Gold Standard Verification and Certification Report

of

CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand

GLC Report No: 363_GS, Rev. 04

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GS Verification and Certification Report

GLC Report No: 363_GS, Rev. 04

Organisational Unit Germanischer Lloyd Certification GmbH (GLC), Greenhouse Gas Services		
Client South Pole Carbon Asset Management Ltd	Client reference person Mr. Santosh Kumar Singh	
Summary:		
UNFCCC Ref.	2141	
Gold Standard Ref.	GS560	
Project Name:	CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand	
Project Country:	Thailand	
Sectoral Scope, Technical Area	CDM Sectoral Scope 13, Technical Area 13.1	
Methodology(ies) / Version(s):	AM0022, Version 04	
Project Size:	☒ Large Scale	☐ Small Scale
Number of verification:	4th	
Dates of monitoring period (incl. both days)	2013-01-01 to 2013-08-20	
Verified emission reductions	46,136 t CO_2	
Included post registration changes	☐ yes ☒ no	
Project Assessment Team:	Technical Review Team:	Approval by:
Mr. Karunakar Avuram Dr. Komsilp Wangyao	Ms. Anu Chaudhary	Mr. Markus Weber
Date of this revision:	Revision No.	Number of pages
2014-01-24	04	33

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History of report revisions:

Rev.	Date	Person (short sign or name)	Function	Action
01	2013-12-06	Karunakar Avuram / Komsilp Wangyao	Assessment team leader / Technical expert	Draft report
02	2013-12-09	Anu Chaudhary	Technical Reviewer	Review of project documents
03	2013-12-10	Markus Weber	Final Reviewer and Approver	Final reviewed and approved
04	2014-01-24	Karunakar Avuram / Markus Weber	Assessment team leader / Final Reviewer and Approver	Update based on GS review comment

Abbreviations

CAR	Corrective Action Request
CDM	Clean Development Mechanism
CDM-EB	CDM Executive Board (the board)
CER	Certified Emission Reduction
CL	Clarification request
CMP	Meeting of the Parties to the Kyoto Protocol
CO_2	Carbon dioxide
CO_2e or CO_{2eq}	Carbon dioxide equivalent
COP/MOP	The Conference of the Parties to the United Nations Framework Convention on Climate Change serving as the Meeting of the Parties to the Kyoto Protocol
DOE	Designated Operation Entity
ER	Emission Reduction
FAR	Forward Action Request
GHG	Greenhouse gas(es)
GLC	Germanischer Lloyd Certification GmbH
GS	Gold Standard
HFO	Heavy Fuel Oil
IPCC	Intergovernmental Panel on Climate Change
MP	Monitoring Plan
MR	Monitoring Report
NCV	Net Calorific Value
PDD	Project Design Document
PP	Project Participant
QA/QC	Quality Assurance / Quality Control
SCADA	Supervisory Control And Data Acquisition
t CO_2e	Ton of Carbon dioxide equivalent
UASB	Up-flow Anaerobic Sludge Blanket
UNFCCC	United Nations Framework Convention on Climate Change
VVS	Validation and Verification Standard

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1 INTRODUCTION

"South Pole Carbon Asset Management Ltd" has commissioned the Germanischer Lloyd Certification GmbH (GLC) to carry out the 4th verification of the project, CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand with regard to the relevant requirements for CDM and GS project activities.

The project activity was registered with UNFCCC on 2009-03-25 with CDM reference number 2141 and with Gold Standard under version 1 on 2010-05-24 with GS project ID GS560. The verifiers have reviewed the implementation of the project activity as described in the Project Design Document (PDD)[1] and carbon monitoring activities as per the monitoring plan (MP)[2] and as reported in the Monitoring Report /4/. The verification team also reviewed the implementation of the sustainability monitoring plan as described in the GS Annex of the PDD and as reported in the GS monitoring report.

GHG data for the monitoring period was verified in detailed manner applying the set of requirements, audit practices and principles as required under the Validation and Verification Standard /1/ of the UNFCCC. This report summarizes the findings and conclusions of the 4th verification (covering the period from 2013-01-01 to 2013-08-20) of the above mentioned GS CDM registered project activity.

1.1 Objective

The objective of the verification is the review and ex-post determination by an independent entity of the GHG emission reductions. It includes the verification

- that the project activity has been implemented and operated as per the registered PDD and that all physical features (technology, project equipment, and monitoring and metering equipment) of the project are in place;
- that the monitoring report and other supporting documents provided are complete and verifiable and in accordance with applicable CDM requirements;
- that actual monitoring systems and procedures comply with the monitoring systems and procedures described in the monitoring plan and the approved methodology;
- that the Sustainable Development Indicators are monitored as per the Gold Standard monitoring plan of the GS Annex of the registered PDD;
- that the data is recorded and stored as per the monitoring methodology.

[1] It is to be noted that the Project Design Document (PDD) was revised during the 2nd verification and the revised PDD was approved by the CDM-EB on 2012-03-16. Therefore, the PDD referred in the report refers to the approved revised PDD, version 4.1, dated 2012-01-31.

[2] The monitoring plan (MP) was revised during the 1st verification and the revised MP was approved on 2010-08-12. Therefore, the assessment is based on the approved revised MP and the reference made to MP in the report refers to the approved revised MP.

