

VERIFICATION REPORT OF THE “CHOL CHAROEN GROUP WASTEWATER TREATMENT WITH BIOGAS SYSTEM I (CHOLBURI)” IN THAILAND



Document Prepared By: Germanischer Lloyd Certification GmbH

Project Title	Chol Charoen Group Wastewater Treatment with Biogas System I (Cholburi)
Version	06

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Summary:

Germanischer Lloyd Certification GmbH (GLC) has performed the VCS verification of the project "Chol Charoen Group Wastewater Treatment with Biogas System I (Cholburi)" with regard to the relevant requirements for VCS project activities.

The project was validated and registered with reference no. 430 under VCS (Verified Carbon Standard) program on 21-05-2010. This is the third verification of this project which covers the period from 01-10-2010 to 31-12-2011. The project is verified against the VCS Version 3^{/2/}.

The project activity involves recovery of biogas from wastewater generated from starch manufacturing process through Anaerobic Fixed Film Reactor (AFFR) technology. The recovered biogas is used in boiler to generate heat required for starch drying process and in gas engines to produce electricity. Surplus gas, if any, is flared in an enclosed flaring system from safety point of view.

The project is a small scale project activity and there are three methodologies applied to estimate the GHG emission reductions.

- AMS III.H, version 13: Methane recovery in wastewater treatment
- AMS I.D, version 14: Grid connected renewable electricity generation
- AMS I.C, version 15: Thermal energy production with or without electricity

A risk based approach has been followed in this verification. In the course of verification, 8 Corrective Action Requests (CAR) and 3 Clarification Requests (CL) have been raised. All the CARs and CLs have been closed out successfully. The FARs from previous verification, applicable to the current verification period, have been verified and closed out. The verification is based on the monitoring plan of registered VCS Project Description document (VCS PD)^{/3/}. The project document is found at VCS registry under the reference number 430 (VCS Ref. No. 430), Monitoring report (MR)^{/4/}, Project Description (VCS PD)^{/3/}, and other supporting documents are made available to the verification team by project participants.

As a result of the verification, the verifiers confirm that:

The GHG emission reduction in the verification period (01-10-2010 to 31-12-2011, including both the days) is: **57,130 tCO₂e**.

Emission reductions in 2010:	13,365	t CO ₂ e
Emission reductions in 2011:	43,765	t CO ₂ e

Total Emission reductions during 57,130 t CO₂e
monitoring period:

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 participants to an approved VCS Program Registry based on the requirements set out under the most recent version of the VCS Program Guidelines on VCS Registration and issuance process. 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 3rd verification of the emission reductions reported for the VCS project activity “Chol Charoen Group Wastewater Treatment with Biogas System I (Cholburi)” with regard to the relevant requirements for VCS program as per the Verified Carbon Standard version 3 (VCS version 3) ^{/2/}. This verification report summarizes:

1. The findings from the VCS verification for the current monitoring period from 01-10-2010 to 31-12-2011; and
2. 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 a 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 project activity “Chol Charoen Group Wastewater Treatment with Biogas System I (Cholburi)” for the monitoring period from 01-10-2010 to 31-12-2011. 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 ensure that the project activity has been implemented and operated as per the registered VCS PD^{/3/} 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 registered VCS PD^{/3/}.
- To evaluate the GHG emission reduction data and express a conclusion with a reasonable level of assurance 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 in order to be certified.

The project design, its eligibility as project activity under VCS 2007.1 guidelines and the correct application of the approved CDM baseline and monitoring methodologies have already been validated and registered (Report No. 53208109–08/510 issued on 14-11-2009). As stated in the validation report, the validation opinion of the DOE is that the project activity as described in the registered VCS PD, version 3.1 dated 16-09-2009 meets all VCS Program requirements as set out in the VCSA Rules

(Voluntary Carbon Standard – 2007.1 and Voluntary Carbon Standard Program Guidelines 2007.1) and correctly applies the CDM approved baseline and monitoring methodologies.

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 latest version of the “Validation and Verification Manual (VVM)”^{1/}, “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”^{2/}.

According to the requirements and guidance of VCS Version 3, the criteria of this verification include the relevant applicable rules and steps for VER 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 Certification Statement.

1.3 Level of assurance

As VCS Version 3 only recognizes verified emission reductions, GLC has focused on providing a reasonable level of assurance that the emission reduction calculation methodologies used are appropriate and correctly applied, and that emission reductions have been accurately monitored. In accordance with the recommendation in the latest version of the Validation and Verification Manual, GLC may “discount verified emission reductions or request 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 VERs, 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 Chol Charoen Co. Ltd., a tapioca starch factory in Choburi, Thailand. The starch factory has a total design production capacity of 240 tons of dried starch per day generating approximately 2400 m³ of wastewater every production day.

Prior to project implementation, the wastewater released from the plant was treated with an open anaerobic lagoon system consisting of 13 cascading open lagoons. With the depth of these ponds being greater than 2 m from the water surface and the mean temperature of the area in the range of 29°C, there is a suitable anaerobic environment within the ponds for anaerobic bacteria. This results in the breakdown of organic compounds in the wastewater, which consequently leads to methane generation that is released into the atmosphere.

The project activity involves modification of previous open lagoon system into closed anaerobic system for treatment of wastewater containing high organic matter. The modified system is based on the Anaerobic Fixed Film Reactor (AFFR) technology. The use of AFFR technology to treat wastewater enables capturing of methane that would have been released into the atmosphere. The captured methane (biogas) is utilized as fuel in existing boiler and gas engines to generate thermal and electrical

energy respectively. The project activity, thereby, contributes to green house gas (GHG) emission reduction.

As per the registered VCS PD (VCS Ref No: 430) of the VCS project, total baseline emissions are calculated as the sum of baseline emissions of the wastewater treatment system affected by the project activity, baseline emissions from electricity generation and baseline emissions from heat displacement by the project activity. Project emissions are calculated as the sum of emissions from electricity or fuel consumption, methane emissions from wastewater treatment system affected by the project activity, fugitive methane emissions released from capturing system and methane emissions from flaring. 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.

Further background information on the project activity can be found in the VCS PD as well as the Validation report, 1st Verification report & 2nd verification report which are available on the VCS website at:

<https://vcsprojectdatabase2.apx.com/myModule/Interactive.asp?Tab=Projects&a=2&i=430&lat=13%2E296&lon=101%2E1518&bp=1>

The first verification corresponds to the monitoring period from 01-01-2007 to 31-12-2008. The second verification corresponds to the monitoring period from 01-01-2009 to 30-09-2010.

This is the third verification period and the total emission reduction for the current verification period (from 01-10-2010 to 31-12-2011) is 57,130 tCO₂e. The emission reduction is calculated conservatively as per the applied methodologies.

The project activity is located at the industrial facility of Chol Charoen Co. Ltd., 204 Moo 3 Nongchak, Banbung, Choburi, 20170 – Thailand.

Main components of the project activity include AFFR, Covered lagoons, Hot oil boiler, Gas engines, Cascading lagoons (Evaporation ponds) and Flaring system.

Table: Brief technical description of the project components

Component	Description
AFFR	There are two AFFR based digesters with a total volumetric capacity of about 10,000 m ³ . The design COD removal efficiency is 80%. The Hydraulic retention time is approximately 5 days as per the design provided by the supplier.
Boiler	This is a dual fired boiler with a thermal capacity of 3.78 MW _{th} . The boiler has biogas consumption capacity of 834 Nm ³ /hr at full operation capacity.
Gas Engines	There are three gas engines as part of the project activity; one of them has a rated capacity of 952 kW and two of them have 500 kW each. The total biogas consumption rate at full load is 926 Nm ³ /hr.
Auxiliary drives	The total capacity of auxiliary drives installed under the project activity

	is 139.35 kW.
Gas storage system	Three covered lagoons and two AFFR are used as gas storage system.

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

NA

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. In addition, the verification team followed the guidelines of the latest version of the Validation and Verification Manual^{/1/}. Standard auditing techniques 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 and registered VCS PD^{/3/}, the monitoring report (MR)^{/4/}, emission reduction calculation spreadsheet^{/5/}, supporting documents made available to the verifier 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
- CDM Validation and Verification Manual^{/1/}
- Other relevant rules, including the host country legislation

- Monitoring plan as given in the registered VCS PD^{/3/}
- Approved CDM Methodologies (AMS III.H., AMS I.D., & AMS I.C.)^{/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:

- Monitoring report ^{/4/},
- Emission reduction calculation sheet^{/5/},
- The validated VCS PD ^{/3/}, including the monitoring plan and the corresponding validation report,^{/6/}
- Previous verification reports^{/17/}
- The applied monitoring methodologies ^{/7/},
- Requirements and guidance of VCS Version 3 ^{/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, data on electricity generation in the national grid or laboratory analysis and national regulations)
- Addressing of FARs identified during previous verifications,

3.3 Interviews

Project Proponents

1. Chol Charoen Co., Ltd.
Project owner (Responsible for implementation and operation of the project activities)
2. South Pole Carbon Asset Management Ltd.,
Carbon consultant (Responsible for development of emission reductions through the VCS)

Representatives of Chol Charoen Co. Ltd. including the operational staff of the 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 • Technical equipment and operation • Changes since validation	Ms. Nattaya Lonawan, M & V Project Manager, South Pole Carbon Asset Management Ltd. Ms. Kamontorn Muckvichit, QC Supervisor, Chol Charoen Co. Ltd.

