

Verification and Certification Report

of “Bangna Starch Wastewater Treatment and Biogas Utilization Project” in Thailand

GLC Report No: 127, Rev. 07

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Organisational Unit Germanischer Lloyd Certification GmbH (GLC), Greenhouse Gas Services		
Client South Pole Carbon Asset Management Ltd.	Client reference person Mr Patrick Bürgi	
Summary:		
UNFCCC Ref.	2556	
Project Name:	Bangna Starch Wastewater Treatment and Biogas Utilization Project	
Project Country:	Thailand	
Sectoral Scope, Technical Area	CDM Sectoral Scope: 1 and 13, Technical Area: 1.1 and 13.1	
Applied Methodology (ies):	AMS III.H., Version 09 AMS I.D., Version 13	
Project Size:	☐ Large Scale	☒ Small Scale
Number of verification: 1		
Dates of monitoring period (incl. both days) 2009-11-10 to 2010-12-31		
Project assessed by: Ms. Yanwei Chen Mr. Karunakar Avuram Dr. Stephen P Etheridge Mr. Chotipat Sangmanee	Assessment reviewed by: Ms. Anu Chaudhary Mr. Jose-Emilio Moreno Mr. Markus Weber	Work approved by: Mr. Markus Weber
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History of report revisions:

Rev.	Date	Person (short sign or name)	Function	Action
01	2011-12-07	KAV / CY / SPE	Auditor / ATL / TE	Draft report preparation
02	2012-01-05	AC	Technical Reviewer	Review with corrections and comments
03	2012-01-12	KAV / CY	Auditor / ATL	Addressing TR comments
04	2012-01-19	JMor	Technical Reviewer	Review with corrections and comments
05	2012-02-03	KAV / CY	Auditor / ATL	Addressing TR expert comments
06	2012-02-13	KAV / CY	Auditor / ATL	Final report preparation
07	2012-02-14	MWeb	Final Reviewer / Approver	Final Review and Approval

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Abbreviations

BOOT	Built Own Operate and Transfer
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CH ₄	Methane
CO ₂ e	Carbon dioxide equivalent
COD	Chemical Oxygen Demand
CL	Clarification Request
EB	UNFCCC's Executive Board
ER	Emission Reduction
FAR	Forward Action Request
GHG	Greenhouse gas(es)
GLC	Germanischer Lloyd Certification GmbH
MP	Monitoring Plan
MR	Monitoring Report
NA	Not Applicable
NCV	Net Calorific Value
PDD	Project Design Document
PP	Project Participant
QA/QC	Quality Assurance / Quality Control
SCADA	Supervisory Control And Data Acquisition
UASB	Up-flow Anaerobic Sludge Blanket
UNFCCC	United Nations Framework Convention on Climate Change
VVM	Validation and Verification Manual

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1. INTRODUCTION

South Pole Carbon Asset Management Ltd. has commissioned the Germanischer Lloyd Certification GmbH (GLC) to carry out the 1st verification of the project “Bangna Starch Wastewater Treatment and Biogas Utilization Project” (UNFCCC CDM project reference number [2556](#)) with regard to the relevant requirements for CDM project activities.

The project was validated and registered with UNFCCC on 2009-11-10. This is the 1st verification of the project which covers the period from 2009-11-10 to 2010-12-31.

The verification team of GLC has reviewed implementation of the project activity described in the registered PDD ^{/2/} and the monitoring plan of the revised PDD ^{/3/}. GHG data for the monitoring period covering from 2009-11-10 to 2010-12-31 was verified in detailed manner applying the set of requirements, audit practices and principles as required under the latest version of Validation and Verification Manual ^{/1/} of the UNFCCC.

This report summarizes the findings and conclusions of this 1st verification of the above mentioned UNFCCC 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 of the revised PDD and the approved methodology;
- that the data is recorded and stored as per the monitoring methodology

1.2 Scope

The verification of this registered project is based on the validated registered PDD ^{/2/}, approved revised PDD ^{/3/}, monitoring report (MR) ^{/4/}, emission reduction calculation spread sheet (ER sheet) ^{/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 is carried out on the basis of the following requirements, applicable for this project activity:

- Article 12 of the Kyoto Protocol ^{/6/}

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- Guidelines for the implementation of Article 12 of the Kyoto Protocol as presented in the Marrakech Accords under decision 3/CMP.1 ^{/7/} and subsequent decisions made by the Executive Board and COP/MOP
- Other relevant rules, including the host country legislation
- CDM Validation and Verification Manual ^{/1/}
- Registered PDD ^{/2/} and approved revised PDD ^{/3/}
- Approved small scale CDM baseline and monitoring methodologies^{/8/}; AMS III.H., version 09: "Methane Recovery in Wastewater Treatment" and AMS I.D., version 13: "Grid connected renewable electricity generation"

1.3 GHG Project Description

Project Characteristics:

Essential data of the project is presented in the following Table 1-1.

Table 1-1: Project Characteristics

Item	Data
Project title	Bangna Starch Wastewater Treatment and Biogas Utilization Project
Project Description	The project activity consists of installation of a new biogas reactor for wastewater treatment with methane capture and utilisation for energy generation purposes at an existing starch manufacturing facility. The project activity avoids the release of methane into the atmosphere, which would occur due to the anaerobic digestion of the organic content in the open lagoon based wastewater treatment system. In addition, the biogas reactor produces sufficient quantities of biogas to fuel three gas engines of 0.95 MW_{el} each for the generation of electricity. The displacement of electricity from the national grid, which is generated by fossil fuel fired power plants to a large extent, leads to further reductions of greenhouse gases.
Project size	☐ Large Scale ☒ Small Scale
CDM Reference No.	2556

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Date of registration	2009-11-10	
Project Scope (according to UNFCCC sectoral scope numbers for CDM)	13 1	Waste handling and disposal Energy industries
Applied Methodologies	AMS III.H., version 09: Methane Recovery in Wastewater Treatment AMS I.D., version 13: Grid connected renewable electricity generation	
Crediting period	7 years (Renewable Crediting Period)	

Technical Project Description:

The wastewater from the starch factory is collected in a collection pond (or storage lagoon). From the collection pond, it is pumped into UASB reactor. In the UASB process, wastewater flows upward through a sludge blanket composed of microorganisms that naturally form granules or particles of 0.5 to 2 mm in diameter ("sludge granules"). When wastewater comes in contact with the granules, anaerobic decomposition of the organic material contained in the wastewater takes place, resulting in the generation of methane-rich biogas.

