.

The project activity involves treatment of wastewater produced in a palm oil factory at The Natural Palm Group Co., Ltd. through CSTR and covered lagoon technology. The use of CSTR and covered lagoon to treat the wastewater enables capturing of methane produced during the process which would otherwise be released into the atmosphere. The captured methane (or biogas) is utilised as fuel in onsite gas engines and the surplus biogas, if any, is either utilised in onsite boiler or flared into the atmosphere through an open flare.

This verification covers the period from 01-01-2009 to 31-05-2012 (including both days).

The Natural Palm Group Co. Ltd. and South Pole Carbon Asset Management Ltd. are responsible for the collection of data in accordance with the validated monitoring plan and the reporting of GHG emissions reductions from the project.

It is GLC's responsibility to express an independent verification statement on the reported GHG emission reduction from the project. GLC does not express any opinion on the selected baseline scenario or on the validated and registered VCS PD.

The scope of this verification covers the determination of voluntary greenhouse gas emission reduction generated by the above mentioned project. GLC conducted the verification based on the registered VCS PD/1/, validation report/6/, monitoring report/4/, ER sheet/5/, approved small scale monitoring methodologies; AMS III.H. – Methane Recovery in Wastewater Treatment, version 13 and AMS I.D. – Grid connected renewable electricity generation, version 14 and supporting documents made available to the verifiers by the project participants. The verification included:

(i) Checking whether the design of the project is implemented and installed as planned and described in the registered VCS PD

(ii) Checking whether the provisions of the monitoring methodologies and the monitoring plan in the VCS PD were consistently and appropriately applied

(iii) The collection of evidence supporting the reported data

(iv) Checking whether the installed monitoring equipment are calibrated appropriately

As a result of the verification, GLC confirms that;

- All operations of the project are implemented and installed as planned and described in the registered VCS PD.
- The monitoring system is in place and functional and is inline with the applied monitoring methodologies and the monitoring plan
- The installed equipments essential for estimating emission reductions work reliable and are calibrated appropriately.

- GHG emission reductions are calculated without significant misstatements in a conservative and appropriate manner.

The verification of reported emission reductions is based on the information made available to GLC and the engagement conditions detailed in this report. Hence, GLC cannot be held liable by any party for decisions made or not made based on this report. Also all the documents checked during on-site visit and verification process will be kept confidential and will not be disclosed without the Project Participant's consent as required by VCSA.

In GLC's opinion, the GHG emissions reduction for the "Wastewater Treatment with Biogas System in Palm Oil Mill at Sawi, Chumporn, Thailand" as reported in the Monitoring Report issued on "25-09-2012, version 03.1" are calculated without material misstatements in a conservative and appropriate manner. The GHG emission reductions were correctly calculated on the basis of the approved small scale methodologies; AMS III.H., version 13 and AMS I.D., version 14 and the monitoring plan contained in the validated VCS PD for the project.

Germanischer Lloyd Certification GmbH herewith confirms that the project has achieved emission reduction during the reporting period from 01-01-2009 to 31-05-2012 (including both the days) as follows:

GHG Emission Reductions or Removals	Unit	2009	2010	2011	2012	Total during the 1st verification period
Baseline Emissions	tCO_2e	32,502	35,924	36,869	13,191	118,486
Project Emissions	tCO_2e	9,893	6,403	8,346	2,723	27,365
Leakage	tCO_2e	0	0	0	0	0
Net GHG emission reductions or removals	**tCO_2e**	**22,609**	**29,521**	**28,523**	**10,468**	**91,121**

It is confirmed that the project activity has achieved total emission reduction of **91,121 tCO_2e** during the monitoring period from 01-01-2009 to 31-05-2012.