• Monitoring and measurement equipment • Remaining issues from validation • Calibration procedures • Quality management system • Involved personnel and responsibilities • Training and practice of the operational Personnel • Implementation of the monitoring plan • Monitoring data management • Data uncertainty and residual risks • GHG calculation • Procedural aspects of the verification • Maintenance • Environmental aspects	Mr. Panya Wisetchart, QC Operator, Chol Charoen Co. Ltd. Mr. Trirour Muchvichit, Engineer, Chol Charoen Co. Ltd. Ms. Aoy Wisetchart, QC Operator, Chol Charoen Co. Ltd.
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3.4 Site Inspections

On 05-03-2012, GLC carried out an on-site visit to Chol Charoen Co., Ltd. (CCCL), where the project has been implemented. The project activity is located at 204 Moo 3 Nongchak, Banbung, Choburi-20170 in Thailand with the geographic coordinates being 13° 7.736'N Latitude and 101°09.108'E Longitude.

During the visit, GLC verified that the actual implementation of the project was as described in the registered VCS PD^{/3/}. On-site inspection included review of data and records, interviews with shift engineer, section manager and plant managers, operations and maintenance personnel, confirming all data sources and constants used in the Monitoring Report.

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

- Confirmation that all project equipments have been installed and are operated as per the monitoring plan in the VCS PD^{/3/}.
- 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

- Monitoring processes, routines and documentations were audited
- 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:

- The verification is not able to obtain sufficient evidence for the reported emission reductions or part of the reported emission reductions. In this case these emission reductions shall not be verified and certified;
- The verification has identified significant misstatements in the reported emission reductions.

A detailed list of verification findings form the findings report, which is sent to the client for resolution of raised CARs, CLs and FARs. Nonconformities raised during the verification can either be seen as a non-fulfillment of criteria ensuring the proper implementation of a project or where a risk to deliver high quality emission reductions is identified.

Corrective Action Requests (CARs) are issued, if:

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

Clarification Request (CL) is raised if the information is insufficient or not clear enough to determine whether the applicable VCS or CDM requirements have been met.

Forward Action Request (FAR) is raised if the monitoring and reporting require attention and/or adjustment for the next verification period.

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

Before submission of the final report a technical review of the verification report is carried out. The technical reviewer is a competent GHG auditor appointed for the scope the project activity falls under.

As a result of the internal review process the verification opinion and the topic specific assessments as prepared by the verification team leader may be confirmed or revised. Furthermore reporting improvements might be achieved.

4 VERIFICATION FINDINGS

4.1 Project Implementation Status

During the verification an onsite visit was carried out. On the basis of this on-site visit and the reviewed project documentation, the verification team confirms that the project was implemented as described in the VCS PD. All the physical components and project boundary are in conformity with the description in registered VCS PD.^{/3/}

The project activity involves capturing of methane generated from the wastewater treatment through AFFR technology. The captured methane (biogas) is utilized as fuel in hot oil boiler and gas engines replacing conventional fossil fuel.

As part of the verification GLC has also assessed that all eligibility criteria of the project under VCS previously assessed by DOE (Report No. 53208109-08/510 issued on 14-11-2009) are still valid along the monitoring period from 01-10-2010 to 31-12-2011:

- The project activity has not created or attempted to create another form of environmental or carbon credit.
- CDM is a GHG Program approved by the VCS Board and currently there are no time or geography limitations in the application of the CDM baseline and monitoring methodologies; AMS III.H, version 13: "Methane Recovery in Wastewater Treatment", AMS I.C., version 15: "Thermal energy production with or without electricity" and AMS I.D., version 14: "Grid Connected Renewable Electricity" under VCS.
- The project has neither been presented nor rejected to/by any other GHG program.

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.

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:

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, FM2 & FM3). The measured data is logged in on a daily basis. The verification team has checked the log sheets ^{/12/} and interviewed the site personnel and found that the log book data is consistent with

	the data provided in the final ER sheet and the plant operating personnel are competent.												
Reporting frequency:	Daily The recorded data in the log sheets is reported to the QA manager on a daily basis.												
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. The measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PD.												
Type of monitoring equipment:	Electromagnetic liquid flow meters : <table border="1"> <thead> <tr> <th>Type of meter</th><th>Serial no.</th><th>Accuracy ^{/10/}</th></tr> </thead> <tbody> <tr> <td>FM1</td><td>YAL1263</td><td>0.2%</td></tr> <tr> <td>FM2</td><td>YAL1264</td><td>0.2%</td></tr> <tr> <td>FM3</td><td>YAL1265</td><td>0.2%</td></tr> </tbody> </table>	Type of meter	Serial no.	Accuracy ^{/10/}	FM1	YAL1263	0.2%	FM2	YAL1264	0.2%	FM3	YAL1265	0.2%
Type of meter	Serial no.	Accuracy ^{/10/}											
FM1	YAL1263	0.2%											
FM2	YAL1264	0.2%											
FM3	YAL1265	0.2%											
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. The accuracy of the flow meters is as specified in the VCS PD.												
Calibration frequency /interval:	The flow meters are calibrated at least once in 3 years. <table border="1"> <thead> <tr> <th>Flow meter</th><th>Latest Calibration ^{/9/}</th><th>Previous Calibration ^{/9/}</th></tr> </thead> <tbody> <tr> <td>FM1</td><td>16-05-2011</td><td>21-10-2010 07-09-2009</td></tr> <tr> <td>FM2</td><td>15-05-2011</td><td>21-10-2010 07-09-2009</td></tr> <tr> <td>FM3</td><td>15-05-2011</td><td>21-10-2010 07-09-2009</td></tr> </tbody> </table>	Flow meter	Latest Calibration ^{/9/}	Previous Calibration ^{/9/}	FM1	16-05-2011	21-10-2010 07-09-2009	FM2	15-05-2011	21-10-2010 07-09-2009	FM3	15-05-2011	21-10-2010 07-09-2009
Flow meter	Latest Calibration ^{/9/}	Previous Calibration ^{/9/}											
FM1	16-05-2011	21-10-2010 07-09-2009											
FM2	15-05-2011	21-10-2010 07-09-2009											
FM3	15-05-2011	21-10-2010 07-09-2009											
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 defined calibration frequency is inline with the monitoring plan of registered VCS PD. As mentioned above, the actual calibration frequency is less than 3 years which represents a good practice.												
Company performing the calibration:	The calibration was carried out by "Miracle International Technology Co. Ltd", Bangkok ^{/9/}												
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. From the verified calibration reports, it is confirmed that the calibration is valid for the whole reporting period.												

If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	The values mentioned in the monitoring report have been verified during the site visit with the daily log sheets ^{12/} . The reported data was found to be consistent.
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, the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place.

Assessment/ Observation							
Data / Parameter: (as in monitoring plan of the VCS PD):	COD _{ww,untreated,y} (COD of wastewater entering the treatment plant, mg/l)						
Measuring frequency:	Every operational day. Wastewater samples are collected every hour and the COD of the composite sample is analyzed once a day.						
Reporting frequency:	Daily The COD content is analyzed using a colorimetric method in the on-site laboratory of the treatment plant. The results are logged by the operators in the log sheets on a daily basis. The recorded data in the log sheets is reported to the QA manager on a daily basis.						
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. The measuring and reporting frequency is in accordance with the monitoring plan of the VCS PD.						
Type of monitoring equipment:	<table border="1"> <tr> <td>Type of meter</td><td>Spectrophotometer</td></tr> <tr> <td>Serial number</td><td>050100006010</td></tr> <tr> <td>Accuracy</td><td>±1 nm of wave length or ± 0.13%^{/10/}</td></tr> </table>	Type of meter	Spectrophotometer	Serial number	050100006010	Accuracy	±1 nm of wave length or ± 0.13% ^{/10/}
Type of meter	Spectrophotometer						
Serial number	050100006010						
Accuracy	±1 nm of wave length or ± 0.13% ^{/10/}						
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 the accuracy of the instrument, as mentioned above, represents a good practice.						
Calibration frequency /interval:	The calibration frequency was not defined in the monitoring plan. However, the calibration frequency has been mentioned as 3 years in the MR. From the						

	onsite interviews with the PPs it was learnt that the calibration frequency of at least 3 years has been selected inline with the CDM guidelines. The PPs have also provided the annual calibration plan to the verification team during the site visit which indicates majority of the monitoring equipments would be calibrated on annual basis. The spectrophotometer was calibrated at regular intervals during the monitoring period. The calibration reports of the meter have been provided to the verification team. The calibration dates are as below: <table><tr><td rowspan="2">Spectrophotometer (CS)</td><td>Latest Calibration ^{/9/}</td><td>Previous Calibration ^{/9/}</td></tr><tr><td>12-05-2011</td><td>14-05-2010</td></tr></table> From the above mentioned calibration dates, it is confirmed that the calibration frequency is less than one year.	Spectrophotometer (CS)	Latest Calibration ^{/9/}	Previous Calibration ^{/9/}	12-05-2011	14-05-2010
Spectrophotometer (CS)	Latest Calibration ^{/9/}		Previous Calibration ^{/9/}			
	12-05-2011	14-05-2010				
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?	Calibration frequency was not defined in the monitoring plan of registered VCS PD. However, as mentioned above, the calibration frequency is less than 1 year which represents a good practice.					
Company performing the calibration:	The calibration was carried out by “SPC Calibration Center Co. Ltd.”, Bangkok. ^{/9/}					
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 sent to external laboratory “King Mongkut’s University of Technology, Thonburi “ in August 2011. The COD analysis report ^{/22/} from the external laboratory has been provided to the verification team. It is confirmed from the report that the COD values of the onsite laboratory are comparable to the COD values of the external laboratory.					
How were the values in the monitoring report verified?	The values mentioned in the monitoring report have been verified during the site visit with the log sheets. ^{/12/}					
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, the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place.					