1.2 Scope

The verification of this registered project is based on the project design document /2/, the approved revised monitoring plan/3/, GS Annex of the PDD /6/, the monitoring report /4/7/, the emission reduction calculation spread sheet /5/, supporting documents made available to the verifier, the information collected during onsite verification and the interviews during the on-site assessment. Furthermore publicly available information was considered as far as available and required.

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

- Article 12 of the Kyoto Protocol /8/,
- Guidelines for the implementation of Article 12 of the Kyoto Protocol as presented in the Marrakech Accords under decision 3/CMP.1 /9/ and subsequent decisions made by the Executive Board and COP/MOP,
- Other relevant rules, including the host country legislation,
- CDM Validation and Verification Standard /1/,
- GS requirements of version 1 and The GS Validation & Verification Manual for CDM Projects /14/
- The PDD /2/ and the monitoring plan/3/,
- Approved CDM Methodology AM0022, ver. 04: Avoided Wastewater and On-site Energy Use Emissions in the Industrial Sector /10/

2 VERIFICATION TEAM

2.1 Assessment Team

A competent team with relevant knowledge and experience in the specific sectoral scopes and project activity was appointed by GLC. Furthermore the appointment of the team takes into account the required knowledge of the host country and general project activity knowledge requirements for verifying the project activity design and the relevant emission reduction achieved. The assessment team can be composed of an Assessment Team Leader (ATL), auditors (A) and host country or technical expert (E). Table 2-1 below shows the composition of the assessment team, the qualification of the team members and their functions.

Table 2-1: Verification team

Name	Function [1)]	Sectoral scope specific knowledge	Technical area specific knowledge	Local knowledge	Type of involvement				
					Desk review	On-site visit / interviews	Reporting	Supervision of work	Expert input
Avuram, Karunakar	ATL/ A			X	X	X	X	X	
Wangyao, Komsilp	TE/ LE	X	X	X	X	X	X		X

A	Auditor	FE	Financial expert	T-ATL	Trainee ATL
ATL	Assessment team leader	LE	Local expert	T-A	Trainee auditor
				TE	Technical expert

2.2 Technical Review Team and Approval

Before submission of the final verification report to the CDM EB of UNFCCC and to the GS registry, a technical review of the whole verification and the draft report was carried out by an appointed technical review (TR) team. The TR team is composed of persons competent to the technical area the project activity falls under. Each person involved in the reviewer is independent to the verification assessment.

The complete assessment prepared by the verification team is checked, if required adjusted and finally confirmed by the TR process.

The TR team and the person responsible for approval of the report are found in the table below:

Table 2-2: Technical review team and approval

Name	Qualification / Function [2)]	Technical Area knowledge	Sectoral Scope Expertise	Type of Involvement	
				Review	Approval
Anu Chaudhary	R / TE	X	X	X	
Markus Weber	TE/FR/AP	X	X	X	X

AP Approver
FR Final reviewer
TE Technical expert
T-R Trainee reviewer
R Reviewer

3 METHODOLOGY

3.1 Verification Process

The verification process is based on the guidelines described in the Validation and Verification Standard and the GS Requirements of version 1[/14/]. In addition to that standard auditing techniques have been applied. The verification team performed first a desk review, followed by an on-site visit to review the project realisation. Based on the document review and onsite assessment, verification findings were raised and sent to project participant (PP) for resolving. The next step was to close out the findings based on the response, evidence documents and through direct communication with the PP. Finally the verification report is prepared. This verification report and other supporting documents then undergo a technical review by the "GLC GmbH" prior to the submission to the CDM-EB and to GS registry.

3.2 Desk review

From 2013-09-02 to 2013-09-06, GLC conducted a desk review of all documents initially provided by the client and publicly available documents relevant for the verification. The main reviewed documents are listed below:

- The PDD[/2/] and the corresponding validation report [/12/];
- The approved revised monitoring plan [/3/] and the corresponding validation opinion;
- GS Annex of the PDD [/6/] and the corresponding GS validation report [/12/];
- Previous verification reports [/13/];
- The applied monitoring methodology [/10/];
- The CDM monitoring report [/4/] and the corresponding emission reduction calculations [/5/];
- The GS monitoring report [/7/];
- Relevant decisions, clarifications and guidance from the CMP and 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 the previous verification

3.3 On-site assessment

From 2013-09-16 to 2013-09-17, Mr. Karunakar Avuram and Dr. Komsilp Wangyao of GLC's verification team carried out an on-site visit.

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

- The on-site assessment included an investigation of whether all relevant equipment was installed and operated as described in the PDD/2/
- The operating staff was interviewed and observed in order to check the risks of inappropriate operation and data collection procedures
- Assessing the competency levels of the operating team to implement and monitor the project activity as described in the PDD
- Interview with the local villagers and the operating team to assess the implementation of the sustainability monitoring plan
- Information processes for generating, aggregating and reporting the selected monitored parameters were reviewed
- The monitoring processes, routines and documentations were audited to check their proper application
- The monitoring data were checked completely /31/34/
- The data aggregation trails were checked
- The duly calibration of all metering equipment was checked /18...29/.