The biogas is collected through a dedicated pipeline network and treated in a bio scrubber to remove sulphur before it is stored in a gas storage tank (a covered lagoon) of 5000 m³. Gas storage tank acts as a buffer to ensure smooth flow of biogas. The biogas is used as a fuel in gas engines of 2.85 MW_{el} (3x0.95 MW_{el}) capacity for electricity generation. An enclosed flaring system is also provided in order to flare out the excess biogas, if any, into the atmosphere.

The key components of the project activity are given in table 1-2:

Table 1-2: Key components of the project

Component	Design Specifications ^{/12/}
UASB	Handling Capacity: 3750 m ³ / day COD load: 7 – 15 kg COD / m ³ COD removal efficiency: ~ 90%
Gas engines	Capacity: 3 No's of 0.95 MW _{el} each
Gas storage tank	5000 m ³

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Involved Parties and Project Participants:

The following parties to the Kyoto Protocol and project participants are involved in this project activity (Table 1-3).

Table 1-3: Project Parties and project participants

Characteristic	Party	Project Participant
Host party	Thailand	P & Papop Renewable Co., Ltd.
Other involved party	Switzerland	South Pole Carbon Asset Management Ltd
Other involved party	Portugal	Luso Carbon Fund

Project Location:

The details of the project location are given in table 1-4:

Table 1-4: Project Location

No.	Project Location
Host Country	Thailand
Region:	Kalasin Province
Project location address:	45 Rimmaenumarn, Theenanon Road, Yangthalat-46120
Latitude:	16°23'7.71"N (16.385475)
Longitude:	103°28'21.28"E (103.472578)

2. VERIFICATION TEAM

The appointment of the team takes into account the required scope and sector specific knowledge requirements for verifying the ER achieved by the project activity in the relevant monitoring period for this verification.

The verification team consists of the following members:

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Table 2-1: Verification team members, qualification and knowledge

	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	Technical review	Expert input	Approval
☐ Mr. ☒ Ms.	Yanwei Chen	ATL	X			X			X			
☒ Mr. ☐ Ms.	Karunakar Avuram	A				X	X	X				
☒ Mr. ☐ Ms.	Stephen P Etheridge	E	X	X	X	X	X				X	
☒ Mr. ☐ Ms.	Chotipat Sangmanee	E			X	X	X				X	
☐ Mr. ☒ Ms.	Anu Chaudhary	TR	X	X						X		
☒ Mr. ☐ Ms.	Jose-Emilio Moreno	TR/E	X	X						X	X	

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	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	Technical review	Expert input	Approval
☒ Mr. ☐ Ms.	Markus Weber	TR/E /FA	X	X						X	X	X

1) ATL: Assessment Team Leader; A: Auditor, E: Expert; TR: Technical Reviewer; FA: Final Approver

3. METHODOLOGY OF VERIFICATION

3.1 Verification Process

The verification process is based on the guidelines described in the Validation and Verification Manual (VVM). In addition to VVM, standard auditing techniques have also been applied. The verification team performs first a desk review, followed by an on-site visit to review the project realisation. The findings raised are provided in Annex A. In case of lack of clarity or inconsistencies, related findings are raised. The next step is to close out the findings through direct communication with the PPs and finally prepare the verification report. This verification report and other supporting documents then undergo a technical review by the "GLC GmbH" prior to the submission to the CDM-EB.

3.2 Desk review

GLC has conducted a desk review of all documents, between 2011-03-16 and 2011-03-25, initially provided by the client and publicly available documents relevant for the verification. The main reviewed documents are listed below:

- Monitoring report ^{/4/}
- Emission reduction calculation spread sheet ^{/5/}
- The registered PDD ^{/2/} and the corresponding validation report ^{/13/}
- The approved revised PDD ^{/3/}
- The applied monitoring methodology ^{/8/}
- Relevant decisions, clarifications and guidance from the CMP and the CDM Executive Board;

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- 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).

3.3 On-site assessment

On 2011-03-31 and 2011-04-01, GLC's verification team carried out an on-site visit to the project site. The project site is located at the Yangthalat starch production facility of Bangna Tapioca Flour Co., Ltd. The project activity was implemented by P & Papop Renewable Co. Ltd. on a BOOT (Build Own Operate and Transfer) basis. Therefore, the project is being operated by P & Papop Renewable Co. Ltd. and the BOOT contract is for 10 years.

The main tasks covered during the site visit include, but were not limited to:

- The on-site assessment included an investigation of whether all relevant equipment is installed and working as anticipated.
- 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.
- The duly calibration of all metering equipment was checked.
- The monitoring processes, routines and documentations were audited to check their proper application.
- The monitoring data was checked completely.
- The data aggregation trails were checked via spot sample down to the level of the meter recordings and COD analysis at on-site laboratory

Representatives of P & Papop Renewable Co. Ltd. and South Pole Carbon Asset Management Ltd including the operational staff of the plant were interviewed. The main topics of the interviews are summarised in Table 2-2.