processes in place?	
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Assessment/ Observation							
Data / Parameter: (as in monitoring plan of the VCS PD):	COD _{removed,PJ,k,y} (COD of water exiting the AFFR treatment process, tonnes/m ³)						
Measuring frequency:	The parameter is calculated as the difference between inflow COD and the outflow COD of the AFFR system. Wastewater samples are collected every hour and the COD of the composite sample is analyzed once a day.						
Reporting frequency:	Daily The COD content is analyzed using a colorimetric method in the on-site laboratory of the treatment plant. The results are logged by the operators in the log sheets on a daily basis. The inlet and outlet COD of the AFFR system is measured on every operational day. The recorded data in the log sheets is reported to the QA manager on a daily basis.						
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. The measuring and reporting frequency is in accordance with the monitoring plan of the VCS PD.						
Type of monitoring equipment:	<table> <tr> <td>Type of meter</td><td>Spectrophotometer</td></tr> <tr> <td>Serial number</td><td>050100006010</td></tr> <tr> <td>Accuracy</td><td>±1 nm of wave length or ± 0.13%^{/10/}</td></tr> </table>	Type of meter	Spectrophotometer	Serial number	050100006010	Accuracy	±1 nm of wave length or ± 0.13% ^{/10/}
Type of meter	Spectrophotometer						
Serial number	050100006010						
Accuracy	±1 nm of wave length or ± 0.13% ^{/10/}						
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 the accuracy of the instrument, as mentioned above, represents a good practice.						
Calibration frequency /interval:	The calibration frequency was not defined in the monitoring plan. However, the calibration frequency has been mentioned as 3 years in the MR. From the onsite interviews with the PPs it was learnt that the calibration frequency of at least 3 years has been selected inline with the CDM guidelines. The PPs have also provided the annual calibration plan to the verification team during the site visit which indicates majority of the monitoring equipments would be calibrated on annual basis.						

	The spectrophotometer was calibrated at regular intervals during the monitoring period. The calibration reports of the meter have been provided to the verification team. The calibration dates are as below: <table><tr><td rowspan="2">Spectrophotometer (CS)</td><td>Latest Calibration ^{/9/}</td><td>Previous Calibration ^{/9/}</td></tr><tr><td>12-05-2011</td><td>14-05-2010</td></tr></table> From the above mentioned calibration dates, it is confirmed that the calibration frequency is less than one year.	Spectrophotometer (CS)	Latest Calibration ^{/9/}	Previous Calibration ^{/9/}	12-05-2011	14-05-2010
Spectrophotometer (CS)	Latest Calibration ^{/9/}		Previous Calibration ^{/9/}			
	12-05-2011	14-05-2010				
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?	Calibration frequency was not defined in the monitoring plan of registered VCS PD. However, as mentioned above, the calibration frequency is less than 1 year which represents a good practice.					
Company performing the calibration:	The calibration was carried out by “SPC Calibration Center Co. Ltd.”, Bangkok. ^{/9/}					
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 sent to external laboratory “King Mongkut’s University of Technology, Thonburi” in August 2011. The COD analysis report ^{/22/} from the external laboratory has been provided to the verification team. It is confirmed from the report that the COD values of the onsite laboratory are comparable to the COD values of the external laboratory.					
How were the values in the monitoring report verified?	The values mentioned in the monitoring report have been verified during the site visit with the calculation in ER sheet . The reported values have found to be 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, the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place.					

Assessment/ Observation

Data / Parameter: (as in monitoring plan of the VCS PD):	BG _{combusted,y} (Amount of biogas combusted for gainful use, Nm ³)																	
Measuring frequency:	The parameter indicates the sum of biogas utilized for boiler and gas engines. Biogas utilized for boiler and gas engines is measured continuously by gas flow meters, GM1 and GM3 respectively.																	
Reporting frequency:	Daily. The measured data is logged in on a daily basis. The recorded data in the log sheets ^{/12/} is reported to the QA manager on a daily basis. The verification team has checked the log books and interviewed the site personnel and found that the plant operating personnel are competent.																	
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. The measuring and reporting frequency is in accordance with the monitoring plan of the VCS PD.																	
Type of monitoring equipment:	<table border="1"> <tr> <th>Monitoring Equipment</th> <th>GM1</th> </tr> <tr> <td>Type of meter</td> <td>Differential Pressure transmitter</td> </tr> <tr> <td>Serial number</td> <td>V9107-03.1</td> </tr> <tr> <td>Accuracy</td> <td>1.0%^{/10/}</td> </tr> <tr> <th>Monitoring Equipment</th> <th>GM3</th> </tr> <tr> <td>Type of meter</td> <td>Thermal mass flow meter</td> </tr> <tr> <td>Serial number</td> <td>7565</td> </tr> <tr> <td>Accuracy</td> <td>1%^{/10/}</td> </tr> </table>		Monitoring Equipment	GM1	Type of meter	Differential Pressure transmitter	Serial number	V9107-03.1	Accuracy	1.0% ^{/10/}	Monitoring Equipment	GM3	Type of meter	Thermal mass flow meter	Serial number	7565	Accuracy	1% ^{/10/}
Monitoring Equipment	GM1																	
Type of meter	Differential Pressure transmitter																	
Serial number	V9107-03.1																	
Accuracy	1.0% ^{/10/}																	
Monitoring Equipment	GM3																	
Type of meter	Thermal mass flow meter																	
Serial number	7565																	
Accuracy	1% ^{/10/}																	
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. The accuracy of the meters is as specified in the monitoring plan of registered VCS PD.																	
Calibration frequency /interval:	Calibration reports of the monitoring equipments have been provided to the verification team. The calibration dates of the meters are as below: <table border="1"> <tr> <th>Differential Pressure transmitter</th> <th>Latest Calibration^{/9/}</th> <th>Previous Calibration^{/9/}</th> </tr> <tr> <td>GM1</td> <td>23-05-2011</td> <td>12-01-2010</td> </tr> <tr> <th>Thermal mass flow meter</th> <th>Latest Calibration^{/9/}</th> <th>Previous Calibration^{/9/}</th> </tr> <tr> <td>GM3</td> <td>23-05-2011</td> <td>27-10-2010</td> </tr> </table>		Differential Pressure transmitter	Latest Calibration ^{/9/}	Previous Calibration ^{/9/}	GM1	23-05-2011	12-01-2010	Thermal mass flow meter	Latest Calibration ^{/9/}	Previous Calibration ^{/9/}	GM3	23-05-2011	27-10-2010				
Differential Pressure transmitter	Latest Calibration ^{/9/}	Previous Calibration ^{/9/}																
GM1	23-05-2011	12-01-2010																
Thermal mass flow meter	Latest Calibration ^{/9/}	Previous Calibration ^{/9/}																
GM3	23-05-2011	27-10-2010																

			27-05-2009
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?	As per the monitoring plan of the VCS PD, the gas flow meters are calibrated once in every 3 years according to equipment's specifications and industrial standards. However, the calibration frequency specified by the equipment manufacturer for GM3 is 2 years. The actual calibration frequency for both the meters is less than 2 years which represents good practice.		
Company performing the calibration:	The gas flow meters are calibrated by Miracle International Technology Co. Ltd., Bangkok. ^{/9/}		
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 calibration is valid for the whole reporting period.		
If applicable, has the reported data been cross-checked with other available data?	NA		
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet have been verified during the site visit with the 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, the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place.		

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	BG _{TOFlare,y} (Amount of biogas flared, Nm ³)
Measuring frequency:	Gas flow meter (GM2) was installed to measure continuously and to record the cumulative reading daily. However, the flaring system was not operated even once during the monitoring period. The reason understood by interviewing the plant personnel during the site visit was that the biogas requirement for boiler and gas engines is more than the biogas generation.
Reporting frequency:	Not applicable for this monitoring period
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Not applicable for this monitoring period.

Type of monitoring equipment:	Monitoring Equipment		GM2
	Type of meter	Differential Pressure transmitter	
	Serial number	V10S08-01.1	
	Accuracy	1.0% ^{/10/}	
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. The accuracy of the meters is as specified in the monitoring plan of registered VCS PD.		
Calibration frequency /interval:	The gas flow meter (GM2) is calibrated at least once in every 3 years. The calibration frequency is within the specified period. The verification team verified the calibration reports of the meter.		
	Differential Pressure transmitter	Latest Calibration ^{/9/}	Previous Calibration ^{/9/}
	GM2	21-05-2011	12-01-2010
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. As per the VCS PD, the calibration is carried out at least once in 3 years by external agency.		
Company performing the calibration:	Miracle International Technology Co. Ltd., Bangkok ^{/9/}		
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?	Not applicable for this monitoring period.		
How were the values in the monitoring report verified?	Not applicable for this monitoring period.		
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?	Not applicable for this monitoring period.		