The interviewed persons during the site visit are summarized in the Table 3-1. The main topics of the interviews were:

- General aspects of the project
- Technical equipment and operation
- Changes since validation
- Monitoring and measurement equipment
- Remaining issues from previous verification
- Calibration procedures
- Quality management system
- Involved personnel and responsibilities
- Training and practice of the operational personnel
- Implementation of the CDM monitoring plan

- Implementation of the Sustainability monitoring plan
- Monitoring data management
- Data uncertainty and residual risks
- GHG calculation
- Procedural aspects of the verification
- Maintenance
- Environmental aspects

Table 3-1: Interviewed persons

Name	Organization/Function
Mr. Santosh Kumar Singh	Head of Implementation, South Pole Carbon Asset Management Ltd.
Ms. Suwipa Rukwongtrakool	CDM Project Manager, South Pole Carbon Asset Management Ltd.
Mr. Tanapon Yuenyong	Managing Director, CYY Bio Power Co Ltd.
Ms. Yupin Amwan	Head of Quality Control, CYY Bio Power Co Ltd.
Mr. Nakorn Phaisri	Factory Manager, CYY Bio Power Co Ltd.
Ms. Karnchana Luangsoongnern	Technician – Quality Control, CYY Bio Power Co Ltd.
Mr. Chanachai Decha	Operator – Gas engines, CYY Bio Power Co Ltd.
Ms. Kanitta Chamnarnlien	Villager, Bungaor village
Mr. Saard Kaewkiew	Villager, Nhongmuang village

The local villagers were interviewed to confirm monitoring of relevant SD indicators. A brief summary of the interviews is provided in section 6 of the report.

3.4 Resolution of Findings and Reporting

On the basis of the desk review, the on-site visit, follow-up interviews and further background investigation the verification findings were prepared in a separate document and sent to PP for resolving

the issues. In case any inconsistencies or lack of clarity were identified during the verification the team has raised a

Corrective Action Requests (CARs), if:

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

Clarification Request (CL), if:

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

In case the team has identified essential risks for further verifications or the actual status requires a special focus on this item for the next consecutive verification, or an adjustment of the monitoring plan is recommended a Forward Action Request (FAR) was raised.

All CARs, CLs and FARs raised have been sent to the client with the request to address the findings. After the findings have been answered by the client in an appropriate manner, the CARs, and CLs were closed out.

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

The verification team also reviewed validation report /12/ and the previous verification reports/13/ to find out if there are any open issues or FARs to be addressed. It is confirmed that there are no pending issues or FARs from the validation or from the previous verification. It is also worth to mention that PP did not monitor the GS sustainability parameters during the previous monitoring period and therefore GS Labelling is not requested for the CERs issued from 2009-03-25 till 2012-12-31. This was informed to GS team through a letter on 2013-11-26 and a response from Technical Expert of the GS Foundation was also received accepting the letter on 2013-12-04. This is confirmed based on the email copy forwarded to GLC verification team on 2013-12-05. This verification covers the period from 2013-01-01 to 2013-08-20.

4 VERIFICATION REPORTING

(Please refer to section 4 of the CDM verification report; GLC Report No: 363 submitted along with this report)

5 DEVIATION IN GHG EMISSION REDUCTIONS

The emission reductions being claimed for the 4th monitoring period from 2013-01-01 to 2013-08-20 are nearly 29% less than the estimated emission reductions in the registered PDD, as given in the table below:

Table 4-4: Emissions Reduction claimed in comparison to the estimates as per PDD

Emission Reductions (tCO_2e)	
As per PDD	64,979
Monitoring report	46,136
% Deviation (+/-)	(-) 28.99%

The main reason for achieving lower emission reductions, as provided in response to a clarification request (please refer to CL2 in Annex A of the CDM verification report), can be attributed to lower wastewater volume, lower COD and lower biogas concentration. A comparison of data between the estimated amount in the PDD and actual data during the monitoring period is also provided in the ER sheet for the sake of transparency. The verification team is of the opinion that volume of wastewater and COD concentration of wastewater depends on the quality of raw material which is beyond the control of PP. Therefore, the achieved emission reduction is reasonable.

Since the achieved emission reductions are less than the estimated emission reductions, no justification has been provided in the MR. It is considered to be appropriate as it is inline with the guideline "Completing the monitoring report form", version 03.2 (EB 70, Annex 11) /45/.

6 SUSTAINABILITY MONITORING CHECK

The following sustainability parameters were monitored as per the GS sustainability monitoring plan provided in the registered PDD Annex /6/. The monitored parameters during the monitoring period are described in a separate monitoring report submitted by PP along with the CDM monitoring report. The verification team has verified all the parameters with appropriate means of verification. The assessment on sustainability monitoring parameters is provided below:

	Assessment/ Observation
No	1
Indicator	Water quality and quantity
Chosen parameter	COD concentration in wastewater at the outlet of the UASB reactor (in kg COD / m^3)
Monitoring approach	The parameter was monitored through the COD (Chemical Oxygen Demand) analysis of wastewater collected at the outlet of UASB (Upflow Anaerobic Sludge Blanket) reactor. From the onsite verification and interview with the QC (Quality Control) laboratory staff, it is confirmed that the samples of wastewater from the outlet of UASB are collected for every two hours starting at 8 AM every day. Therefore, total 12 samples are collected. After collecting 6 samples, the samples are mixed and COD of the composite sample is analysed at onsite laboratory by Colorimetric method. COD analysis is carried out twice a day; at 8 AM and at 8 PM. The readings from the COD analysis is recorded in log sheets and reported to the Head of QC on a daily basis. During the onsite interview, the QC staff described the COD analysis procedure and the procedure was found to be in accordance with the written procedures/32/ available at the QC lab. Besides, GLC's sectoral expert confirms that the COD analysis procedures are appropriate. Besides, as part of quality assurance, the PP got the COD analysis of wastewater carried out by an accredited external laboratory once in 6 months. The COD analysis by external laboratory was conducted in December 2012 and June 2013/33/. The corresponding reports were provided to the verification team; the COD values in the reports were found within the range of COD measured at onsite laboratory.