Table 2-2: Interviewed persons and interview topics

Interview Topic	Interviewed persons
• General aspects of the project	<u>Staff of P & Papop Renewable Co. Ltd.</u>
• Technical equipment and operation	Mr Suchai Rattananadhekul, Project Manager

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Interview Topic	Interviewed persons
• Changes since validation • Monitoring and measurement equipment • 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 Parinyr Wongsomboor, Plant Manager Mr Eakachai Prasartmongkol, Head of Production Ms Chompoo Punthasri, Laboratory Supervisor Mr Kornvush Hormlek, Head of Power Management <u>Staff of South Pole Carbon Asset Management Ltd</u> Mr Patrick Burgi, Regional Director Ms Suwipa Rukwongtrakool, Project Manager Mr Harshpreet Singh, Project Consultant

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

Corrective Action Requests (CARs), 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;

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- issues identified in a FAR during validation to be verified during verification have not been resolved by the project participants

Clarification Request (CL), if:

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

In case the team has identified essential risks for further verifications or the actual status requires a special attention or an adjustment during the next consecutive verification, a Forward Action Request (FAR) is 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 have been closed out.

For a detailed list of all CARs, CLs and FARs raised in the course of the verification please refer Annex A. The general project and procedural description of the verification and a detailed list of the verification findings forms the draft verification report.

3.5 Technical Review

Before submission of the final verification report GLC has carried out a technical review of the whole verification procedure and the draft report between 2012-01-05 and 2012-02-13. The technical reviewer is a competent GHG auditor being appointed for the scope this project falls under. The reviewer is not part of the assessment team and thus not involved in the decision making process up to the technical review.

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

4. VERIFICATION FINDINGS

This section summarises the findings from the verification of the emission reductions reported for the “Bangna Starch Wastewater Treatment and Biogas Utilization Project” for the period from 2009-11-10 to 2010-12-31. The findings of the verification are documented in more detail in the Findings List given in Annex A.

In each case where GLC had identified an issue that needed clarification or that represented a risk to the fulfilment of the project objectives, a CL or a CAR have been issued respectively. All raised CARs and CLs are documented in Annex A. The verification of “Bangna Starch Wastewater Treatment and Biogas Utilization Project” has resulted in ten (10) CARs and three (3) CL. Upon successful closure of the raised CARs and CLs and based on the on-site findings and the reviewed project documentation; the verification team confirms that there are no remaining non-conformities. Two FARs have also been raised during the verification which shall be verified during the next verification.

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By assessing the validation report for the project activity, the verification team identified no missing steps, open issues or considerable discrepancy from the validation phase of the project activity. Thus, there were no pending issues from the validation phase of the project. Moreover, as this is the 1st CER verification for the project activity, no previous FAR was thus identified with regards to remaining issues from a previous CER verification.

The main changes between the first version of the monitoring report made available (version 1, dated 2011-02-28) and the final monitoring report (version 2.1 dated 2012-02-03) ^{/4/} are summarized below:

- Section B.4 was updated as a notification of changes in the PDD was submitted
- The organisation chart in section C was revised
- The project activity flow diagram (i.e. figure-2) was revised
- Section D.2 was updated inline with the revised monitoring plan
- Emission reductions in section E.5 were updated

5. VERIFICATION REPORTING

5.1 Project implementation in accordance with the registered PDD

During the verification, an on-site visit was carried out. The onsite visit revealed that a gas storage tank (a covered lagoon) of 5000 m³ capacity is also in place which was not described in the PDD and two other additional gas storage tanks are also provided as standby. The gas storage system reduces the fluctuations and ensures smooth flow of gas. This improves the flexibility of operation of gas engines and reduces the frequent operation of the flare. The system boundary diagram provided section B.3 of the registered PDD indicates a bypass wastewater line with a flow meter. However, there is no bypass line at the project site. Though the identified changes do not raise any concerns with respect to either additionality, scale of project activity or application and applicability of baseline methodology, GLC has raised a CAR to address the changes.

The project participants have revised the corresponding sections in the PDD and a notification on changes in the PDD was submitted in accordance with the guidelines provided in Annex 66 & 67 of EB 48 report. The Board has approved the changes and therefore, the CAR has been closed out. The revised PDD was approved on [2011-09-23](#). Under consideration of the successful correction of the CAR and based on the on-site findings and the reviewed project documentation the verification team confirms that the realized technology, the project equipment, as well as the monitoring and metering equipment, have been implemented and operated as described in the approved revised PDD.

The emission reductions being claimed during the period 2009-11-10 to 2010-12-31 are 44% lower than the estimated emission reductions in the registered PDD, as given in the table below.

Parameter	As per PDD	Monitoring report
Emission Reductions (tCO ₂ e)	48,558	26,907

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% Deviation (+/-)	0	(-) 44%
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(The estimated annual emission reduction as per the registered PDD is 41,701 tCO₂e, which corresponds to 48,558 tCO₂e for the length of the 1st monitoring period)

The primary reason for the lower emission reduction is lower starch production^{/26/} than expected. Lower starch production has substantially reduced the wastewater generation which in turns resulted in lower availability of biogas for electricity generation. The other reason for reduction in achieved emission reductions is conservativeness applied in the calculation of COD of wastewater, methane content of biogas and project emissions due to flaring. Therefore, the achieved emissions reductions are considerably lower during the current monitoring period compared to the estimated value in the PDD.

5.2 Compliance of the monitoring plan with the monitoring methodology

As per the applied small scale baseline and monitoring methodologies, AMS III.H., version 09 and AMS I.D., version 13^{/8/}, the following parameters are required to be monitored:

- Flow of wastewater treated
- COD of wastewater before and after treatment
- Electricity generated by the project activity
- The amount of fossil fuel and electricity used by the project activity facility

Furthermore,

- The amount of methane recovered, fuelled and flared shall be monitored using continuous flow meters
- Methane content of biogas shall be monitored using continuous analyser or alternatively with periodical measurements at 95% confidence level

The revised monitoring plan sufficiently covers all the requirements of the monitoring methodologies and hence, the verification team confirms that the revised monitoring plan is in compliance with the applied monitoring methodologies.