Hamburg, 19-10-2012

Germanischer Lloyd
Certification

ANNEX 1: ABBREVIATIONS

CAR	Corrective Action Request
CDM	Clean Development Mechanism
CDM-EB or EB	CDM Executive Board
CH_4	Methane
CL	Clarification Request
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COD	Chemical Oxygen Demand
CSTR	Complete Stirred Tank Reactor
DOE	Designated Operational Entity
ER	Emission Reduction
ER sheet	Emission Reduction calculation spread sheet
FAR	Forward Action Request
GHG	Greenhouse gas(es)
GLC	Germanischer Lloyd Certification GmbH
HFO	Heavy Fuel Oil
ISO	International Organisation for Standardization
MP	Monitoring Plan
MR	Monitoring Report
NA	Not Applicable
PD	Project Design document
PP	Project Proponent or Project Participant
QA/QC	Quality Assurance / Quality Control
t CO_2e	Ton of Carbon dioxide equivalent
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Verified Carbon Standard
VCSA	VCS Association

VCS PD	VCS Project Design document
VCU	Verified Carbon Unit
VVS	Validation & Verification Standard

ANNEX 2: REFERENCES

Reference	Author: Title, version, date of issue
/1/	VCS registered Project Description document for project : "Wastewater Treatment with Biogas System in Palm Oil Mill at Sawi, Chumporn, Thailand", (VCS PD version 3.1 dated 15-11-2009)
/2/	VCS: VCS Version 3 Requirements Document • VCS Standard, v3.2, 01-02-2012 • VCS Program Guide, v3.3, 01-05-2012
/3/	CDM-EB: Clean Development Mechanism Validation and Verification Standard (Version 02.0)
/4/	Draft Monitoring Report of "Wastewater Treatment with Biogas System in Palm Oil Mill at Sawi, Chumporn, Thailand", Version 01, dated 29-06-2012 Final Monitoring Report of "Wastewater Treatment with Biogas System in Palm Oil Mill at Sawi, Chumporn, Thailand", Version 03.1, dated 25-09-2012
/5/	Draft Emission reduction calculation spreadsheet "ER cal_rev.01_120629_nl.xlsx" Final Emission reduction calculation spreadsheet "ER cal_1st ver_rev.03.1_25-09-2012.xls", dated 25-09-2012
/6/	TUV NORD CERT GmbH: Validation report for the project "Wastewater Treatment with Biogas System in Palm Oil Mill at Sawi, Chumporn, Thailand", issued on 18-11-2009
/7/	Small-Scale CDM methodologies CDM-EB: AMS III.H., version 13 – "Methane Recovery in Wastewater Treatment" CDM-EB: AMS I.D., version 14 – "Grid connected renewable electricity generation"
/8/	Methodological Tools CDM-EB: Tool to determine project emissions from flaring gases containing methane (EB 28,

Reference	Author: Title, version, date of issue
	Annex 13) CDM-EB: Tool to calculate the emission factor for an electricity system, version 1.1
/9/	CDM-EB: General Guidelines for SSC CDM methodologies, version 18 (EB 66, Annex 23)
/10/	ISO 14064 gases -- Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions; -3:2006; Greenhouse http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=38700; (25-09-2009)
/11/	GLC GmbH: Germanischer Lloyd CDM Procedures
/12/	IPCC: 1996 IPCC Guidelines for National Greenhouse Gas Inventories: work book IPCC: 2006 IPCC Guidelines for National Greenhouse Gas Inventories: work book
/13/	Monitoring Equipment specifications: ENDRESS + HAUSER: Technical Information of Proline Promag 50W (Electromagnetic Flow Measuring system, Flow Measurement of liquids in water or wastewater applications) - http://www.us.endress.com/#product/50W?tab=spareparts&filter=allspares ENDRESS + HAUSER: Technical Information of Proline t-mass 65F, 65I (Thermal Mass Flow Measuring System, Direct Mass Flow Measurement of Gases) - http://www.endress.com/corporate#product/65I ACTARIS: Specifications of Fluxi 2000/TZ Turbine Gas Meter (http://www.scribd.com/doc/76823693/Actaris-Manual) Geotech: Biogas Check Portable Gas Analyser, Technical Specifications (http://www.ert.pt/24/images/stories/catalogos/geotech/Geotech%20-%20Biogas.pdf) Hanna Instruments: C 214 Multiparameter Bench Photometer for Wastewater Treatment Analysis – Instruction Manual (http://www.hannainst.com/manuals/manHI_83214.pdf) Merlin Gerin: Power Meter Series 700 – Technical Data Sheet, 2007 (http://www.pitigroup.com/2009/product/merlin%20gerin/spec/Spec_Merlin%20Gerin%20Power%20meter.pdf)