	A detailed assessment on parameters related to COD of wastewater is provided in section 4.1.3 of the CDM verification report. The verification team can confirm that the project resulted in improving the baseline wastewater treatment facilities and avoiding any harm or threat to the environment or people.
Is monitoring approach inline with the GS monitoring plan of registered Passport / PDD Annex? (Yes/ No)	Yes, the monitoring approach is inline with the GS monitoring plan of the registered PDD Annex/6/. The monitoring plan states, "*Wastewater quality format the outlet of the reactor is already subject to continuous monitoring under CDM and periodic controls by environmental authorities.* *Given the fact that the treated wastewater cannot be discharged and is constantly re-circulated and re-used in the starch plant, which was already done prior to the project, the project activity does not have a significant impact on water quantity,* *From this, it is evident that the impact on the water quality is crucial for an overall positive impact on sustainable development and its monitoring would thus be required in the verification period*."
How were the values or parameters reported in the monitoring report verified?	From the onsite verification, it is confirmed that appropriate monitoring system is in place to measure and record the required parameter. The values reported in the monitoring report/4/ and the corresponding ER sheet/5/ were verified with the original hand written daily log sheets/31/. The reported data was crosschecked with the monthly reports/34/ approved by the Plant Manager. It is confirmed that the values reported in the final MR are correct. Average COD concentration in wastewater at the outlet of the UASB reactor during the monitoring period was 1,965 mg/l or 1.965 kg COD / m^3 while the COD at the inlet of the UASB was 21,389 mg/l. The verification team, therefore, confirms that the project activity has resulted in improving the water quality.

	Assessment/ Observation
No	2
Indicator	Air quality
Chosen parameter	Volume of biogas production and combustion (Nm^3)
Monitoring approach	The parameter was monitored by measuring the total biogas production, biogas utilised in onsite boiler and gas engines and biogas destructed in an open flare using gas flow meters. The parameters are continuously measured and recorded daily. A detailed assessment on parameters related to biogas production and biogas combustion is provided in section 4.1.3 of the CDM verification report. The project treatment system involves capturing of biogas (or methane) through UASB which is a closed system and utilising the biogas as a fuel in boiler and gas engines. Any excess biogas is flared out through an open flare system. Therefore, the odour is reduced and the air quality is improved. A desulphurization system (gas scrubber) was also installed to remove H_2S from the gas stream that goes to gas engines. The scrubber further helps in improving the air quality by removing H_2S from the gas.
Is monitoring approach inline with the GS monitoring plan of registered Passport / PDD Annex? (Yes/ No)	Yes, the monitoring approach is inline with the GS monitoring plan of the registered PDD Annex/6/.
How were the values or parameters reported in the monitoring report verified?	From the onsite verification, it is confirmed that appropriate monitoring system is in place to measure and record the required parameters. The values reported in the monitoring report/4/7/ were verified with the original hand written daily log sheets/31/. The reported values were found to be correct. It is to be noted that there was a flow meter installed for measuring the biogas production. The verification team physically observed during the onsite verification that the meter was located right on top of UASB. However, as confirmed from the onsite interviews, the meter encountered technical problem during the monitoring period and therefore the data obtained from the meter was not taken into account. Since the biogas utilised in

	gas engines and boiler and biogas combusted through open flare was separately monitored, the total biogas production was calculated based on mass balance as mentioned in the monitoring plan. Measured biogas parameters during the monitoring period are as below: Volume of biogas sent to boiler: 1,809,398 Nm^3 Volume of biogas sent to gas engines: 2,880,845 Nm^3 Volume of biogas sent to flare: 4,286 Nm^3 Volume of biogas produced: 4,694,529 Nm^3 The project activity resulted in destruction of methane which would have otherwise been released into the atmosphere in the absence of the project activity. The verification team, therefore, confirms that the project activity has resulted in improving the air quality.

	Assessment/ Observation
No	3
Indicator	Employment (numbers)
Chosen parameter	Number of employed staffs and the level of income generation
Monitoring approach	The number of employees and the level of income was monitored through salary payment records on monthly basis. The list of employees along with their salary for each month/43/ has been provided to the verification team. The GLC verification team can confirm that the total number of staff employed for the project activity during the monitoring are 14. Since the salary of employees or income generation is sensitive information, it is not provided in the verification report. However, relevant evidence documents are available with GLC which can provided on demand as confidential documents.

Is monitoring approach inline with the GS monitoring plan of registered Passport / PDD Annex? (Yes/ No)	Yes, the monitoring approach is inline with the GS monitoring plan of the registered PDD Annex.
How were the values or parameters reported in the monitoring report verified?	The parameter was verified from the employment records and salary payment records /43/. The verification team also interviewed the employees working for the project to confirm the information provided. The information provided in the GS MR is confirmed to be correct. The GLC verification team is of the opinion that the project activity resulted in employment and income generation to the local community during the monitoring period.