5.3 Compliance of the monitoring with the monitoring plan

During the verification, it was observed that the monitoring of data was not in compliance with the registered monitoring plan. Therefore, a revision of monitoring plan was proposed along with the notification of changes in the PDD in order to suite monitoring practices and meeting the requirements of monitoring methodologies. The PDD was revised incorporating changes in the project design as described above in section 5.1 and the revision of monitoring plan. The revised PDD along with validation opinion was submitted to UNFCCC by GLC. The revised PDD was approved on 2011-09-23. The revised PDD can be found at <http://cdm.unfccc.int/Projects/DB/RWTUV1241593452.75/view>

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Following are the details of monitoring in accordance with the revised monitoring plan:

	Assessment/ Observation	
Data / Parameter: (as in monitoring plan of PDD):	Q _{y, ww} Volume of wastewater treated in the year y (m ³)	
Measuring frequency:	Continuously The parameter is monitored continuously using flow meter.	
Reporting frequency:	Daily The parameter is recorded by the operator in log sheets on a daily basis. The recorded values by the operators are checked by the Plant's manager. The log sheets are signed and filed by the Plant's manager. The monitored data is transferred into electronic format (excel files) and stored.	
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, the measuring and reporting frequency of the parameter is inline with the revised monitoring plan	
Type of monitoring equipment:	Type of meter	Electromagnetic flow meter with flow converter
	Meter tag	FM1
	Serial No.	93120819000
	Accuracy	± 0.5% /18/
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The accuracy of the monitoring equipment was defined neither in the revised monitoring plan nor in the applied methodology. However, GLC's Sectoral expert confirms that ±0.5% of accuracy represents good practice.	
Calibration frequency /interval:	At least once in three years As per the approved revised monitoring plan, the flow meter is calibrated at least once in three years inline with the manufacturer's recommendation.	
Is the calibration interval in line with the	Yes, the calibration interval of the flow meter is inline	
Germanischer Lloyd Certification Code: DC-GHG 007_C, Rev.04 Date: 2011-07-20; MN; Jis Page 17		
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monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	with the monitoring plan of the approved revised PDD. The flow meter was calibrated on 2010-09-21, 2009-11-30 and 2008-07-24 ^{/19/} . This shows that the flow meter was calibrated within the specified interval. Hence, it represents good practice.
Company performing the calibration:	The calibration of the meter was carried by Endress & Hauser (Thailand) Ltd., Nonthaburi, Thailand. ^{/19/}
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration reports were verified by the verification team and they confirm the proper functioning of the meter.
Is (are) calibration(s) valid for the whole reporting period?	Yes. As mentioned above, the calibrations are valid for the whole monitoring period.
If applicable, has the reported data been cross-checked with other available data?	Yes, the reported data was cross checked with operator log sheet information ^{/25/} and the data was found to be correct.
How were the values in the monitoring report verified?	Please refer to section 5.4
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?	Please refer to the description at the end of the section

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	COD _{y, inflow, j} The COD of the wastewater entering the project treatment system j (mg/l or tonnes/m ³)
Measuring frequency:	Daily Multiple samples of wastewater are collected from inlet of UASB. Composite sample of three hourly samples is analysed four times a day using colorimetric method at onsite laboratory to determine the COD.

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Reporting frequency:	Daily The COD values are recorded in the log sheet by the laboratory supervisor each time when the COD is determined. The daily values are reported to the Plant Manger. The log sheet information is transfered into electronic format (excel files).						
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. According to the revised monitoring plan, the COD of wastewater would be analysed at least once per day and the COD test results are logged in on a daily basis. Therefore, the monitoring practice complies with the approved monitoring plan and represents good practice.						
Type of monitoring equipment:	<table border="1"> <tr> <td>Type of meter</td><td>Colorimeter</td></tr> <tr> <td>Serial No.</td><td>070290C62433</td></tr> <tr> <td>Accuracy</td><td>$\pm 0.24\%$ ^{/18/}</td></tr> </table>	Type of meter	Colorimeter	Serial No.	070290C62433	Accuracy	$\pm 0.24\%$ ^{/18/}
Type of meter	Colorimeter						
Serial No.	070290C62433						
Accuracy	$\pm 0.24\%$ ^{/18/}						
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The accuracy of the colorimeter was not defined in the revised monitoring plan. However, GLC's Sectoral expert confirms that $\pm 0.24\%$ of accuracy represents good practice.						
Calibration frequency /interval:	Yearly As per the approved revised monitoring plan, the colorimeter is calibrated at least once a year inline with the supplier recommendation.						
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The colorimeter was calibrated internally every month during the verification period ^{/19/} . Therefore, a clarification (CL) was requested on the compliance of internal calibration procedure. The latest calibration report from an external laboratory was also requested. The calibration of the colorimeter was carried out by EnviScience Company Limited, Bangkok on 2011-05-31 ^{/19/} . From the calibration test results, it was observed that the error of the instrument before calibration was varying from 0.6% to 5.1% with different standard absorbance at different wave lengths. The PPs have applied the						

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	maximum error of 5.1% to recalculate the COD values according to the calibration guidelines of EB 52, Annex 60^{11/}. The error has been applied for the whole monitoring period. Accordingly, the emission reductions have been recalculated conservatively. As the same measuring device is used for COD measurement at the inlet and outlet of the UASB, the error has been applied such that it results lower value of the inlet COD i.e. the measured parameter. The verification team is of the opinion that the approach followed by PPs is appropriate. Please refer CL 2 in the enclosed Annex A.
Company performing the calibration:	As mentioned above, the calibration of the colorimeter was carried out internally by the plant's team.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	The internal calibration confirms proper functioning of the meter.
Is (are) calibration(s) valid for the whole reporting period?	Please refer above and CL 2.
If applicable, has the reported data been cross-checked with other available data?	Yes, the reported data was cross checked with operator log sheet information. Few of the reported values in the ER sheet were found to be inconsistent with the log sheet values. Therefore, a CAR (please refer CAR 5 in Annex A) was raised. The revised ER sheet was submitted by the PPs.
How were the values in the monitoring report verified?	Please refer to section 5.4
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?	Please refer to the description at the end of the section