Reference	Author: Title, version, date of issue
/14/	Calibration Reports: **1. Wastewater Flow meter (FM1): Serial Number: 79006020000** Miracle International Technology Co., Ltd. (MIT): Calibration Report, Report No. R0706-114 (Calibration date: 03-07-2007) Endress & Hauser (Thailand) Ltd. (Endress + Hauser): Flowmeter Verification Certificate, Certificate No. BN9-069-2/37 (Calibration date: 29-08-2009) Endress + Hauser: Calibration Certificate, Certification No. RC1012-221 (Calibration date: 04-03-2011) **2. Wastewater Flow meter (FM2): Serial Number: A2019020000** MIT: Calibration Report, Report No. R0706-115 (Calibration date: 03-07-2007) Endress + Hauser: Flowmeter Verification Certificate, Certificate No. BN9-069-1/37 (Calibration date: 29-08-2009) MIT: Calibration Certificate, Certification No. R1109-026 (Calibration date: 24-09-2011) **3. COD meter: Serial Number: H105199** Hanna Instruments (Thailand) Ltd.: Certificate of Conformity, Certificate No. HIT-0852-0323, Issued on 10-10-2008 Hanna Instruments (Thailand) Ltd.: Certificate of Conformity, Certificate No. HIT-1048-0369, Issued on 02-12-2010 **4. Portable Gas Analyser: Serial Number: BM 12438** Geotechnical Instruments (UK) Ltd.: Certificate of Calibration, Certificate No. BM12438_2/5366 (Calibration date: 08-04-2010) Geotech: Certificate of Calibration, Certificate No. BM12438_2/7219 (Calibration date: 07-04-2011) Entech Associate Co., Ltd.: Calibration Certificate, Certificate No. G 550075 (Calibration date: 06-03-2012) **5. Biogas flow meter at outlet of CSTR (GM1): Serial Number: A30CEA02000** Endress + Hauser: Calibration Certificate with Certificate no. 47707761 (Calibration date: 03-04-

Reference	Author: Title, version, date of issue
	2008) MIT: Calibration Certificate, Certificate No. L1009-199 (Calibration date: 24-09-2010) **6. Biogas flow meter at outlet of covered lagoon (GM5): Serial Number: AC0A3602000** Endress + Hauser: Calibration Certificate with Certificate no. 47709210 (Calibration date: 21-10-2008) MIT: Calibration Certificate, Certificate No. L1008-372 (Calibration date: 25-08-2010) **7. Biogas flow meter to 1 MW Generator (GM2): Serial Number: 8759701001** MIT: Calibration Certificate, Certificate No. L0707-163 (Calibration date: 12-07-2007) PTT Public Company Limited: Certificate of Calibration, Certificate No. GMCL 295/52 (Calibration date: 24-08-2009) **8. Biogas flow meter to 1.4 MW Generator (GM3): Serial Number: A20B2B02000** Endress + Hauser: Calibration Certificate with Certificate no. 47707553 (Calibration date: 29-02-2008) MIT: Calibration Certificate, Certificate No. L1009-198 (Calibration date: 24-09-2010) **9. Biogas flow meter for boiler (GM4): Serial Number: 9908A202000** MIT: Calibration Certificate, Certificate No. L0709-052 (Calibration date: 23-09-2007) MIT: Calibration Certificate, Certificate No. L1009-200 (Calibration date: 28-09-2010) **10. Biogas flow meter for flare (GM6): Serial Number: E1059F02000** Endress + Hauser: Calibration Certificate with Certificate no. 47714722 (Calibration date: 17-02-2011) **11. Electricity Meter (EM2): PM 700 Model** Schneider Electric: Certificate of Calibration, dated 18-10-2008 Schneider Electric: Site Acceptance Test Report, dated 26-09-2010

Reference	Author: Title, version, date of issue
/15/	Operator log sheets of Natural Palm Group Co., Ltd. • Wastewater flow meter readings • COD measurement of wastewater • Biogas consumption for gas engines • Biogas consumption for boiler • Biogas consumption for flare • Biogas generation • Methane content (% CH_4) in biogas • Electricity Consumption for Biogas plant • Electricity generated by the gas engines
/16/	Approved daily reports of Natural Palm Group Co., Ltd. • Wastewater flow through CSTRs • COD of wastewater • Biogas production • Biogas consumption in gas engines • Biogas consumption in boiler • Biogas consumption for flare • Methane content (% CH_4) in biogas • Electricity Consumption
/17/	PEA: Monthly Reports of Electricity export to the grid (from January 2009 to May 2012)
/18/	Endress+Hauser: Standard Operating Procedure for Calibration and Maintenance, Issue date: 25-02-2004
/19/	The Natural Palm Group Co., Ltd.: Calibration Plan for Year 2012, QF-CAL-100-03
/20/	COD Analysis Reports by ENVI Lab and Consultant CO., Ltd. for 2009 and 2010