	Assessment/ Observation
No	4
Indicator	Technological self reliance
Chosen parameter	Training records
Monitoring approach	The parameter was monitored through training records. Trainings on the below subjects were provided to the operating team during the monitoring period: - Operation and maintenance of biogas system - Safety in biogas operation - Knowledge of biogas - Wastewater analysis Besides, the operating team also informed during the onsite interviews that the technology supplier, GWE, provided onsite training to the operating team while implementing the project activity. Relevant training records were provided to the GLC verification team.
Is monitoring approach inline with the GS monitoring plan of registered Passport /	Yes, the monitoring approach is inline with the GS

PDD Annex? (Yes/ No)	monitoring plan of the registered PDD Annex.
How were the values or parameters reported in the monitoring report verified?	The parameter was verified from the training records /44/. The verification team also interviewed the employees working for the project to confirm the information provided. The information provided in the GS MR is confirmed to be correct. The GLC verification team is of the opinion that the project activity created positive impact regarding technological self reliance by enhancing the skills of the operating team.

	Assessment/ Observation
No	-
Indicator	Sludge application
Chosen parameter	Type of sludge application
Monitoring approach	This parameter was chosen to monitor based on GS registration review comment. Whenever sludge is removed from the treatment system, it shall be recorded in plant records about the application of the sludge. As per the monitoring plan, the sludge shall only be used for soil application as fertiliser. However, no sludge was removed from the treatment system during the monitoring period. This is confirmed from the onsite interviews with the operating team. No traces of sludge could also be observed at project site by the GLC verification team during the onsite verification.
Is monitoring approach inline with the GS monitoring plan of registered Passport / PDD Annex? (Yes/ No)	Not applicable No sludge was removed from the treatment system during the monitoring period.
How were the values or parameters reported in the monitoring report verified?	Not applicable No sludge was removed from the treatment system during the monitoring period.

Brief Summary of Interview with Local Stakeholders:

Since the chosen monitoring parameters of the SD indicators are closely related to the people living in the surrounding areas of the project's location, GLC's verification team decided to interview the local villagers from the nearest villages. Two villagers representing the two nearby villagers were interviewed on 2013-09-17 to confirm the impact of the project activity on sustainable development indicators. The villagers were interviewed on the following SD parameters:

- Air quality
- Employment
- Utilisation of sludge as fertiliser
- Any other community development programs by the project proponent

The villagers confirmed that there was a reduction in odour from the plant after implementation of the biogas plant. They also mentioned that several persons from their villages were employed during construction and operation of the biogas plant, although they could not confirm on the exact number of persons employed. The main occupation in the villages is agriculture. Treated wastewater from the open lagoons (open lagoon – 2 and 3) is used for agriculture. The villagers expressed their happiness as utilisation of this water also results in increase in produce. The wastewater is given at free of cost to the farmers. However, a nominal fee was charged to the farmers to cover up the cost of pipeline which the PP had to lay to supply the water from the open lagoons. No sludge was supplied from the plant, though the villagers would be happy to use it for agriculture. The plant's operating team also confirmed that sludge was not removed from the treatment system. The villagers further informed that the project owner also involved in other developmental activities such as providing sports equipment to the schools, development of roads, etc. No concerns were expressed by the villagers on the project activity.

GLC verification team further confirms based on the review of monitoring documents that the methane utilisation for energy generation purpose in the project activity was 99.9% during the monitoring period which is more than the required minimum limit of 65%. Out of 4,694,529 Nm^3 of biogas captured from the treatment system, 4,690,243 Nm^3 of biogas was utilised in gas engines and boiler to produce electricity and heat respectively (4,690,243 / 4,694,529 = 0.999)[5]. The verification team can confirm that, in overall, the sustainability parameters were monitored sufficiently in accordance with the monitoring plan.

7 VERIFICATION STATEMENT

Germanischer Lloyd Certification GmbH (GLC) has performed the 4th verification of the project: CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand with regard to the relevant requirements for CDM and GS project activities. The project reduces GHG emissions by capturing methane from wastewater treatment through UASB technology and utilising it as a fuel in onsite thermal oil boiler and electricity generators.

This verification covers the period from 2013-01-01 to 2013-08-20 (including both days).

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 PDD. GLC conducted the verification on the basis of the monitoring methodology "AM0022" (version 04)/10/, the approved revised monitoring plan/3/, the Sustainability monitoring plan described in the GS Annex of the PDD/6/, the CDM monitoring report of dated 2013-10-09 (version 2)/4/ and the GS monitoring report of dated 2013-11-12 (version 2.1)/7/. The verification included:

i) checking whether the design of the project was implemented and installed as planned and described in the project design document /2/;

ii) checking whether the provisions of the monitoring methodology/10/ and the monitoring plan/3/ were consistently and appropriately applied;

iii) checking if the sustainability parameters were monitored as per the sustainability monitoring plan of the GS Annex of the PDD/6/;

iv) the collection of evidence supporting the reported data;

v) checking whether the installed equipment essential for measuring parameters required for calculating emission reductions were calibrated appropriately

GLC's verification approach draws on an understanding of the risks associated with reporting of GHG emission data and the controls in place to mitigate these. GLC planned and performed the verification by obtaining evidence and other information and explanations that GLC considers necessary to give reasonable assurance that reported GHG emission reductions are fairly stated.

In GLC's opinion, the GHG emissions reduction for the "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand" as reported in the final Monitoring Report are calculated without considerable misstatements in a conservative and appropriate manner. The GHG emission reductions were correctly calculated on the basis of the approved monitoring methodology mentioned above and the approved revised monitoring plan for the project.