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	COD_{y, outflow, j} The COD of the wastewater exiting the project

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	treatment system j (mg/l or tonnes/m ³)	
Measuring frequency:	Daily Multiple samples of wastewater are collected from outlet of UASB. Composite sample of three hourly samples is analysed four times a day using colorimetric method at onsite laboratory to determine the COD.	
Reporting frequency:	Daily The COD values are recorded in the log sheet by the laboratory supervisor each time when the COD is determined. The daily values are reported to the Plant Manger. The log sheet information is transfered into electronic format (excel files).	
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. According to the revised monitoring plan, the COD of wastewater would be analysed at least once per day and the COD test results are logged in on a daily basis. Therefore, the monitoring practice complies with the approved monitoring plan and represents good practice.	
Type of monitoring equipment:	Type of meter	Colorimeter
	Serial No.	070290C62433
	Accuracy	± 0.24% /18/
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The accuracy of the colorimeter was not defined in the revised monitoring plan. However, GLC's Sectoral expert confirms that ±0.24% of accuracy represents good practice.	
Calibration frequency /interval:	Yearly As per the approved revised monitoring plan, the colorimeter is calibrated at least once a year inline with the supplier recommendation.	
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good	The colorimeter was calibrated on a monthly basis internally during the verification period. Therefore, a clarification (CL) was requested on the compliance of internal calibration procedure. The latest calibration	

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monitoring practise?	report from an external laboratory was also requested. The calibration of the colorimeter was carried out by EnviScience Company Limited, Bangkok on 2011-05-31 ^{/19/}. From the calibration test results, it was observed that the error of the instrument before calibration was varying from 0.6% to 5.1% with different standard absorbance at different wave lengths. The PPs have applied the maximum error of 5.1% to recalculate the COD values according to the calibration guidelines of EB 52, Annex 60^{/11/}. The error has been applied for the whole monitoring period. The error has been applied such that it results higher value of the outlet COD i.e. the measured parameter. Accordingly, the emission reductions have been recalculated conservatively. The verification team is of the opinion that the approach followed by PPs is appropriate. Please refer CL 2 in the enclosed Annex A.
Company performing the calibration:	As mentioned above, the calibration of the colorimeter was carried out internally by the plant's team.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	The internal calibration confirms proper functioning of the meter.
Is (are) calibration(s) valid for the whole reporting period?	Please refer above and CL 2.
If applicable, has the reported data been cross-checked with other available data?	Yes, the reported data was cross checked with operator log sheet information. Few of the reported values in the ER sheet were found to be inconsistent with the log sheet values. Therefore, a CAR (please refer CAR 5 in Annex A) was raised. The revised ER sheet was submitted by the PPs.
How were the values in the monitoring report verified?	Please refer to section 5.4
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?	Please refer to the description at the end of the section

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	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	COD _{y, removed, j} The COD removed by the project treatment system (tonnes / m ³)
Measuring frequency:	The parameter is calculated as the difference of COD at inlet and outlet of UASB $\text{COD}_{y, \text{ removed, } j} = \text{COD}_{y, \text{ inflow, } j} - \text{COD}_{y, \text{ outflow, } j}$
Reporting frequency:	Daily The COD values are reported to the Plant Manager on a daily basis.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	The parameter is monitored inline with the description provided in the revised monitoring plan.
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	NA
Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	NA
Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is(are) calibration(s) valid for the whole reporting period?	NA

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If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	Please refer to section 5.4
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?	Please refer to the description at the end of the section

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	COD _{y, ww, treated} COD of the wastewater prior to discharge (mg/l or tonnes/m ³)
Measuring frequency:	Monthly The parameter is monitored on a monthly basis.
Reporting frequency:	Monthly Wastewater samples are collected at the discharge from last open lagoon. The COD content is analyzed using a standard method in an external laboratory on a monthly basis. 90/10 confidence/precision level approach is applied for the measured monthly COD readings. Upper bound value is taken to calculate the emission reductions conservatively.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, the measuring and reporting frequency of the parameter is inline with the approved revised monitoring plan
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good	NA

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monitoring practise?	
Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	NA
Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is(are) calibration(s) valid for the whole reporting period?	NA
If applicable, has the reported data been cross-checked with other available data?	The reported values were crosschecked with the COD reports provided by the external laboratory ^[22] .
How were the values in the monitoring report verified?	Please refer to section 5.4
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?	Please refer to the description at the end of the section

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	$S_{y, final}$ Amount of sludge generated by the wastewater treatment system in the year y (Tonnes)
Measuring frequency:	Measured when the sludge is removed There was no removal of sludge during the current verification period.
Reporting frequency:	Not applicable for this verification period
Is measuring and reporting frequency in accordance with the monitoring plan and	NA

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monitoring methodology? (Yes / No)	
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	NA
Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	NA
Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is(are) calibration(s) valid for the whole reporting period?	NA
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	NA
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	NA

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	%CH ₄ Methane content in biogas (%)
Measuring frequency:	The parameter was monitored using portable

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	analyser on a daily basis during the monitoring period. Multiple readings were taken every day and the average of the readings was taken as daily %CH₄. As per the methodological requirements 95/5 confidence/precession level was applied to determine %CH₄.						
Reporting frequency:	Daily. The values are recorded in log sheets and reported to the Plant Manager on a daily basis. The reported values are cross checked by the Plant Manager and then transferred into electronic format.						
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	According to the approved revised monitoring plan, the parameter is monitored continuously using online analyser. In case of malfunctioning of online system, the methane content in the biogas is measured using portable analyser at least twice a day. In such cases, the methane content to be used in emission reduction calculations is established using 95% confidence level in a conservative manner. Therefore, the measuring and reporting frequency is in accordance with the approved revised monitoring plan.						
Type of monitoring equipment:	<table border="1"> <tr> <td>Type of meter</td><td>Gas Analyser</td></tr> <tr> <td>Serial No.</td><td>BM 11452</td></tr> <tr> <td>Accuracy</td><td>± 3% /18/</td></tr> </table>	Type of meter	Gas Analyser	Serial No.	BM 11452	Accuracy	± 3% /18/
Type of meter	Gas Analyser						
Serial No.	BM 11452						
Accuracy	± 3% /18/						
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The PDD does not specify the accuracy of the monitoring equipment. However, the accuracy of the instrument is periodically crosschecked with standard gas. The verification team verified the reports of internal calibration carried out with standard gas and the error of the instrument was observed to be less than 0.2%. Therefore, the accuracy of the equipment represents a good monitoring practice.						