Assessment/ Observation

Data / Parameter: (as in monitoring plan of the VCS PD):	W _{CH₄} (Methane content in biogas, %)								
Measuring frequency:	Daily Methane content (% CH₄) is analyzed for every 4 hours at three locations; common header, before boiler and before gas engines. The parameter is measured by a portable gas analyzer and the values are recorded in the log books on a daily basis.								
Reporting frequency:	Daily The recorded data in the log sheets is reported to the QA manager on a daily basis.								
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	According to the monitoring plan, online gas analyzer is used for continuous monitoring of the parameter. However, it was noticed during the onsite verification that portable gas analyser was used during the monitoring period for monitoring of %CH₄ due to frequent problems with online gas analyser. Therefore CAR 4 was raised. As a compliance 95% confidence level has been applied by PP for the measured values of %CH₄ and the values have been considered conservatively for emission reduction calculation. The deviated approach has been sufficiently described in section 2.2 of the MR. The approach is considered to be appropriate since it is inline with Para 36 of the applied methodology, AMS III.H., version 13								
Type of monitoring equipment:	Type of meter	Portable gas analyzer (MS)							
	Serial number	VI3-3005							
	Accuracy	2.0% ^{/10/}							
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. GLC, based on verification during site visit and the experience of verifying similar other projects, understands that the accuracy of the meters represents good monitoring practice..								
Calibration frequency /interval:	The gas analyzer is calibrated at least once in every 3 years. The calibration reports of the meter have been provided to the verification team. The calibration dates are as below: <table border="1"> <tr> <th>Portable gas analyzer (MS)</th> <th>Latest Calibration ^{/9/}</th> <th>Previous Calibration ^{/9/}</th> </tr> <tr> <td></td> <td>21-12-2011</td> <td>01-09-2010</td> </tr> </table>			Portable gas analyzer (MS)	Latest Calibration ^{/9/}	Previous Calibration ^{/9/}		21-12-2011	01-09-2010
Portable gas analyzer (MS)	Latest Calibration ^{/9/}	Previous Calibration ^{/9/}							
	21-12-2011	01-09-2010							
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD	Yes. As per the monitoring plan the calibration is carried out once in 3 years by an external agency.								

does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	The actual calibration frequency, from the above mentioned calibration dates, is less than 3 years which represents a good practice.
Company performing the calibration:	The calibration is carried out by Thai Steam Service & Supply Co. Ltd., Bangkok ^{/9/}
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. As discussed above the calibration certificates were verified and found valid for the whole monitoring period. Hence the observed measurement represent good quality.
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	The values mentioned in the monitoring report have been verified during the site visit with the available hard copy of 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, the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place.

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	Q _{FO,y} (Quantity of fossil fuel used in boiler in year y, Liters)
Measuring frequency:	Measured continuously with liquid flow meter
Reporting frequency:	Daily. The recorded parameter by the flow meters is archived into log sheets on a daily basis by plant's operators. The recorded data is reported to the QA manager on a daily basis.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. It is inline with the monitoring plan of registered VCS PD.

Type of monitoring equipment:	Monitoring Equipment		OM (Old Meter)	
	Type of meter		Liquid flow meter	
	Serial number		92049	
	Accuracy		1.0% ^{/10/}	
	Monitoring Equipment		OM (New Meter)	
	Type of meter		Liquid flow meter	
	Serial number		4624027	
	Accuracy		1.0% ^{/10/}	
	During the onsite interviews with the operating team, it was revealed that the oil flow meter of boiler (OM) was changed on 2011-08-30 which was evident from the monitoring data presented in the ER sheet. A CAR was raised since the draft MR does not contain the information about the other meter (please refer to CAR 7 in Annex 3). The old flow meter (Sr No.: 92049) was replaced with new flow meter (Sr No.: 4624027).			
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?	The VCS PD does not specify accuracy of oil flow meter. However, the PP has a good monitoring practice in place. Accuracy of 1% for the oil flow meter also represents good practice.			
Calibration frequency /interval:	The flow meter is calibrated at least once in every 3 years.			
	Liquid meter	flow	Latest Calibration ^{/9/}	Previous Calibration ^{/9/}
	OM (Old meter)	(Old)	04-11-2010	10-07-2009
	OM (New Meter)	(New)	16-05-2011	N/A
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 frequency. As the calibration frequency was also not specified by the equipment supplier, PP has chosen a calibration frequency of 3 years which is inline with Para 17 C of General guidelines to SSC methodologies (EB 59, Annex 9). The error from the available calibration reports was found to be within the limits. During the onsite interviews with the operating team, it was revealed that the oil flow meter of boiler (OM) was changed on 30-08-2011. Verification team has reviewed calibration certificate of the new meter during the site visit.			
Company performing the calibration:	Miracle International Technology Co. Ltd.,			

	Bangkok ^{/10/}
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. As discussed above the calibration certificates were verified and found valid for the whole monitoring period. Hence the observed measurement represent good quality.
If applicable, has the reported data been cross-checked with other available data?	Yes. The reported data was cross checked with the fuel purchase records during the verification site visit ^{/18/} . All the reported values were found to be appropriate.
How were the values in the monitoring report verified?	The values mentioned in the monitoring report have been verified during the site visit with the log sheets and the plant's team was also interviewed. It was found that the data is correct and the plant personnel are competent.
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, the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place.

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	$Q_{Starch,y}$ (Quantity of dry starch produced, Tonnes)
Measuring frequency:	Monitored daily. The data is recorded on a daily basis on operational log sheets at the plant.
Reporting frequency:	Daily
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. It is inline with the monitoring plan of registered VCS PD.
Type of monitoring equipment:	Log sheets The data is obtained from the production department
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?	Not applicable
Calibration frequency /interval:	Not applicable

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?	Not applicable
Company performing the calibration:	Not applicable
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not applicable
Is (are) calibration(s) valid for the whole reporting period?	Not applicable
If applicable, has the reported data been cross-checked with other available data?	The starch production data was also crosschecked with the sales records ^{/19/} of starch during the site visit. The reported data was found to be appropriate.
How were the values in the monitoring report verified?	The values mentioned in the monitoring report have been verified during the site visit with the log sheets. The values have been found to be 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, the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place.

Assessment/ Observation	
Data / Parameter: (as in monitoring plan of the VCS PD):	EG _y (Net electricity production by the generators during year y, MWh/y)
Measuring frequency:	Continuously. The parameter is measured electronically with energy meters on a continuous basis.
Reporting frequency:	Daily. The measured data is archives into log sheets on a daily basis. The recorded data in the log sheets is reported to the QA manager on a daily basis.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. The measuring frequency is in accordance with the monitoring plan of VCS PD.
Type of monitoring equipment:	Meter
	Type of meter
	Serial number
	EM1
	3-phase power meter
	61580000N0050

	Accuracy	± 0.5% for voltage / current ± 1% for energy ^{/10/}
	Meter	EM2
	Type of meter	Multi-function power monitor
	Serial number	HT08051884
	Accuracy	+ 0.2% for voltage / current ^{/10/}
		+ 0.5% for other electric data
	Meter	EM3
	Type of meter	Multi-function power monitor
	Serial number	HT09050004
	Accuracy	+ 0.2% for voltage / Current ^{/10/}
		+ 0.5% for other Electric data
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?	The VCS PD does not specify any accuracy for power meters. However, from the specifications of the installed meters it shows that the PP has a good monitoring practice.	
Calibration frequency /interval:	The power meter EM1 is calibrated once in three years; it was calibrated on 06-11-2010. During site visit it was revealed that no previous calibration report was available as there was no supplier who could do calibration of this meter. The manufacturer could not provide the calibration certificate. Therefore, the calibration in 2010 is the 1st calibration for EM1 since its installation in 2006. EM2 & EM3 were calibrated on 03-03-2006 which was the initial calibration at the time of installation. As per the initial certificate provided by the supplier, it was mentioned that the life time is 10 years. Moreover, PP has a contract agreement with the supplier for annual maintenance of generators (EG-2 & EG-3) and metering systems. The service report ^{/11/} has been provided to the verification team. It is mentioned in the service report that the generator and metering system were checked and normal functioning of the meters was observed..	

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?	As per the VCS PD, the calibration is carried out once in three years. For meter EM1 the latest calibration was carried out on 06-11-2010. There is a calibration gap from 01-10-2010 to 05-11-2010. Therefore a CAR (please refer to CAR 8) was raised. In response to the CAR 8, the PPs have applied the calibration guidelines as per EB 52, Annex 60 and calculated the measured values of energy generation conservatively. Since the error identified during the calibration, as per the calibration report, is from 0.98% to 1% at different applied values while the maximum permissible error of the meter is $\pm 1\%$, PPs have applied the maximum permissible error of 1% for a period from 2010-10-01 to 2010-11-05. The approach is considered to be appropriate. Based on the initial certificate provided by the supplier and the regular service reports, the calibration of EM-2 and EM-3 is considered to be appropriate.
Company performing the calibration:	For EM1, calibration was done by Calibration Laboratory Co. Ltd. ^{/9/} For EM2 and EM3, calibration was carried out by Shengli Oilfield Shengli Power Machinery Group
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration reports were verified and the meters were found functioning properly.
Is (are) calibration(s) valid for the whole reporting period?	As mentioned above, there was a delay in the calibration of meter EM1. Therefore the calibration guidelines as per EB 52, Annex 60 have been applied and the values of energy generation were calculated conservatively.
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	The values mentioned in the monitoring report have been verified during the site visit with the daily log sheets. The reported data in the MR and ER sheet was found to be correct. EM4 records the net electricity produced by Generator-4. As the Generator-4 was installed after the installation of the project activity, the generation from this generator was not included in the emission reduction calculation. Therefore, the estimated emission reduction is a conservative value.
Does the data management (from monitoring equipment to emission reduction calculation)	Yes, the data management ensures correct transfer of data and reporting of emission reductions and the

ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	necessary QA/QC procedures are in place.
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	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	EC _y (Electricity consumption by wastewater treatment plant in year y, MWh)
Measuring frequency:	Calculated value It is calculated as maximum rated consumption based on total electrical capacity of the entire wastewater treatment plant and operation period.
Reporting frequency:	Not applicable
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Not applicable
Type of monitoring equipment:	Not Applicable
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?	The calculation approach is as described in the monitoring plan of the VCS PD. It results in conservative estimation of emission reduction.
Calibration frequency /interval:	Not Applicable
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?	Not Applicable
Company performing the calibration:	Not Applicable
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not Applicable
Is (are) calibration(s) valid for the whole reporting period?	Not Applicable
If applicable, has the reported data been cross-checked with other available data?	Not Applicable.
How were the values in the monitoring report verified?	The values mentioned in the monitoring report have been verified with the ER sheet calculation. It has been verified that maximum rated consumption as per the installed capacity is used to calculate the emission reduction.