In GLC's opinion, the project contributes to the sustainable development of local community by improving water quality and air quality and creating additional employment during the monitoring period.

Germanischer Lloyd Certification GmbH herewith confirms that the project has achieved emission reductions in the above mentioned reporting period as follows:

Emission reductions: 46,136 t CO_{2e}

2014-01-

Germanischer Lloyd
Certification

Markus Weber

8 REFERENCES

Reference	Author: Title, version, date of issue
/1/	CDM-EB: Clean development mechanism validation and verification standard (version 05.0)
/2/	Project Design Document for CDM project: "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand" (version 4.1, dated 2012-01-31) approved on 2012-03-16
/3/	Revised monitoring plan of "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand" project approved on 2010-08-12 RINA: Validation opinion of RINA on the request for revision in the monitoring plan in case of "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand", CDM project registration no: 2141 (Report No: 09IQ150ME)
/4/	Draft Monitoring Report (webhosted) of "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand" project, (version 1) dated 2013-08-30 Final MR of "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand" project, (version 2) dated 2013-10-09
/5/	Draft Emission reduction calculation spreadsheet (version 1) dated 2013-08-30 Final Emission reduction calculation spreadsheet (version 2) dated 2013-10-09
/6/	GS Annex of the PDD for "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand", (version 2.1) dated 2010-05-13
/7/	Draft GS MR of "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand" project, (version 01) dated 2013-08-30 Final GS MR of "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand" project, (version 2.1) dated 2013-11-12

/8/	UNFCCC: Kyoto Protocol to the United Nations Framework Convention on Climate Change (1998)
/9/	UNFCCC: Decision 3/CMP. 1 (Marrakesh – Accords)
/10/	CDM-EB: Approved CDM baseline and monitoring methodology AM0022, Version 04: "Avoided Wastewater and Onsite Energy Use Emissions in the Industrial Sector"
/11/	CDM-EB: Methodological "Tool to determine project emissions from flaring gases containing methane" (Version 1) - EB 28, Annex 13 CDM-EB: Methodological tool "Project emissions from flaring" (Version 02.0.0) – EB 68, Annex 15
/12/	TUV NORD CERT GmbH: Validation report of "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand" (report no. 8000352987– 07/150) dated 2009-03-09 TUV NORD: Validation Report for Retroactive Gold Standard Registration of "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand" (report no. 8000352987– 07/150GS) dated 2010-01-19
/13/	RINA Services S.p.A.: First verification report of "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand" (Report no. 2009-IQ-150-ME) GLC: Second verification report of "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand" (Report no. 126) dated 2012-04-20 GLC: Third verification report of "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand" (Report no. 350) dated 2013-07-29
/14/	GS: The Gold Standard Validation and Verification Manual for CDM Projects
/15/	Technical specifications of UASB and Gas engines Global Water Engineering Ltd: "Proposal for a Biogas Plant for CYY", dated 2006-02-01 Pro2 Analgentechnik GmbH: Technical data of gas engines, January 2006
/16/	Commissioning Certificates Global Water Engineering Ltd.: Certificate of Civil / Mechanical / Electrical Completion, dated 2007-11-03 PRO2: Minutes of Commissioning of gas engine, dated 2008-12-09 (Commissioning period:

	from 2008-12-02 to 2008-12-08)
/17/	Specifications of monitoring equipment KROHNE: 'Technical data sheet' of electromagnetic flow converter – wastewater flow meter HACH: Key specifications of Spectrometers and Colorimeters YOKOGAWA: 'General Specifications' of Differential Pressure Transmitter – Gas flow meters Drager: 'Technical Data' of methane gas analyser DEIF: 'Designer's Reference Handbook' – Technical specifications of multi-line 2 PPU power meter Industrial Scientific: Specifications of MX4 multi-gas monitor – Portable gas detector Weighing machine specifications (Load: 100,000 kg; Accuracy: ± 20 kg)
/18/	Calibration report of Wastewater flow meter – Serial No. A06 42633 (MITCL): Calibration Certificate of Certificate No. L1210-636 issued on 2012-10-25 (Calibration date: 2012-10-19)
/19/	Calibration report of Portable Colorimeter – Serial No. 07089C64902 EnviScience Company Limited: Test report (report no. LEVS 1204104), date of test: 2012-10-30
/20/	Calibration report of Biogas flow meter to boiler – Serial No. 91FA19282 639 MITCL: Calibration Certificate of Certificate No. C1210-639 issued on 2012-10-25 (Calibration date: 2012-10-19)
/21/	Calibration report of Biogas flow meter to flare – Serial No. 265DS6600065941 MITCL: Calibration Certificate of Certificate No. C1210-638 issued on 2012-10-25 (Calibration date: 2012-10-19)
/22/	Calibration report of Biogas flow meter to Gen-A – Serial No. 265DS6600032493 MITCL: Calibration Certificate of Certificate No. C1210-640 issued on 2012-10-25 (Calibration date: 2012-10-19)
/23/	Calibration report of Biogas flow meter to Gen-B – Serial No. 265DS6600028459 MITCL: Calibration Certificate of Certificate No. C1210-641 issued on 2012-10-25 (Calibration date: 2012-10-19)