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Calibration frequency /interval:	The portable gas analyser was calibrated every month internally using the standard gas during the monitoring period.
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	According to the monitoring plan of the revised PDD, periodic calibration of the measuring equipment according to the manufacturer's recommendation is carried out. Therefore, a clarification was requested (please refer CL 2) to provide the manufacturer recommendation on calibration and the acceptance of internal calibration. The verification team checked the calibration frequency from the manufacturer recommendation. It was learnt that the recommended calibration frequency for portable gas analyser is 6 months. As internal calibration procedure cannot be confirmed with the acceptable international calibration standards, the verification team requested the PPs to calibrate the analyser from an external agency and provide the calibration report. The PPs have submitted the latest calibration report to the verification team. The calibration was carried out by Entech Associate Co., Ltd., Bangkok on 2011-06-15 ^{/19/}. The maximum error observed from the calibration test report was 2.16%. Therefore, PPs have applied the maximum permissible error of 3% for the measured values of %CH₄ for the whole monitoring period. The %CH₄ was calculated as per the calibration guidelines of EB 52, Annex 60 and applied conservatively i.e. lower for baseline emissions and higher for project emissions. This approach resulted in conservative emission reductions. Hence, the validation is of the opinion that the approach followed by PPs is appropriate. Please refer to CL 2 in Annex-A.
Company performing the calibration:	As mentioned above, the calibration was carried out internally during the monitoring period.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	The internal calibration results confirm the proper functioning of the gas analyser.
Is(are) calibration(s) valid for the whole	As mentioned above, the gas analyser was

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reporting period?	calibrated internally only. Refer to CL 2.
If applicable, has the reported data been cross-checked with other available data?	Yes, the reported data was crosschecked with operator log sheets. Few of the reported values in the ER sheet were found to be inconsistent with the log sheet values. Therefore, a CAR (please refer CAR 5 in Annex A) was raised. The ER sheet was revised and submitted by the PPs.
How were the values in the monitoring report verified?	Please refer to section 5.4
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?	Please refer to the description at the end of the section

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	Q _{biogas, total, y} Amount of biogas that is generated using the project activity in year y (Nm ³)
Measuring frequency:	Continuously The parameter is monitored on a continuous basis using gas flow meters.
Reporting frequency:	Daily The gas flow meter display indicates cumulative gas flow. The parameter is recorded in log sheets on a daily basis by the operators. The recorded data is reported to the Plant Manager. The Plant Manager verifies the data and then the data is transferred into electronic format (Excel sheets). The log sheets and Excel sheets are stored for verification purpose.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, the measuring and reporting frequency of the parameter is inline with the approved revised monitoring plan.

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Type of monitoring equipment:	Type of meter	Thermal mass gas flow meter indicating cumulative reading
	Tag No.	GM 1
	Serial No.	9502C002000
	Accuracy	$\pm 1\%$ ^{/18/}
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The accuracy of the monitoring equipment was not stated in the revised monitoring plan. However, GLC's technical expert confirms that $\pm 1\%$ of accuracy represents good practice.	
Calibration frequency /interval:	At least once in three years The flow meter was calibrated on 2010-09-21, 2009-11-16, 2008-08-05 and 2007-05-09. ^{/19/} The calibration carried out in 2007 and 2010 was by an external agency. However, the flow meter was calibrated internally by PAPOP CO.,LTD in 2008 and 2009. Therefore, a CL (refer to CL 2 in Annex A) was raised to provide manufacturer recommendations of calibration. The PPs have provided the recommendations of manufacturer^{/20/}. The manufacturer's recommendation says that the flow meters should be calibrated at least once in 3 to 5 years depending on the ambient conditions. Therefore, the calibration practice is inline with the manufacturer's recommendations.	
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The approved revised monitoring plan states that the flow meter is calibrated at least once in every three years in line with the manufacturer's recommendation and the latest EB guidelines for small-scale project. http://cdm.unfccc.int/Reference/Guidclarif/ssc/methS SC_guid06.pdf. As mentioned above, the calibration frequency by external agency still meets the requirements recommended by the manufacturer and further the meter was calibrated internally in 2008 and 2009. Therefore, verification team is of the opinion that the	

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	calibration frequency represents good practice.
Company performing the calibration:	The latest calibration of the meter was carried out by Endress & Hauser (Thailand) Ltd., Nonthaburi, Thailand ^{/19/} .
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration reports were verified by the verification team and they confirms the proper functioning of the meters.
Is(are) calibration(s) valid for the whole reporting period?	Yes. The calibration is valid for the whole verification period.
If applicable, has the reported data been cross-checked with other available data?	Yes, the reported data was cross checked with operator log sheet information ^{/25/} and the reported data was found to be correct.
How were the values in the monitoring report verified?	Please refer to section 5.4
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?	Please refer to the description at the end of the section

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	Q _{biogas, flare, y} Amount of biogas that is flared (Nm ³)
Measuring frequency:	Continuously The parameter is monitored on a continuous basis using gas flow meters.
Reporting frequency:	Daily The gas flow meter display indicates cumulative gas flow. The parameter is recorded in log sheets on a daily basis by the operators. The recorded data is reported to the Plant Manager. The Plant Manager verifies the data and then the data is transferred into electronic format (Excel sheets). The log sheets and