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, the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place.
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	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	Sludge removed and its application (The quantity of organic material / sludge removed from treatment plant and its application, Tonnes / and type of application)
Measuring frequency:	Measured by weighing equipment at the time of sludge removal.
Reporting frequency:	Every time when the sludge is removed. However, the quantity of sludge removed is 'zero' during the current monitoring period.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Measuring frequency is not applicable. However, the approach is inline with the VCS PD.
Type of monitoring equipment:	Not Applicable
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?	Not Applicable
Calibration frequency /interval:	Not Applicable
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?	Not Applicable
Company performing the calibration:	Not Applicable
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not Applicable
Is (are) calibration(s) valid for the whole reporting period?	Not Applicable
If applicable, has the reported data been cross-checked with other available data?	Not Applicable.
How were the values in the monitoring report verified?	Not Applicable
Does the data management (from monitoring	Yes, the data management ensures correct transfer

equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	of data and reporting of emission reductions and the necessary QA/QC procedures are in place.
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		Assessment/ Observation	
Data / Parameter: (as in monitoring plan of the VCS PD):	Q biogas, flare, h Biogas sent to flare during a particular hour h (Nm ³ /hr)		
Measuring frequency:	Measured continuously during the time of flaring		
Reporting frequency:	As the flare was not operated during the monitoring period, no data of flame temperature of flaring is available.		
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Not Applicable		
Type of monitoring equipment:	Monitoring Equipment		GM2
	Type of meter	Differential Pressure transmitter	
	Serial number	V10S08-01.1	
	Accuracy	1.0% ^{/10/}	
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. The accuracy of the meters is as specified in the monitoring plan of registered VCS PD.		
Calibration frequency /interval:	The gas flow meter (GM2) is calibrated at least once in every 3 years. The calibration frequency is within the specified period. The verification team verified the calibration reports of the meter.		
	Differential Pressure transmitter (GM2)	Latest Calibration ^{/9/} 21-05-2011	Previous Calibration ^{/9/} 12-01-2010
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. As per the VCS PD, the calibration is carried out at least once in 3 years by external agency.		
Company performing the calibration:	Miracle International Technology Co. Ltd., Bangkok ^{/9/}		

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?	Not Applicable.
How were the values in the monitoring report verified?	Not Applicable
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?	Not Applicable

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	$T_{\text{flare, h}}$ (Temperature at the flame of flare, Deg C)
Measuring frequency:	Measured continuously during the time of flaring
Reporting frequency:	As the flare was not operated during the monitoring period, no data of flame temperature of flaring is available.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Not Applicable
Type of monitoring equipment:	Enclosed flaring with temperature detection system (N type thermo couple) ^{/23/}
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?	Not Applicable
Calibration frequency /interval:	Not Applicable
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?	Not Applicable
Company performing the calibration:	Not Applicable
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not Applicable
Is (are) calibration(s) valid for the whole	Not Applicable

reporting period?	
If applicable, has the reported data been cross-checked with other available data?	Not Applicable.
How were the values in the monitoring report verified?	Not Applicable
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, the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place.

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 frequency of monitoring, the accuracy of the measurement equipments and the calibration frequency are in line with the monitoring plan.

Remaining Issues from Validation or Previous Verification

The verification team has reviewed validation report and previous verification reports available on VCS database at

<https://vcsprojectdatabase2.apx.com/myModule/Interactive.asp?Tab=Projects&a=2&i=430&lat=13%2E296&lon=101%2E1518&bp=1>

There were three FARs from the validation. One of the FARs was closed during the previous (2nd) verification and the other two FARs were carried forward. Therefore, two FARs were raised during the 2nd verification as mentioned below.

FARs from the previous verification

FAR Ref No. from the 2nd Verification Report	Description of FAR	Verification team's Assessment
FAR 1	The operational conditions of the dual fuel boiler need to be verified during the subsequent verifications. In case it is found that the existing boiler is replaced with new boiler during any monitoring period, no emission reduction shall be claimed for heat displacement.	The operational conditions of the dual fuel boiler were verified during the site visit. Based on onsite observations and interview with the plant's operating team, the verification team confirms that there was no replacement of boiler during the monitoring period. This FAR is valid for the sub-sequent verifications. Please refer to FAR 1 in

		Annex 3.
FAR 2	It was observed during the site visit that the flow direction and name of the fluid was indicated on HDPE pipelines. However, the marking is not visible at some of the locations. Therefore, PP is requested to mark the fluid and its direction clearly at all locations for easy traceability. This would be verified during the next periodic verification.	It was observed during the site visit that the name of the fluid and the flow direction has been marked and is clearly visible on all HDPE pipelines. Therefore, the FAR can be closed.

Previously Validated Methodology Deviations

There were three deviations taken during the validation which are stated in the registered VCS PD and the corresponding validation report. The deviations have been presented in the section 2.2 of the MR. The summary of the deviations are described in below table.

Data / Parameters / Variables	Reference of Methodology	Description of Deviations	Assessment by validation team
The baseline emissions from the heat displaced by the project activity is estimated through an alternative equation against the prescribed equation by the applied methodology	AMS I.C., version 15, Para 15, Equation 2 & Para 30 (b)	Since there is no metering mechanism for measurement of net quantity of heat supplied by the project activity an alternative approach is used. This approach is based on amount of heat required for starch drying, which is estimated on heat requirements per tonne of starch when only fuel oil was used. The approach compensates the fuel oil usage from total fuel oil requirement (in baseline) and conservatively estimates the fuel oil replaced by biogas, irrespective of quantity of biogas combusted. The deviated approach ensures that efficiency lost in system due to dual fired system is conservatively adjusted in the baseline emissions.	The deviated approach described in the section 4.1, of the final PD ver. 3.1 is verified by the validation team and found to be conservative as efficiency loss due to dual fired system is accounted in biogas usage, thereby estimating lower fuel oil replacement for baseline emission estimation. The efficiency drop due to dual fuel firing is confirmed from the expert opinion. Thus the deviated approach is deemed appropriate and hence acceptable to the validation team. Thus the validation team confirms that the deviations do not affect the conservativeness of the baseline. Moreover since this parameter is not used for demonstration of financial additionality, the deviation has no impact on the additionality of the project. Therefore the deviation

			taken, satisfies the requirement of para 5.3, page 13 of VCS 2007.1 standard.
Flare efficiency is assumed 100% in case of combustion Mdy (i.e. gainful utilisation of biogas in boiler and gas engine. Whereas it need to be measured as per the applied methodology.	Paragraph 32 and equation 16 of of AMS III.H. Ver.13	In the case that biogas is combusted for a gainful use of the released energy, a flare efficiency (combustion efficiency in boiler and gas engines) can be assumed to be 100% in case calculation of Mdy.	This approach has been confirmed by the SSC WG (Small Scale Working Group) on 29 th July 2009, who agreed to include such approach in a future revision of AMS III.H. Based on this, it can be concluded that the adopted approach is appropriate and acceptable.
The volume of gas has to be estimated in Nm ³ from the volume of gas available in m ³ . But due to unavailability of regular measurement of pressure and temperature values, a conversion of biogas from measured condition (m ³) to normal conditions (Nm ³).	Paragraph 36 of AMS III.H, Ver. 13	The approach assumes that no pressure measurement is one in the supply pipe and thus pressure difference is assumed to be zero, estimating the volume in Nm ³ to be on a lower side.	The deviated approach described in the section 4.1, of the final PD ver. 3.1 is verified by the validation team & found acceptable as it satisfies the requirement of VCS 2007.1 standard. Moreover the validation team has also confirmed that the deviation do not affect the conservativeness of the baseline and the additionality of the project.

4.2 Accuracy of GHG Emission Reduction or Removal Calculations

GLC verification team has verified that all the parameters are monitored as described in the monitoring plan of the VCS PD in order to calculate the achieved emission reductions.

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 PD and the applied monitoring methodologies.

The emission reduction due to methane capturing was estimated by two approaches. One of the approaches is by measuring the COD reduction and the quantity of wastewater treated. The other approach is from the total biogas consumption. The formulae have been correctly applied as stated in the methodology, AMS III.H., Version 13 for both the approaches. It was observed that the emission reduction estimated by COD measurement method is lesser than the emission reduction estimated from the total biogas consumption. Thus, the verification team is of the opinion that the emission reductions determined using COD measurement approach is more conservative and accurate.

The emission reduction due to electricity generation is estimated by measuring the total net electricity produced and taking the ex-ante grid emission factor. The estimated approach is inline with the methodology AMS I.D., version 14. There are four gas engines (generators) at present. According to the registered VCS PD, there were only three gas engines and the fourth gas engine (Generator-4) was installed after the implementation of the project activity. Therefore, the energy generated by the fourth gas engine is not included in the emission reduction calculation.

The emission reduction due to thermal energy production is estimated according to the methodology, AMS I.C., version 15. The biogas recovered is also used in the hot oil boilers replacing part of the heavy fuel oil used in the baseline scenario. Specific fuel consumption in the hot oil boiler (liter/ton of starch production) was estimated as ex-ante from the historical data of fuel consumption and starch production. Fuel oil consumption in the project activity situation (i.e. current scenario) is measured by a flow meter. Therefore, the amount of fuel oil replaced by biogas is estimated from the total starch production and the amount of fuel oil used in the current situation.

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 total emission reduction achieved for the current monitoring period (01-10-2010 to 31-12-2011) is compared with the annual emission reduction estimated in the VCS PD and is presented below.

Comparison emission reductions for current monitoring period:

	Estimated VERs as per the VCS PD	Achieved VERs for the 3 rd monitoring period
Emission Reductions	36,101	57,130
% Deviation (+/-)	0	+ 58 %

A clarification request was raised for the increase in achieved emission reductions (please refer to CL4 in Annex 3). In response to the CL 4, the justification has been provided in the MR. Two scenarios were described in the VCS PD; for the first verification period the outlet COD would be measured after the AFFR and before the covered lagoons and after complete implementation of the project activity the outlet COD would be measured after the covered lagoons. It is understood that the emission reduction was estimated in the VCS PD for the scenario during 1st verification period which was not for the complete implementation of the project activity. The ex-ante calculation considered only the biogas produced from the AFFR. Since the covered lagoons also result into the COD reduction and biogas capturing, the emission reduction during the current monitoring period is higher. Therefore, GLC is of the opinion that the increase in emission reduction is appropriate and is justified.