/24/	Calibration report of Energy meter of Gen-A – Serial No. A010393 TIP Industry Services Co., Ltd.: Certificate of Calibration (Certificate No. 413/2012) issued on 2012-10-29 (Calibration date: 2012-10-27)
/25/	Calibration report of Energy meter of Gen-B – Serial No. A004997 TIP Industry Services Co., Ltd.: Certificate of Calibration (Certificate No. 414/2012) issued on 2012-10-29 (Calibration date: 2012-10-27)
/26/	CYY Bio Power: Operation Check Sheet dated 2013-05-26
/27/	Calibration report of CH4 Analyser – Serial No. ARCC-0038 MITCL: Calibration Certificate of Certificate No. C1212-916 issued on 2013-01-02 (Calibration date: 2012-12-22)
/28/	Calibration reports of Portable gas detector – Serial No. 10110R4-006 Industrial Services: Calibration Certificate of Gas Detector, Certificate No. G 550346, Issued on 2012-11-29 (Date of Calibration: 2012-11-29)
/29/	Verification certificates of Weighing machine – Serial No. 0000237 Central Bureau of Weights & Measurement: Verification Certificate, dated 2011-03-01 (Expiry date: 2013-02-28) Central Bureau of Weights & Measurement: Verification Certificate, dated 2013-01-18 (Expiry date: 2015-01-15)
/30/	CYY Bio Power Co., Ltd.: Calibration plan for 2012 & 2013
/31/	CYY Bio Power: Daily log sheet records from 2013-01-01 to 2013-08-20 for the following parameters • COD analysis of wastewater at inlet and outlet of UASB • Wastewater flow • Biogas sent to facility heaters • Biogas consumption in electricity generators • Biogas consumption for flare • Methane concentration in biogas • Electricity generation • Chemical oxidising agents (Sulphates) entering system boundary

	• Leakage test reports
/32/	CYY Bio Power: Work Instruction manual dated 2009-09-20 – Laboratory procedures of COD analysis and SO_4 analysis
/33/	External laboratory reports of COD analysis Suranaree University of Technology: Report no. 1271, dated 2012-12-19 Suranaree University of Technology: Report no. 1797, dated 2013-06-28
/34/	CYY Bio Power: Electronic files of monitored data (Excel files of monthly monitoring reports submitted to the Plant Manager) from 2013-01-01 to 2013-08-20 CYY Bio Power: Monthly reports checked and signed by the Plant Manager from January 2013 to August 2013
/35/	Combustion efficiency test reports of Boiler by United Analyst and Engineering Consultant Co., Ltd Report dated: 2013-03-16 & Analysis date: 2012-02-24 Report dated: 2013-03-15 & Analysis date: 2013-03-10 Combustion efficiency test reports of Gas engine Generator A by United Analyst and Engineering Consultant Co., Ltd Report dated: 2013-03-16 & Analysis date: 2012-02-23 Report dated: 2013-03-15 & Analysis date: 2013-03-09 Combustion efficiency test reports of Gas engine Generator B by United Analyst and Engineering Consultant Co., Ltd Report dated: 2013-03-16 & Analysis date: 2012-02-23 Report dated: 2013-03-15 & Analysis date: 2013-03-09
/36/	CYY Bio Power: Internal leakage test procedure and test reports
/37/	Global Water Engineering Ltd.: Installation, operation & maintenance manual for an elevated flare Global Water Engineering Ltd.: Flare operating sequence at CYY Biopower, document dated 2009-05-20
/38/	CYY Bio Power: Monitoring & reporting procedures approved by the Plant Manager on 2009-08-03
/39/	CYY Bio Power: Training records on safety, operation and maintenance of biogas plant
/40/	Global Water Engineering Ltd.: Process Operation Manual for the wastewater treatment plant,

<table>
<tr><td></td><td>November 2007</td></tr>
<tr><td>/41/</td><td>CYY Bio Power: Work Instruction Manual for Emergency Preparedness and Response, dated 2009-01-09</td></tr>
<tr><td>/42/</td><td>CYY Bio Power: SCADA system screen shots indicating the monitoring system</td></tr>
<tr><td>/43/</td><td>CYY Bio Power: List of employees along with their salary
<table>
<tr><td>1</td><td>Ms.Yupin Amwan</td></tr>
<tr><td>2</td><td>Mr.Tossapol Kanokpinij</td></tr>
<tr><td>3</td><td>Ms.Karnjana Luangsoongnern</td></tr>
<tr><td>4</td><td>Ms.Ungsumalin Lorsoongnern</td></tr>
<tr><td>5</td><td>Mr.Chanachai Decha</td></tr>
<tr><td>6</td><td>Mr.Anurak Jermkuntod</td></tr>
<tr><td>7</td><td>Ms.Sukanya Korbsantia</td></tr>
<tr><td>8</td><td>Mr.Artitpong Singhakam</td></tr>
<tr><td>9</td><td>Mr.Suwit Akkarapreechanon</td></tr>
<tr><td>10</td><td>Mr.Sarawut Rattanasorn</td></tr>
<tr><td>11</td><td>Mr.Niruj Prasertkarn</td></tr>
<tr><td>12</td><td>Mr.Jakkrit Kampangsantia</td></tr>
<tr><td>13</td><td>Mr.Teeratep Wangpingklang</td></tr>
<tr><td>14</td><td>Mr.Tawatchai Dermsantia</td></tr>
</table>
Since the salary of employees or income generation is sensitive information, it is not provided in the verification report. However, relevant evidence documents are available with GLC which can provided on demand as confidential documents.</td></tr>
<tr><td>/44/</td><td>CYY Bio Power: Training records
Summary of trainings conducted in 2013:
<table>
<tr><th>Training</th><th>Date</th><th>Attendees</th><th>Organized by</th></tr>
<tr><td rowspan="3">Operation and Maintenance of Biogas System</td><td rowspan="3">2013-01-15</td><td>1. Yupin Umwan (Head of Biogas Production/QC)</td><td rowspan="3">CYY Bio Power Co.,Ltd.</td></tr>
<tr><td>2. Sarawut Rattanasorn (Biogas production operator)</td></tr>
<tr><td>3. Chanachai Decha (Biogas production operator)</td></tr>
</table></td></tr>
</table>