Reference	Author: Title, version, date of issue
	Analysis Report of wastewater sample at CSTR1 inlet, Ref no. 0413/52, dated 06-04-2009 Analysis Report of wastewater sample at CSTR1 outlet, Ref no. 0412/52, dated 06-04-2009 Analysis Report of wastewater sample at CSTR2 inlet, Ref no. 0415/52, dated 06-04-2009 Analysis Report of wastewater sample at CSTR2 outlet, Ref no. 0414/52, dated 06-04-2009 Analysis Report of wastewater sample at Covered lagoon inlet, Ref no. 0416/52, dated 06-04-2009 Analysis Report of wastewater sample at Covered lagoon outlet, Ref no. 0417/52, dated 06-04-2009 Analysis Report of wastewater sample at CSTR1 inlet, Ref no. 0176/53, dated 10-02-2010 Analysis Report of wastewater sample at CSTR1 outlet, Ref no. 0175/53, dated 10-02-2010 Analysis Report of wastewater sample at CSTR2 inlet, Ref no. 0178/53, dated 10-02-2010 Analysis Report of wastewater sample at CSTR2 outlet, Ref no. 0177/53, dated 10-02-2010 Analysis Report of wastewater sample at Covered lagoon inlet, Ref no. 0174/53, dated 10-02-2010 Analysis Report of wastewater sample at Covered lagoon outlet, Ref no. 0173/53, dated 10-02-2010
/21/	Wastewater Analysis Reports by SGS for 2011 and 2012 SGS: Analysis Report of wastewater sample at CSTR1 inlet, Test Report No. 2117333, dated 15-11-2011 SGS: Analysis Report of wastewater sample at CSTR1 outlet, Test Report No. 2117332, dated 15-11-2011 SGS: Analysis Report of wastewater sample at CSTR2 inlet, Test Report No. 2117331, dated 15-11-2011 SGS: Analysis Report of wastewater sample at CSTR2 outlet, Test Report No. 2117330, dated 15-11-2011 SGS: Analysis Report of wastewater sample at Covered lagoon inlet, Test Report No. 2117329, dated 15-11-2011 SGS: Analysis Report of wastewater sample at Covered lagoon outlet, Test Report No. 2117328, dated 15-11-2011 SGS: Analysis Report of wastewater sample at CSTR1 inlet, Test Report No. 2207197, dated 05-

Reference	Author: Title, version, date of issue
	04-2012 SGS: Analysis Report of wastewater sample at CSTR1 outlet, Test Report No. 2207196, dated 05-04-2012 SGS: Analysis Report of wastewater sample at CSTR2 inlet, Test Report No. 2207195, dated 05-04-2012 SGS: Analysis Report of wastewater sample at CSTR2 outlet, Test Report No. 2207194, dated 05-04-2012 SGS: Analysis Report of wastewater sample at Covered lagoon inlet, Test Report No. 2207193, dated 05-04-2012 SGS: Analysis Report of wastewater sample at Covered lagoon outlet, Test Report No. 2207192, dated 05-04-2012
/22/	The Natural Palm Group Co., Ltd.: On the Job Training and Performance Evaluation of Biogas Operators, Form No. QF-PSL-100-06 The Natural Palm Group Co., Ltd.: On the Job Training and Performance Evaluation of Quality Control Laboratory Staff, Form No. QF-PSL-100-06
/23/	GekaKonus GmbH: Burner Manual – Operating Instructions 2006, Date: 01-01-2006
/24/	CSTR Specifications – Digestor Tank and Equipment Installation Digestor No. 2
/25/	GE: Technical Data of 1.4 MW Gas engine and Generator GE: Technical Data of 1 MW Gas engine and Generator
/26/	The Natural Palm Group Co., Ltd.: Log sheets of COD, March 2006 (For commissioning of CSTR1)
/27/	The Natural Palm Group Co., Ltd.: Memo for cancellation of Equalisation basin, dated 14-08-2011