4.3 Quality of Evidence to Determine GHG Emission Reductions or Removals

During the verification, all relevant documents as included in “Annex-2: References” were checked to assess the correctness and quality of data submitted by the project participant which are used to determine emission reductions.

During the verification site visit, quantity of wastewater treated, COD of wastewater inlet to AFFR and closed lagoon, COD of wastewater outlet, biogas consumption of boiler and gas engines, methane concentration of biogas, fuel oil consumption in boiler, electricity generation, etc. were verified with the log

book values to ensure that there is no over estimation of the VERs. 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 on-site verification. Hence, the verification team confirms that the monitoring system ensures required quality of the monitoring system to ensure the quality of the monitored data. All internal data are subjected to QA/QC measures.

All the meters (wastewater flow meters, biogas flow meters, COD measuring equipment, gas analyzer and oil meter) are calibrated as per the manufacturers' specifications or best practices in the industry to ensure the quality of data. In the case of delay in calibration of power meter (EM1), the PP has taken a conservative approach in accordance with the CDM guidelines of EB 52, Annex 60 (Guidelines for Assessing Compliance with the Calibration Frequency Requirements). Maximum permissible error of 1% was applied for the measured values of energy and the emission reduction has been calculated conservatively (please refer to CAR 8). Hence the verification team confirms that the quality of data is good and the emission reductions are determined in a conservative manner. The monitoring personnel at site are well experienced and follow established and documented routines. This was verified during the verification site interview. Hence, the verification team concludes that competent staff is employed by the project participant to carry out the relevant tasks with sufficient accuracy.

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

4.4 Management and Operational System

The allocation of responsibilities is documented in a written form ^{/21/} and is followed as described in the registered VCS PD. Data acquisition for the wastewater flow meters and gas flow meters is executed through the manual process control unit of biogas plant and then integrated with plant operation software. The plant is operated by well trained personnel. The data is collected and stored under the supervision of QA manager. 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 and ER sheets. Hence, the DOE confirms that the calculations laid down in the monitoring report are in line with the actual data verified on site.

The verification team interviewed the site personnel who are involved in the monitoring of the parameters used to determine the emission reductions of the VER project. The verification team was convinced that the organization structure ^{/20/} is followed as per the monitoring plan of the registered VCS PD. Based on the onsite verification it is confirmed that 4 operators are involved in data recording for 3 shifts a day. Operators record the data in log sheets once a shift. The log sheets are submitted to QA manager on a daily basis. The QA manager checks the recorded parameters and inputs the data into electronic format (Excel sheets) on a daily basis. Based on daily sheets, QA manager prepares monthly reports on MIS (Management Information System) for the plant's management and also inputs the data into ER sheets and submits to the project's consultant (i.e. South Pole Carbon Asset Management Ltd.) on a monthly basis.

All internal data are subjected to QA/QC measures. During verification site visit, the verification team has verified the various documents which are included in the Annex-2 "References" and interviewed the site personnel and the verification team was convinced that the project participant is following the required QA-QC measures as per the monitoring plan of the registered VCS PD. All monitored data is achieved physically and stored electronically. The data is backed-up in MIS, Office of South Pole and in hard discs. The data will be kept for the whole crediting period and additional 2 years as mentioned in the VCS PD.

As discussed above, the verification team concludes that management and operational system of the project is implemented and operated well. Thus it adequately ensures the quality of data required for calculating the emission reductions.

5 VERIFICATION CONCLUSION

Germanischer Lloyd Certification GmbH (GLC) has performed the 3rd verification of the project: “Chol Charoen Group Wastewater Treatment with Biogas System I (Cholburi)” with regard to the applicable relevant requirements for VCS project activity.

The project activity involves treatment of wastewater produced in a starch manufacturing process at Chol Charoen Co. Ltd through AFFR and covered lagoon technology. Use of this technology enables capturing of methane produced from highly organic wastewater characterised by its COD and thereby avoiding it to be released into the atmosphere. The captured methane is utilised as fuel in existing boiler replacing heavy fuel oil and also in gas engines in the plant.

This verification covers the period from 01-10-2010 to 31-12-2011 (including both days).

Chol Charoen 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 reductions 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 reductions generated by the above mentioned project. The verification is based on the registered VCS PD ^{/3/}, validation report ^{/6/}, monitoring report ^{/4/}, ER sheet ^{/5/} and supporting documents made available to the verifiers by the project participants. As a result of the verification, the verifier 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.
- The installed equipments essential for estimating emission reductions work reliable and are calibrated appropriately.
- The verifier confirms that the GHG emission reductions are calculated without significant misstatements in a conservative and appropriate manner. 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.
- 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.
- Germanischer Lloyd Certification GmbH herewith confirms that the project has achieved emission reductions during the reporting period from 01-10-2010 to 31-12-2011 (including both days) as follows:

GHG Emission Reductions or Removals	Unit	2010	2011
Baseline Emissions	t CO ₂ e	13,535	61,796
Project Emissions	t CO ₂ e	170	18,031
Leakage	t CO ₂ e	0	0
Net GHG emission reductions or removals	t CO ₂ e	13,365	43,765

Therefore, it is confirmed from the 3rd verification that the total emission reduction achieved during monitoring period (from 01-10-2010 to 31-12-2011) is **57,130 tCO₂e**.

<Hamburg>, 2012-05-21



Markus Weber

Verification Team Leader

ANNEX 1: ABBREVIATIONS

AFFR	Anaerobic Fixed Film Reactor
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CDM EB	CDM Executive Board
CH ₄	Methane
CER	Certified Emission Reduction
CL	Clarification Request
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
COD	Chemical Oxygen Demand
DOE	Designated Operational Entity
ER	Emission Reduction
ER sheet	Emission Reduction calculation spread sheet
FM	Wastewater Flow Meter
FAR	Forward Action Request
GHG	Greenhouse gas(es)
GM	Gas flow meter
HFO	Heavy Fuel Oil
ISO	International Organisation for Standardization
MP	Monitoring Plan
MR	Monitoring Report
PD	Project Description
PP	Project Participant
QA/QC	Quality Assurance / Quality Control
t CO ₂ e	Ton of Carbon dioxide equivalent
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Verified Carbon Standard
VCSA	VCS Association

VCS PD	VCS Project Description
VCU	Verified Carbon Unit
VVM	Validation & Verification Manual

ANNEX 2: REFERENCES

Reference	Author: Title, version, date of issue
/1/	CDM-EB: Clean Development Mechanism Validation and Verification Manual (Version 1.2)
/2/	VCS: VCS Version 3 Requirements Document 1 February 2012, v3.2 - VCS Standard - VCS Program Guide
/3/	VCS registered Project Description document for project : “Chol Charoen Group Wastewater Treatment with Biogas System I (Cholburi)”, (VCS PD version 3.1 dated 16-09-2009)
/4/	Draft Monitoring Report of “Chol Charoen Group Wastewater Treatment with Biogas System I (Cholburi)”, Version 01 dated 26-01-2012 Final Monitoring Report of “Chol Charoen Group Wastewater Treatment with Biogas System I (Cholburi)”, Version 04 dated 04-05-2012
/5/	Draft Emission reduction calculation spreadsheet <” GHG cal_3rd ver_rev01_26-01-2012.xlsx”> Final Emission reduction calculation spreadsheet <” GHG cal_3rd ver_rev04_04-05-2012.xls”>
/6/	TÜV NORD CERT GmbH: Validation report for the VER project “Chol Charoen Group Wastewater Treatment with Biogas System I (Cholburi)”, (Report Number: 53208109-08/510 dated 14-11-2009)
/7/	CDM-EB: Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories: AMS III.H.: Methane recovery in wastewater Treatment, Version 13 AMS I.D.: Grid connected renewable electricity generation, Version 14 AMS I.C.: Thermal energy production with or without electricity, Version 15
/8/	ISO 14064-3:2006; Greenhouse gases – Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions; http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=38700 ; (25-

Reference	Author: Title, version, date of issue
	09-2009)
/9/	<u>Calibration Reports:</u> 1. Wastewater Flow meter-1 (FM1) : Serial Number : YAL1623 Miracle International Technology Co. Ltd., Calibration Certificate of Certificate No. LC1105-042 issued on 30-05-2011 (Calibration Date : 16-05-2011) Miracle International Technology Co. Ltd., Calibration Certificate of Certificate No. L1010-280 issued on 10-11-2010 (Calibration Date : 21-10-2010) Euromag International, Calibration Certificate of Reference No.: 536/09 issued on 07-09-2009 (Calibration Date: 07-09-2009) 2. Wastewater Flow meter-1 (FM2) : Serial Number : YAL1624 Miracle International Technology Co. Ltd., Calibration Certificate of Certificate No. LC1105-040 issued on 30-05-2011 (Calibration Date : 15-05-2011) Miracle International Technology Co. Ltd., Calibration Certificate of Certificate No. L1010-278 issued on 10-11-2010 (Calibration Date : 21-10-2010) Euromag International, Calibration Certificate of Reference No.: 536/09 issued on 07-09-2009 (Calibration Date: 07-09-2009) 3. Wastewater Flow meter-1 (FM3) : Serial Number : YAL1625 Miracle International Technology Co. Ltd., Calibration Certificate of Certificate No. LC1105-041 issued on 30-05-2011 (Calibration Date : 15-05-2011) Miracle International Technology Co. Ltd., Calibration Certificate of Certificate No. L1010-279 issued on 10-11-2010 (Calibration Date : 21-10-2010) Euromag International, Calibration Certificate of Reference No.: 536/09 issued on 07-09-2009 (Calibration Date: 07-09-2009) 4. Biogas flow meter to Boiler (GM1) : Serial Number : V9107-03.1 Miracle International Technology Co. Ltd., Calibration Certificate of Certificate No.: L1105-237 issued on 28-05-2011 (Calibration date: 23-05-2011) Miracle International Technology Co. Ltd., Calibration Certificate of Certificate No.: L1001-098 issued on 23-01-2010 (Calibration date: 01-01-2010) Miracle International Technology Co. Ltd., Calibration Certificate of Certificate No.: L0906-172 issued on 15-06-2009 (Calibration date: 10-06-2009)