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	Excel sheets are stored for verification purpose.	
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, the measuring and reporting frequency of the parameter is inline with the approved revised monitoring plan.	
Type of monitoring equipment:	Type of meter	Thermal mass gas flow meter indicating cumulative reading
	Tag No.	GM 3
	Serial No.	9A070502000
	Accuracy	$\pm 1\%$ ^{/18/}
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The accuracy of the monitoring equipment was not stated in the revised monitoring plan. However, GLC's technical expert confirms that $\pm 1\%$ of accuracy represents good practice.	
Calibration frequency /interval:	At least once in three years The flow meter was calibrated on 2010-09-21, 2009-11-20, 2008-08-02 and 2007-05-16. ^{/19/} The calibration carried out in 2007 and 2010 was by an external agency. However, the flow meter was calibrated internally by PAPOP CO.,LTD in 2008 and 2009. Therefore, a CL was raised (please refer CL2 in Annex A) to provide manufacturer recommendations of calibration. The PPs have provided the recommendations of manufacturer^{/20/}. The manufacturer's recommendation says that the flow meters should be calibrated at least once in 3 to 5 years depending on the ambient conditions. Therefore, the calibration practice is inline with the manufacturer's recommendations.	
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The approved revised monitoring plan states that the flow meter is calibrated at least once in every three years in line with the manufacturer's recommendation and the latest EB guidelines for small-scale project ^{/10/}. As mentioned above, the calibration frequency by external agency still meets the requirements	

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	recommended by the manufacturer and further the meter was calibrated internally in 2008 and 2009. Therefore, verification team is of the opinion that the calibration frequency represents good practice.
Company performing the calibration:	The latest calibration of the meter was carried by Endress & Hauser (Thailand) Ltd., Nonthaburi, Thailand ^{/19/} .
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration reports were verified by the verification team and they confirm the proper functioning of the meters.
Is(are) calibration(s) valid for the whole reporting period?	Yes. The calibration is valid for the whole verification period.
If applicable, has the reported data been cross-checked with other available data?	Yes, the reported data was cross checked with operator log sheet information ^{/25/} and the reported data was found to be correct.
How were the values in the monitoring report verified?	Please refer to section 5.4
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?	Please refer to the description at the end of the section

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	Q biogas, generator, y Amount of biogas that is used in electricity generators (Nm ³)
Measuring frequency:	Continuously The parameter is monitored on a continuous basis using gas flow meters.
Reporting frequency:	Daily The gas flow meter display indicates cumulative gas flow. The parameter is recorded in log sheets on a

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	daily basis by the operators. The recorded data is reported to the Plant Manager. The Plant Manager verifies the data and then the data is transferred into electronic format (Excel sheets). The log sheets and Excel sheets are stored for verification purpose.	
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, the measuring and reporting frequency of the parameter is inline with the approved revised monitoring plan.	
Type of monitoring equipment:	Type of meter	Thermal mass gas flow meter indicating cumulative reading
	Tag No.	GM 2
	Serial No.	9502C102000
	Accuracy	$\pm 1\%$ ^{/18/}
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The accuracy of the monitoring equipment was not stated in the revised monitoring plan. However, GLC's technical expert confirms that $\pm 1\%$ of accuracy represents good practice.	
Calibration frequency /interval:	At least once in three years The flow meter was calibrated on 2010-09-21, 2009-11-18, 2008-08-03 and 2007-05-09. ^{/19/} The calibration carried out in 2007 and 2010 was by an external agency. However, the flow meter was calibrated internally by PAPOP CO.,LTD in 2008 and 2009. Therefore, a CL was raised (please refer CL2 in Annex A) to provide manufacturer recommendations of calibration. The PPs have provided the recommendations of manufacturer^{/20/}. The manufacturer's recommendation says that the flow meters should be calibrated at least once in 3 to 5 years depending on the ambient conditions. Therefore, the calibration practice is inline with the manufacturer's recommendations.	
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good	The approved revised monitoring plan states that the flow meter is calibrated at least once in every three years in line with the manufacturer's recommendation and the latest EB guidelines for	

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monitoring practise?	small-scale project ^{/10/} . As mentioned above, the calibration frequency by external agency still meets the requirements recommended by the manufacturer and further the meter was calibrated internally in 2008 and 2009. Therefore, verification team is of the opinion that the calibration frequency represents good practice.
Company performing the calibration:	The latest calibration of the meter was carried by Endress & Hauser (Thailand) Ltd., Nonthaburi, Thailand ^{/19/} .
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration reports were verified by the verification team and they confirms the proper functioning of the meters.
Is(are) calibration(s) valid for the whole reporting period?	Yes. The calibration is valid for the whole verification period.
If applicable, has the reported data been cross-checked with other available data?	Yes, the reported data was crosschecked with operator log sheet information ^{/25/} and the data was found to be correct.
How were the values in the monitoring report verified?	Please refer to section 5.4
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?	Please refer to the description at the end of the section

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	T _{flare} Temperature of the exhaust gases of the flare in stack (° C)
Measuring frequency:	The temperature is measured using N type thermo couple on a continuous basis. The SCADA system is in place to record the temperature data automatically.