			4. Artitpong Singhakam (Biogas production operator)	
			5. Anurak Jermkuntod (Biogas production operator)	
	Safety in Biogas Operation	2013-01-23	1. Yupin Umwan (Head of Biogas Production/QC)	CYY Bio Power Co.,Ltd.
			2. Sarawut Rattanasorn (Biogas production operator)	
			3. Chanachai Decha (Biogas production operator)	
			4. Artitpong Singhakam (Biogas production operator)	
			5. Karnchana Luangsoongnern (QC)	
			6. Anurak Jermkuntod (Biogas production operator)	
			7. Sukanya Kromsantia (QC)	
	Knowledge of Biogas	2013-05-14	1. Yupin Umwan (Head of Biogas Production/QC)	CYY Bio Power Co.,Ltd.
			2. Niroot Prasertkarn (Biogas production operator)	
			3. Sarawut Rattanasorn (Biogas production operator)	
			4. Chanachai Decha (Biogas production operator)	
			5. Chakkrit Kampangsantia (Biogas production operator)	
			6. Artitpong Singhakam (Biogas production operator)	
			7. Teelathep Whangpingkrang (QC)	
			8. Karnchana Luangsoongnern (QC)	
			9. Anurak Jermkuntod (Biogas production operator)	
			10. Angsumalin Lorsoongnern (QC)	
	Wastewater Analysis	2013-07-25	1. Yupin Umwan (Head of Biogas Production/QC)	CYY Bio Power Co.,Ltd.
			2. Karnchana Luangsoongnern (QC)	
			3. Teelathep Whangpingkrang (QC)	
			4. Angsumalin Lorsoongnern (QC)	

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

Resolution of Corrective Action and Clarification Requests including list of Forward Action Requests

Description of Finding (CAR, CL, FAR) *Describe the finding in a transparent manner i.e. state clearly what is required and why; address the context (e.g. section)*	Project Participants Response *This section shall be filled by the PP. The finding shall be addressed with suitable arguments and evidence*	GLC's Assessment *The assessment shall include how the finding is closed i.e. how it is found that the response is assessed to be appropriate and meeting the specific requirement of the finding. In case the response is not satisfactory, additional response and DOE assessments (#2, #3, etc.) shall be sought.*	Final Conclusion (OK or OPEN)
CAR 1 (2013-09-24) PP shall provide brief background of the project and the information related to Gold Standard milestones in section 1 of the Gold Standard Monitoring Report (GS MR).	2013-10-24 (1st round): The detail of brief background of the project and the information related to GS registration is provided in section 1 of the GS MR.	2013-10-28 (1st round): OK. It is found that PP provided brief background and information related to GS registration in section 1of the revised MR. Therefore, the CAR is closed.	OK
CAR 2 (2013-09-24) In section 2 of the GS MR under the parameter 'Air quality', monitored values have been presented. However, the information is not transparent; it is not clear which parameter is represented by the values.	2013-10-24 (1st round): The monitored values provided are referred from the parameters, AM0022 ID 5 (volume of biogas sent to boiler), AM0022 ID 9 (volume of biogas sent to flare) and AM0022 ID 10 (volume of biogas sent to gas engines).The details of the parameters can be found in the CDM monitoring report version 2. The same explanation is also provided in section 2 of the GS MR.	2013-10-28 (1st round): OK. The information in section 2 of the MR under the parameter 'Air Quality' is made transparent now. The information related to volume of biogas sent to gas engines, volume of biogas sent to boiler and volume of biogas sent to flare has been provided. The provided values are confirmed to be correct based on the review of ER sheet submitted for CDM verification. Therefore, the CAR is closed.	OK

CAR 3 (2013-09-24) The chosen parameter for monitoring the indicator 'Technological self reliance' is training. Though the training records have been provided to the verification team, it is also required to list in the MR which trainings were provided to the operating team.	2013-10-24 (1st round): List of training programs is provided in the GS MR. Further, the document for summary of the training with attendees and trainer is submitted to the verification team.	2013-10-28 (1st round): OK. The list of trainings provided to the operating staff has been included in the revised MR. All the training documents have been provided to the verification team. Trainings on the following have been provided: - Operation and maintenance of biogas system - Safety in biogas operation - Knowledge of biogas - Wastewater analysis Therefore, the CAR is closed.	OK
CAR 4 (2013-09-24) The PDD Annex also has a monitoring parameter related to sludge application. However, the GS MR does not contain any information related to that parameter.	2013-10-24 (1st round): The information of parameter 'sludge application' is provided in the GS MR. However, there was no record for sludge application since no sludge was removed during the monitoring period.	2013-10-28 (1st round): OK. The monitoring parameter related to sludge application has been included in the revised MR. However, no sludge was removed from the project treatment system during the monitoring period. This was confirmed during the onsite interviews. The CAR is closed.	OK