Reference	Author: Title, version, date of issue
/28/	The Natural Palm Group Co., Ltd.: Memo requesting for new open lagoon no. 9, dated 25-04-2011
/29/	SGS: Certificate of ISO 9001 : 2008 for The Natural Palm Group Co., Ltd. issued on 22-05-2009
/30/	The Natural Palm Group Co., Ltd.: Job Description of Biogas plant Supervisor and Operating Staff, Form No. QF-PSL-100-01 The Natural Palm Group Co., Ltd.: Job Description of Quality Control Laboratory Staff, Form No. QF-PSL-100-01
/31/	The Natural Palm Group Co., Ltd.: Organisation chart
/32/	The Natural Palm Group Co., Ltd.: Memo for Installation of biogas flow meter at flare, 23-02-2010
/33/	The Natural Palm Group Co., Ltd.: Procedure for Control of Biogas Process, QP-BGS-100 The Natural Palm Group Co., Ltd.: Operational manual of Wastewater treatment Plant, QW-BGS-101 The Natural Palm Group Co., Ltd.: Procedure for Quality control of Biogas and Methane content measurement, QW-BGS-102 The Natural Palm Group Co., Ltd.: Procedure for Operation and Control of Generator, QW-BGS-103 The Natural Palm Group Co., Ltd.: Procedure for Quality Control and COD analysis, QW-QC-117
/34/	Department of Business Development, Ministry of Commerce: Company Registration Certificate of “The Natural Palm Group Co., Ltd.” 30-12-2009
/35/	The Natural Palm Group Co., Ltd.: Memo for removal of biogas flow meter at flare – Gage Transfer Form, Form no. QF-CAL-100-10, dated 11-06-2011

Reference	Author: Title, version, date of issue
/36/	The Natural Palm Group Co., Ltd.: Weekly report of Biogas Flare Maintenance, QF-MTP-100-09

ANNEX 3: RESOLUTION OF CORRECTIVE ACTION AND CLARIFICATION REQUESTS (FINDINGS' LIST)

Description of Finding – CAR / CL / FAR (DD-MM-YYYY)	Project Participants Response (DD-MM-YYYY)	GLC's Assessment (DD-MM-YYYY)	Final Conclusion (OK or OPEN)
CAR 1 (31-07-2012) The project proponent name mentioned in section 1.3 of the MR is different from the PDD. During the onsite interview it was understood that the company name was changed from "The Natural Palm Oil (Chumporn) Co., Ltd." to "The Natural Palm Group Co., Ltd." However, the MR does not contain any description on change of company name. Besides, the new name provided in section 1.3 is not exactly the same as informed by the PP during the onsite verification. Furthermore, the PP name in the VCS database still indicates the old name.	**21-08-2012 (1st round)** The name of PP in section 1.1 and 1.3 of MR is updated. The information regarding the changing of company name is provided in section 1.3 of MR. After checking with VCS-coordinator of South Pole, the communication about this issue with VCS can be done via MR and the issuance deed. However, all legal documents will be submitted to VCS during the issuance stage. The reference document is provided.	**31-08-2012 (1st round)** The project proponent (PP) name has been corrected to "The Natural Palm Group Co., Ltd." in section 1.1 and 1.3 of the MR. A description on change of PP name has been included in the MR in page-4 as footnote-1. The project owner has changed the company name from "The Natural Palm Oil (Chumporn) Co., Ltd." to "The Natural Palm Group Co., Ltd." in December 2009. It is confirmed from the provided evidence document that the new name was registered on 2009-12-30. The VCS database shall be updated by the PP with required documents. Therefore, the CAR is closed.	OK
CAR 2 (31-07-2012) Start and end dates of the crediting period are required to be provided in section 1.6 of the monitoring report (MR) as required by the VCS MR	**21-08-2012 (1st round)** The start and end dates of crediting period are added in section 1.6 of MR.	**31-08-2012 (1st round)** The start and end dates of the crediting period have been mentioned as 2006-06-01 and 2016-05-31 which are inline with the registered VCS PD. Therefore, the	OK