Reference	Author: Title, version, date of issue
	5. Biogas flow meter to flare (GM2) : Serial Number : V10S08-01.1 Miracle International Technology Co. Ltd., Calibration Certificate of Certificate No.: L1105-239 issued on 28-05-2011 (Calibration date: 21-05-2011) Miracle International Technology Co. Ltd., Calibration Certificate of Certificate No.: L1001-100 issued on 23-01-2010 (Calibration date: 14-01-2010) Miracle International Technology Co. Ltd., Calibration Certificate of Certificate No.: L0906-171 issued on 15-06-2009 (Calibration date: 10-06-2009) 6. Biogas flow meter to gas engines (GM3): Serial Number : 7565 Miracle International Technology Co. Ltd., Calibration Certificate of Certificate No.: L1105-238 issued on 28-05-2011 (Calibration date: 23-05-2011) Miracle International Technology Co. Ltd., Calibration Certificate of Certificate No.: L1010-281 issued on 10-11-2010 (Calibration date: 27-10-2010) Fox, Calibration Certificate issued on 27-05-2009 (Calibration date: 27-05-2009) 7. Gas Analyzer (MS) : Serial Number : VI3-3005 Thai Steam Service & Supply Co. Ltd., Bangkok, Calibration Certificate issued on 21-12- 2011 (Calibration date : 21-12-2011) Thai Steam Service & Supply Co. Ltd., Bangkok, Calibration Certificate issued on 01-09-2010 (Calibration date : 01-09-2010) 8. Spectrometer (CS) : Serial Number: 50100006010 SPC Calibration Centre Co., Ltd., Bangkok, Calibration Certificate issued on 24-05-2011 (Calibration date: 12-05-2011) SPC Calibration Centre Co., Ltd., Bangkok, Calibration Certificate issued on 17-05-2010 (Calibration date: 14-05-2010) SPC Calibration Centre Co., Ltd., Bangkok, Calibration Certificate issued on 08-06-2009 (Calibration date: 04-06-2009) 9. Flow meter Old (OM) Serial Number : 92049 Thai Steam Service & Supply Co., Ltd., Bangkok, Calibration Certificate issued on 04-11-2010 (Calibration Date: 04-11-2010) Miracle International Technology Co. Ltd., Calibration Certificate of Certificate No.: LC 0907-070 issued on 13-07-2009 (Calibration Date: 10-07-2009) 10. Flow meter New (OM) Serial Number : 4624027

Reference	Author: Title, version, date of issue
	Miracle International Technology Co. Ltd., Calibration Certificate of Certificate No.: LC 1105-043 issued on 30-05-2011 (Calibration Date: 16-05-2011) 11. Power meter for Generator 1 (EM1) Serial Number : 61580000N0050 Calibration Laboratory Co. Ltd., Bangkok., Calibration Certificate of Certificate No.: Q1024217 issued on 08-11-2010 (Calibration Date: 06-11-2010) 12. Power meter for Generator 2 (EM2) Serial Number : HT08051884 Hautong, Initial Calibration date : 03-03-2006 13. Power meter for Generator 3 (EM3) Serial Number : HT09050004 Hautong, Initial Calibration date : 03-03-2006
/10/	<u>Specifications of monitoring equipments:</u> • EUROMAG INTERNATIONAL: "Technical data sheet Model: MUT 1000EL" of Electromagnetic flow meter • HACH: Technical specification of "DR/2400 Portable Spectrophotometer" (CS) • VERIS: Specifications of gas flow meter (GM1 & GM2) • FOX THERMAL INSTRUMENTS: Specifications of "Gas Mass Flow meter of Model FT2" (GM3) • MESSTECHNIK EHEIM GmbH: Technical specifications of "VISIT 03 Portable gas analyzer for biogas and landfill gas". • CARLO GAVAZZI: Technical data sheet of "Energy Management Modular Smart Power Quality Analyzer Type WM3-96" (EM-1) • HUATONG: Specifications of power meter (EM-2 & EM-3) • AQUA METRO: Specifications of "Contoil Fuel Oil Meter" (OM)
/11/	Generator Service reports (dated 29-03-2010, 19-04-2010 and 19-11-2011)
/12/	Daily log sheets of • Wastewater flow meter readings • COD measurement • Biogas consumption • Methane content (% CH₄) in biogas • Starch production • Fuel oil consumption

Reference	Author: Title, version, date of issue
	Net Electricity generated by Generator 1 and Generator 2
/13/	CDM-EB: Guidelines for assessing compliance with the calibration frequency requirements (EB 52, Annex 60)
/14/	CDM-EB: General Guidelines to SSC CDM methodologies, version 17 (EB 61, Annex 21)
/15/	GLC GmbH: Germanischer Lloyd CDM Procedures
/16/	IPCC: 1996 IPCC Guidelines for National Greenhouse Gas Inventories: work book IPCC: 2006 IPCC Guidelines for National Greenhouse Gas Inventories: work book
/17/	Verification report of the project “Chol Charoen Group Wastewater Treatment with Biogas System I (Cholburi)”, for the 1st verification: 01-01-2007 to 31-12-2008 (dated 18-11-2010) Verification report of the project “Chol Charoen Group Wastewater Treatment with Biogas System I (Cholburi)”, for the 2nd verification: 01-01-2009 to 30-09-2010 (dated 13-04-2011)
/18/	The Shell Company of Thailand Ltd.: Fuel oil invoices from The Shell Company of Thailand Ltd.
/19/	Chol Charoen Co., Ltd.: Starch selling report of Chol Charoen, dated 03-05-2012
/20/	Chol Charoen Co., Ltd.: Chol Charoen Organization Chart
/21/	Chol Charoen Co., Ltd.: Monitoring Procedure for the VCS project
/22/	King Mongkut's University of Technology, Thonburi: COD Analysis Report, dated 03-08-2011
/23/	Thai Steam Service & Supply Co., Ltd.: Operation of closed flare system document dated 29-05-2009

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

Description of Finding (CAR, CL, FAR)	Date (yyyy-mm-dd)	Project Participants Response	Date (yyyy-mm-dd)	GLC Assessment	Date (yyyy-mm-dd)
CAR 1 Complete contact details have not been provided in the first page of the MR as per the VCS MR template.	2012-03-09	The contact details in the first page of MR are revised in MR rev.02.	2012-03-22	OK. In the MR (version 02), complete contact details have been included as per VCS MR template. Therefore, CAR 1 is closed.	2012-03-30
CAR 2 Monitored values presented in the ER sheet were verified with the log sheets during the onsite verification. The readings of the COD parameters could not be found in the log sheets for the following days: 26 December 2010 28 December 2010 8 December 2011	2012-03-09	The COD results on these three days are deleted from emission reductions calculation since there are no reference sources for these values.	2012-03-22	OK. It is observed in the revised ER sheet that the COD values for the three days have been deleted. It is considered to be appropriate since the approach results in conservative estimation of emission reductions. Therefore, CAR 2 is closed.	2012-03-30
CAR 3 The reported values of biogas in the ER sheet were verified with the log sheet values. It was found that	2012-03-09	The specified values are corrected in the emission reduction calculation file.	2012-03-22	OK. It is observed that the identified values have been corrected in the revised ER calculation sheet. Therefore CAR 3 is closed.	2012-03-30

Description of Finding (CAR, CL, FAR)	Date (yyyy-mm-dd)	Project Participants Response	Date (yyyy-mm-dd)	GLC Assessment	Date (yyyy-mm-dd)
the GM-3 value on 2010-10-01 and GM-1 value on 2011-12-25 are different from the log sheet values.					
CAR 4 As per the monitoring plan of the VCS PD, online gas analyser for continuous monitoring is used for the measurement of methane content of biogas (%CH ₄). However, it was noticed during the onsite verification that portable gas analyser was used during the monitoring period for monitoring of %CH ₄ . No justification has been provided in the MR how the methodological requirements are met.	2012-03-09	The deviation 2.1 is provided in section 2.2 of MR rev.02. And more description is added in monitoring table of W _{CH₄} in section 3.2 of MR rev.02.	2012-03-22	OK. A 95% confidence level has been applied for the measured values of %CH ₄ and the values have been considered conservatively for emission reduction calculation. The deviated approach has been sufficiently described in section 2.2 of the MR. The approach is considered to be appropriate since it is inline with Para 36 of the applied methodology, AMS III.H., version 13. Therefore, CAR 4 is closed.	2012-03-30
CAR 5 %CH ₄ values have not been provided during the period from 2011-01-01 to 2011-03-31 though the values were monitored and recorded in the log sheets. No justification for ignoring the parameter for the specified period	2012-03-09	The %CH ₄ of this specified period is added in the emission calculation file.	2012-03-22	OK. In the revised ER calculation sheet, the %CH ₄ values have been included during the period from 2011-01-01 to 2011-03-31. Therefore, CAR 5 is closed.	2012-03-30