template.	Crediting period of this project is ten years, starts from 1st June 2006 to 31st May 2016.	CAR is closed.	
CAR 3 (31-07-2012) Methane content (%CH_4) was not monitored on a regular basis from the beginning of the monitoring period till 14 April 2010. Annual average of the measured values was calculated and 95% confidence level has been applied. However, conservativeness of %CH_4 in the emission reduction calculation has not been justified for the year 2009. Besides, it has been mentioned as continuous measurement in section 3.2 of the MR.	**21-08-2012 (1st round)** More justification is provided in deviation 1, and the deviated approach for year 2009 is revised for more conservativeness in MR and ER calculation sheet. The monitoring description in section 3.2 of MR is revised.	**31-08-2012 (1st round)** The deviation-1 in section 2.2 of the MR has been revised. Since %CH_4 was not periodically monitored during 2009, lowest of the measured values has been considered instead of the average value for baseline emissions and highest value for project emissions. This approach is considered to be appropriate since it results in conservative emission reduction. The monitoring parameter description has been corrected in section 3.2 of the MR. Therefore, the CAR is closed.	OK
CAR 4 (31-07-2012) All the flow parameters (wastewater and biogas) were monitored on a continuous basis and recorded in log sheets on a daily basis. Though the totaliser values were recorded in log sheets, while transferring the data from log sheets to electronic files (excel files) from where the data was taken into ER sheet, only daily consumption was recorded. Therefore, a difference in the annual consumption was observed when the data was crosschecked with totaliser values recorded in the log sheets.	**21-08-2012 (1st round)** The monthly summation numbers of wastewater and biogas volume in ER calculation sheet are firstly compared with the totalized reading (start-ending of month). In case there are gaps, the daily values are checked and corrected in ER calculation sheet. The cross-checking report is provided.	**31-08-2012 (1st round)** The wastewater flow and the biogas consumption values have been corrected in the revised ER sheet. From the crosschecking report, it is confirmed that the followed approach by the PPs is appropriate. This has resulted in overall change in volume of wastewater from 522,371 m^3 to 519,955 m^3 during the monitoring period and overall change in biogas consumption from 14,477,963 Nm^3 to 13,992,367 Nm^3. The changes have in turn resulted in	OK

		reduction in emission reduction. Therefore, the CAR is closed.	
CAR 5 (31-07-2012) In section 3.2 of the MR under the monitoring parameter $BG_{ToFlare,y}$ (Amount of biogas flared in the year y), the monitoring and recording frequency is mentioned as 'continuous monitoring with recording on daily basis'. However, during the onsite verification, the daily recordings of the parameter were not provided and the biogas flow meter was not observed at the flare. When the operating team was interviewed, it was revealed that the meter was removed in November 2011 since the flare was never operated. PPs are requested to justify the compliance of the monitoring plan for the above mentioned parameter. An evidence document for the installation and removal of the meter along with the monitoring information is required.	**21-08-2012 (1st round)** The new biogas flow meter was installed at flare on 23-Feb-2010. Since the flare has never operated, the inspection report and totalized flow recording is carried out on weekly basis. The records show that the totalized reading from this flow meter is always 0. When the construction of the extension phase started, all biogas pipelines in the construction area were cut and all valves were closed for safety issue. The biogas pipe to flare has been cut as well, then this flow meter was removed in Jun'11.	**31-08-2012 (1st round)** From the onsite verification, interview with the operating team and evidence documents it is understood that the biogas meter for flare was installed in February 2010 and removed in 2011 during the construction of extension phase. It is confirmed from the provided evidence documents that weekly maintenance of the flare is carried out and biogas flow meter reading was also noted down during the period when flow meter was there. The biogas flow was mentioned as 0. However, it has not been mentioned in the PP's response when the meter will be re-installed. Deviation-3 has been included in section 2.2 of the MR. As per the deviated approach, the difference of total gas generation and total gas consumption in gas engines and boiler has been accounted as biogas flared. Biogas is produced from CSTRs (CSTR1 and CSTR2) and also from covered lagoon. There are two gas balloons used for gas storage. The gas balloons are interconnected with covered lagoon; some times the gas goes from covered lagoon to gas balloons and some times from gas balloons to covered lagoon. Since the biogas flow meter was installed on biogas line between covered lagoon and gas balloons, it records the flow on both	OK