Description of Finding (CAR, CL, FAR)	Date (yyyy-mm-dd)	Project Participants Response	Date (yyyy-mm-dd)	GLC Assessment	Date (yyyy-mm-dd)
has not been provided in the MR.					
CAR 6 Description of the monitoring plan in section 3.3 is incomplete with reference to the requirements of the MR template.	2012-03-09	The monitoring description in section 3.3 of MR rev.02 is revised.	2012-03-22	Not OK. Section 3.3 of the MR (version 2) has been revised. However, the description has not been provided completely.	2012-03-30
CAR 6 continues...	2012-03-30	The monitoring description in section 3.3 of MR rev.03 is updated.	2012-04-11	OK. Complete description of the monitoring plan has been provided in section 3.3 of the revised MR (version 3). It is confirmed that the description is inline with the monitoring system observed during the verification site visit. Therefore, CAR 6 is closed.	2012-04-18
CAR 7 During the onsite interviews with the operating team, it was revealed that the oil flow meter of boiler (OM) was changed on 2011-08-30.	2012-03-09	The fuel oil flow meter replacement detail is added in monitoring table of Q _{FO} in section 3.2 of MR rev.02.	2012-03-22	Not OK. The fuel oil flow meter replacement details have been added in monitoring table under parameter Q _{FO} in section 3.2 of the MR (version 02). The assessment team has reviewed	2012-03-30

Description of Finding (CAR, CL, FAR)	Date (yyyy-mm-dd)	Project Participants Response	Date (yyyy-mm-dd)	GLC Assessment	Date (yyyy-mm-dd)
However, the MR does not contain any information on this. The new flow meter details shall be included in the MR and the respective calibration information shall be provided to the verification team.		The new flow meter is of the same model but with the upgraded transmitter to support the output signal connection. (previous model : VZO 20 rc 130/16) new model : VZO 20 FL 130/25) All calibration reports of old and new flow meters in year 2009, 2010, 2011(new) have been provided to DOE before and during site visit.		calibration certificates of the old and new flow meter during site visit. However, the calibration date mentioned in Table 5 of the MR does not match with the calibration date of the calibration report for the year 2010.	
CAR 7 continues...	2012-03-30	The calibration date of 2010 is revised in the table 5 of MR rev.03.	2012-04-11	OK. The calibration date has been corrected from 2010-07-01 to 2010-11-04. It is confirmed that the revised calibration date is inline with the calibration report. Therefore, CAR 7 is closed.	2012-04-18
CAR 8 Calibration reports of the monitoring equipments were checked during the verification. The following observations are made	2012-03-09	- The calibration dates are checked and corrected in both emission calculation file and MR rev.02. - These two set of flow meter have many components; flow	2012-03-22	It is observed that the following information has been updated in table 5 of the MR (version 02): The calibration dates of GM1, GM2, GM3 & OM of 2009 have	2012-03-30

Description of Finding (CAR, CL, FAR)	Date (yyyy-mm-dd)	Project Participants Response	Date (yyyy-mm-dd)	GLC Assessment	Date (yyyy-mm-dd)
based on the calibration reports and onsite verification of monitoring equipments: - The calibration dates of GM1, GM2, GM3 and OM of 2009 provided in the MR do not match with the calibration reports - Inconsistencies of serial number, ID number (or tag number) and model number of gas flow meters - The EM1 was calibrated on 2010-11-06 and there is no previous calibration available while the monitoring period starts from 2010-10-01.		detector, converter and transmitter. The available calibration reports identify the S/N of different components. Hence the calibration information in the MR rev.02 is revised to refer to the main equipment, flow detector Veris. Maximum permissible error of 1% applied conservatively for the period from 1 October 2010 to 5 November 2010 for the measured values of EM1		been corrected - Serial number, Tag number and model number of gas flow meter have been corrected - Since the error identified during the calibration (as per the calibration report of 2010-11-06) is from 0.98% to 1% at different applied values, PPs have applied the maximum permissible error of 1% for the measured values of energy by EM1 for a period from 2010-10-01 to 2010-11-05 and calculated conservatively. The approach is considered to be appropriate and is inline with the calibration guidelines of CDM EB (EB 52, Annex 60). The updated information in the MR is inline with the calibration reports. Therefore, CAR 8 is closed.	
CL 1 It was confirmed by the operating team during the onsite verification that the flare was not operated	2012-03-09	The monitoring table of $T_{\text{flare,h}}$ in section 3.2 of MR rev.02 is revised. Since the flare has never been ignited then there is no monitored	2012-03-22	In section 3.2 of the revised MR, the monitoring table of $T_{\text{flare,h}}$ has been revised. It is mentioned in value monitored column in $T_{\text{flare,h}}$ that "There is no monitored value since the flare	2012-03-30

Description of Finding (CAR, CL, FAR)	Date (yyyy-mm-dd)	Project Participants Response	Date (yyyy-mm-dd)	GLC Assessment	Date (yyyy-mm-dd)
during the monitoring period. However, the MR contains a monitored value of $T_{\text{flare,h}}$ as 500 which is not clear.		data during this monitoring period.		has never been operated". The information is considered to be appropriate. Therefore CL1 is closed.	
CL 2 It was observed from the reported values of %CH ₄ in the ER sheet and also from the recorded values in the log sheets that the value on some of the days was found to be more than 80% which appears to be an abnormal value. The parameter is recorded four times a day at three locations; header, burner and generator. It was observed from the log sheet that the value was recorded more than 90% few times. It is not clear what the reason for such abnormal values.	2012-03-09	Referring to the reference source for methane content in biogas used for validation stage, http://www.oregon.gov/ENERGY/RENEW/Biomass/biogas.shtml , the range for methane content from anaerobic digestion is between 55 to 80%. Hence the upper bound for methane content in this emission calculation is set at 80%. The over-range values are not considered in the emission reduction calculation. The emission reduction calculation file rev.02 is revised accordingly.	2012-03-22	OK. Assessment team has crosschecked the statement on the web link : http://www.oregon.gov/ENERGY/RENEW/Biomass/biogas.shtml From the given source, it is confirmed that the methane content of the biogas in facilities using Anaerobic Digester Technology could vary from 55% to 80%. It is observed from the revised ER sheet that %CH ₄ values above 80% have been removed from the emission reduction calculation. This is a conservative approach since %CH ₄ is only used for baseline emission calculation. Since the flare was not operated, the project emissions were considered zero. %CH ₄ value does not have any impact on project emissions. Therefore, CL2 is closed.	2012-03-30
CL 3 It has been indicated as 'error' for	2012-03-09	The wastewater sample from final open lagoon is analysed with Low Range of COD test tube. This LR	2012-03-22	OK. The COD of the final lagoon will be relatively lower since majority of the COD is reduced across AFFR and	2012-03-30

Description of Finding (CAR, CL, FAR)	Date (yyyy-mm-dd)	Project Participants Response	Date (yyyy-mm-dd)	GLC Assessment	Date (yyyy-mm-dd)
some of the COD values in the ER sheet. It is not clear what it represents and the reason for the error.		reagent is suitable only for COD range of 0 – 1500 mg/l or ppm. In case the COD content is higher than 1,500 mg/l, the appearance colour of liquid after digestion is dark green, the spectrophotometer cannot measure this sample and shows the error message.		covered lagoons. Therefore lower range COD test tube is used. Sometimes, if the COD content exceeds the range, the spectrometer indicates error. It is observed from the ER sheet that the error has been treated as zero, which is appropriate. Considering lower value for the COD of final lagoon increases project emissions. It indicates that the emission reductions have been calculated conservatively. Therefore, the CL 3 is closed.	
CL 4 The achieved emission as per section 4.4 of the MR is 57,132 tCO₂e (13,367 tCO₂e during 2010 and 43,765 tCO₂e during 2011) while the estimated annual emission reduction as per the registered PDD is 28,881 tCO₂e. However, no justification has been provided for the increase in emission reduction in section 4.4 of the MR.	2012-03-30	In the registered PD, the ex-ante estimation is not considered the covered lagoons no.1 to 3, as per the project boundary in figure 4. For ex-post calculation, after the fully implementation of the project as per project boundary in figure 5, the three covered lagoons are integrated into project boundary. Then the quantity of wastewater directly fed into covered lagoon is included.	2012-04-11	OK. The justification has been provided in section 4.4 of the MR. It is understood that the emission reduction was estimated in the VCS PD for the scenario during 1st verification period which was not for the complete implementation of the project activity. The emission reduction during the current monitoring period is higher as it takes into the account of the covered lagoons. The project implementation and the monitoring approach are inline with the description in the VCS PD. The justification is considered to be appropriate. Therefore CL 4 is closed.	2012-04-18

Description of Finding (CAR, CL, FAR)	Date (yyyy-mm-dd)	Project Participants Response	Date (yyyy-mm-dd)	GLC Assessment	Date (yyyy-mm-dd)
		The explanation is provided in section 4.4 of MR rev.03.			
FAR 1 (FAR 1 from the 2nd verification) <i>The operational conditions of the dual fuel boiler need to be verified during the subsequent verifications. In case it is found that the existing boiler is replaced with new boiler during any monitoring period, no emission reduction shall be claimed for heat displacement.</i> The operational conditions of the dual fuel boiler were verified during the site visit. Based on onsite observations and interview with the plant's operating team, the verification team confirms that there was no replacement of boiler during the monitoring period. However, the plant team informed that they have a plan to replace the boiler during the next monitoring period. Therefore, in case it is found that the existing boiler is replaced with new boiler during the	2012-03-30	This shall be part of the monitoring report in the following monitoring periods.	2012-04-11	It shall be verified during the 4 th verification.	2012-04-18

Description of Finding (CAR, CL, FAR)	Date (yyyy-mm-dd)	Project Participants Response	Date (yyyy-mm-dd)	GLC Assessment	Date (yyyy-mm-dd)
next monitoring period, no emission reduction shall be claimed for heat displacement.					