	 Pic : Flow meter installed at flare. Due to the incompleteness of monitoring programme, the deviation 3 is added for conservativeness in section 2.2 of MR. In the ER calculation sheet, the daily biogas production volume from CSTRs and CL is added. The calculation to find the difference between the total biogas production and $BG_{combusted,y}$ is done. The total difference is used in the emission calculation as $BG_{TOFlare,y}$. Information on biogas production meters is included in the MR.	directions. Therefore, PPs have considered the biogas generation from covered lagoon as 50% of the value recorded by the flow meter. This is considered to be appropriate. Accounting the difference of gas generation and gas consumption under project emissions results in conservative emission reduction. Details of gas flow meters, GM1 and GM5, used to measure the gas production from CSTRs and from covered lagoon respectively have been included in the revised MR. However, considering 50% flare efficiency cannot be justified since the flare efficiency parameters were not monitored during the monitoring period.	
	04-09-2012 (2nd round) • When the flow meter was installed at flare on 23-Feb-10, the flow meter continuously measures biogas volume. The flow meter recording was done on weekly basis. The monitored record shows 0 since there was no biogas sent to flare during this period.	**13-09-2012 (2nd round)** OK. Based on the provided weekly reports and the interview with the operating team, it is confirmed that the flare was not operated during period from 23-02-2010 to 11-07-2011. Therefore, it is appropriate to take the biogas consumption for flare as zero for the corresponding period.	

	• During the period that flow meter is missing, before 23-Feb-10 and after 11-Jun-11, the different amounts of biogas production and consumption are considered as flared volume. The flare efficiency 0% is used for project emission calculation. This approach is according to conservative principle since it results in the lower emission reductions. The flare flow meter will be installed after the construction is completed at the end of this year.	Though the flare was never operated, as confirmed by the operating team, the biogas consumption for flare was estimated based on the difference of biogas production and biogas consumption (for boiler and gas engines) for the periods from 01-01-2009 to 22-02-2010 and from 12-06-2011 to 31-05-2012 due to unavailability of flow meter. The approach is considered appropriate since it results in conservative estimation of emission reductions. The flow meter shall be installed after completion of the expansion activity. The flow meter for flare and the monitoring values shall be verified during the next verification. Please refer to FAR 3. The CAR is, hence, closed.	
CAR 6 (31-07-2012) (**FAR D1 from validation**) "Marking of flow direction and name of the fluid on all HDPE pipelines (wastewater, biogas gas) within the project boundary are requested to facilitate easy traceability during the verifications. The compliance will be checked during next periodic verification site visit."	**21-08-2012 (1st round)** The flow direction with name of fluid is shown on pipelines which is visible during site visit.	**31-08-2012 (1st round)** It is confirmed from the onsite verification that the flow direction with colour code and letter indicating the type of fluid has been marked on all pipelines. Therefore, the CAR is closed. FAR D1 from validation is, hence, closed now.	OK
CAR 7 (31-07-2012) (**FAR M2 from validation**) "In ex post ER calculation the statistical analysis of CH4% needs to be carried out as per the requirement	**21-08-2012 (1st round)** The inline gas analyser has been installed but this existing unit is appropriate for natural gas. When it works with biogas, the result is not	**31-08-2012 (1st round)** From the onsite interviews with the PP it was understood that inline gas analyser was installed on biogas line to monitor methane content. However, the purchased	OK

of Para 36 of AMS III.H, Version 13. Moreover online analyser may be installed for subsequent verifications for better monitoring and data must be recoded and archived. This requirement will be checked during verifications."	accurate. Then the portable meter is used for temporary solution. The new inline unit will be installed within this year. The deviation is made as per information in MR.	equipment was not functioning since it was not suitable for biogas. Therefore, $\%CH_4$ was measured using portable analyser. A deviation was made in this regard and the methane content values have been considered conservatively by applying the 95% confidence level. The approach is inline with the applied methodology. The CAR is closed. However, inline gas analyser shall be installed and methane content in biogas shall be monitored on a continuous basis. Please refer to FAR2.	
CL 1 (31-07-2012) Accuracy of gas analyser is mentioned as 5% in the MR while the technical specifications of the instrument indicate as ± 3.0%. Furthermore, the requirement as per the monitoring plan of the VCS PD is ± 2%. A clarification is needed on the accuracy of gas analyser.	**21-08-2012 (1st round)** Typing error in MR. The accuracy is corrected to be ±3% as per reference document. The two calibration reports show the error of 1.06% and 0.70%. The errors occurred are less than 2% identified in PD. To ensure the accuracy of the gas analyser, it was calibrated once a year during this monitoring period. The operating team also establish the annual calibration plan for this equipment. Hence, it can conclude that the monitoring equipment used in this monitoring period has the accuracy level according to the requirement in the registered PD.	**31-08-2012 (1st round)** The accuracy of the gas analyser has been corrected to ±3% in the revised MR. From the calibration reports, it can be confirmed that the maximum error identified during the calibration was 1.06% which is below the required accuracy of ± 2%. The gas analyser was calibrated annually to maintain the accuracy within the limits. It is also confirmed from the onsite verification and documents review that the plant's team has developed annual calibration plan to calibrate the gas analyser annually. It convinces the verification team that the accuracy of the gas analyser can be maintained within ± 2%. Therefore, the CL is closed.	OK
CL 2 (31-07-2012) Huge variation in COD values at the inlet of CSTR is observed; from as	**21-08-2012 (1st round)** The justification of high variation of COD at inlet	**31-08-2012 (1st round)** The reason for the high variation in inlet	OK

low as 4,400 mg/l to as high as 158,800 mg/l. A clarification is requested for such a high variation in COD values.	to CSTR is added in monitoring table in section 3.2 of MR. • In case of high Volatile Fatty Acids : VFA in the effluent of CSTR which is the signal of overloading or system failure, the raw wastewater will be mixed with soft water before entering CSTR. This operation will dilute the COD concentration in CSTR in order to recover the bacteria in CSTR. The $COD_{ww,\ untreated,\ y}$ will be lower than normal range on that day. • During peak season, huge amount of fresh palm fruits are supplied to the milling factory. Since the production capacity of the factory is limited, the storage time of fruit palm before milling is longer than normal (more than three days). The free fatty acid content in fresh fruit palm will destroy the palm fruit, so called "rotten palm fruit". When this rotten palm fruit entering the milling process, it will generate very high COD in wastewater discharge from factory.	COD has been sufficiently provided. It has also been included in section 3.2 of the MR. It is understood that lower values of COD is due to dilution of raw wastewater with soft water and higher values of COD are due to rotten palm fruit during peak season. Therefore, the CL is closed.	
CL 3 (31-07-2012) The achieved emission reduction during 2010 and 2011 is higher than the estimated value in the VCS PD. Therefore, a clarification is requested for the increased emission reduction.	**21-08-2012 (1st round)** After applying the conservative approaches , the achieved emission reduction is lower than the estimated value , no justification is provided in MR.	**31-08-2012 (1st round)** As per the revised MR, the achieved emission reductions are less than the estimated values in the VCS DD. Moreover, it is closer to the estimated value. Therefore, no justification is required. The CL is closed.	OK
FAR 1 (31-07-2012) As mentioned in section 2.1 of the MR, new CSTR (no.3) is under construction in place of equalisation pond. The reason for the change as	**21-08-2012 (1st round)** The PO will consider to install the new wastewater flow meter and new biogas flow	**31-08-2012 (1st round)** It shall be verified during the next verifications	

understood from the factory manager is that the project proponent plans to increase the production (to double during peak season). Therefore, in order to take care of additional wastewater generation, CSTR-3 is being installed. It was further understood from the onsite interviews that the capacity expansion and additional wastewater generation will not be included in the project activity. Therefore, it shall be ensured the excess wastewater generated, the new CSTR and the additional biogas generation will not be included in the project activity and the same shall be verified during the next verification.	meter for the new CSTR. And for the new boiler and generator, if any, will also have separate biogas flow meters.		
FAR 2 (31-08-2012) An inline gas analyser will be installed by the PPs to monitor the methane content in biogas on a continuous basis. This shall be verified during the next verification.			
FAR 3 (2012-09-13) The biogas flow meter for flare will be reinstalled by the PPs during the 2nd monitoring period and daily monitoring of biogas flow to flare is ensured. This shall be verified during the 2nd verification.			