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	However, parameter was not recorded during the current monitoring period. Therefore, the PPs have assumed the flare efficiency as zero.
Reporting frequency:	Not applicable for the current monitoring period.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. As per the approved revised monitoring plan, the parameter is monitored using N type thermo couple on a continuous basis and recorded automatically on SCADA system. The monitoring plan further states that in case if automatic data logging is not available or if the recorded temperature is less than 500 ° C, the flare efficiency is assumed to be zero during that period. Therefore, the monitoring approach is inline with the approved revised monitoring plan.
Type of monitoring equipment:	N type thermocouple
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The accuracy of thermocouple is neither specified in the monitoring plan nor in the applied methodology. However, methodological "Tool to determine project emissions from flaring gases containing methane"^{9/} recommends the use of N type thermocouple to measure the temperature of exhaust gas in the flare. Therefore, the type of thermocouple is inline with the requirement.
Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	NA
Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is(are) calibration(s) valid for the whole reporting period?	NA

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If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	Please refer to section 5.4
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?	Please refer to the description at the end of the section

	Assessment/ Observation	
Data / Parameter: (as in monitoring plan of PDD):	Time of biogas sent to flare (Amount of minutes per hour where biogas is sent to the flare)	
Measuring frequency:	The parameter is calculated based on the gas flow meter (GM 3) readings recorded on SCADA system. The number of minutes where the value of gas flow indicated against the flow meter of flare is counted. However, the parameter was not monitored during the current monitoring period and the flare efficiency was assumed to be zero.	
Reporting frequency:	Not applicable for the current monitoring period.	
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	NA	
Type of monitoring equipment:	Type of meter	Gas flow meter
	Tag No.	GM 3
	Serial No.	9A070502000
	Accuracy	$\pm 1\%$ /18/
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does	The accuracy is not specified in the revised PDD. However, the accuracy of the flow meter does not have any significant impact on the calculation of	

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the monitoring equipment represent good monitoring practise?	time.
Calibration frequency /interval:	The flow meter is calibrated at least once three years
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	As described above in the section, the calibration interval of the flow meter is inline with the revised PDD.
Company performing the calibration:	The latest calibration of the flow meter was carried by Endress & Hauser (Thailand) Ltd., Nonthaburi, Thailand ^{/19/} .
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration reports were verified by the verification team and they confirm the proper functioning of the meters.
Is(are) calibration(s) valid for the whole reporting period?	Yes. The calibration is valid for the whole verification period.
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	NA
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Please refer to the description at the end of the section

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	EC _y Electricity consumed by the wastewater treatment facility over the year (MWh)
Measuring frequency:	Continuously The measurement of the parameter is carried out continuously using electricity meter maintained by

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	PEA (Provincial Electricity Authority).	
Reporting frequency:	Monthly The electricity meter is owned by the PEA. The parameter is monitored by PEA and monthly reports (or invoices) are sent to the PP.	
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, the measuring and reporting frequencies are as stated in the revised monitoring plan.	
Type of monitoring equipment:	Type of meter	Electricity meter
	Serial No.	205055772 (PEA No. 20963014)
	Accuracy	$\pm 0.2\%$ ^{/18/}
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The approved revised PDD does not specify the accuracy of monitoring equipment. However, accuracy of $\pm 0.2\%$ represents good monitoring practice. Furthermore, the meter is owned by the PEA.	
Calibration frequency /interval:	The meter is not under the jurisdiction of PP. The meter is calibrated annually according to the internal regulations of PEA.	
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	The meter was not calibrated since the installation. Therefore, a CAR was raised to submit the latest calibration report and recalculate the emission reductions conservatively by applying calibration guidelines^{/11/}. The latest calibration report from PEA was provided to the verification team. The meter was calibrated on 2011-06-27 ^{/19/}. As per the calibration report, the error of the instrument was 0.496%. The PPs have applied an error of 0.5% on a conservative basis as per EB 52, Annex 60 to the measured values of electricity consumption for the whole monitoring period. Please refer to CAR 7 in Annex A of the report.	

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Company performing the calibration:	As discussed above, the meter was not calibrated during the monitoring period. The latest calibration was carried out by PEA.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	The latest calibration report (2011-06-27) confirms proper functioning of the meter.
Is(are) calibration(s) valid for the whole reporting period?	As mentioned above, the meter was not calibrated till the end of the reporting period.
If applicable, has the reported data been cross-checked with other available data?	The PPs have used internal power meter readings in the draft ER calculation sheet ^{/5/} . A CAR was raised to update the ER sheet based on PEA meter readings. Please refer CAR 8. The revised data was crosschecked with the PEA reports ^{/21/} and the data was found to be correct.
How were the values in the monitoring report verified?	Please refer to section 5.4
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?	Please refer to the description at the end of the section

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	EG _y Electricity exported to the grid during the year y by power generation facility (MWh)
Measuring frequency:	Continuously The measurement of the parameter is carried out continuously using electricity meter maintained by PEA.
Reporting frequency:	Monthly The electricity meter is owned by the PEA. The parameter is monitored by PEA and monthly reports are sent to the PP.

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Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, the measuring and reporting frequencies are as stated in the revised monitoring plan.	
Type of monitoring equipment:	Type of meter	Electricity meter
	Serial No.	205055798 (PEA No. 20963040)
	Accuracy	$\pm 0.2\%$ ^{/18/}
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The approved revised PDD does not specify the accuracy of monitoring equipment. However, accuracy of $\pm 0.2\%$ represents good monitoring practice. Furthermore, the meter is owned by the PEA.	
Calibration frequency /interval:	The meter is not under the jurisdiction of PP. The meter is calibrated annually according to the internal regulations of PEA. The meter was calibrated on 2009-02-27 which was before the start of the monitoring period. The meter was not calibrated during the monitoring period.	
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	As stated in the revised monitoring plan, the PP would approach the PEA for annual calibration of the meter. The monitoring plan further states that the meter is not under the jurisdiction of PP. However, in response to CAR 7, the latest calibration of the meter was carried on 2011-06-27 ^{/19/}. The calibration report from PEA was provided to the verification team. As per the calibration report, the error of the instrument identified during the calibration test was 0.27%. The PPs have applied the error of 0.27% (which is more than the maximum permissible error of the meter) on a conservative basis as per EB 52, Annex 60 to the measured values of electricity export for the whole monitoring period. Therefore, verification team is of the opinion that the approach results in conservative emission reduction and is appropriate.	

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Company performing the calibration:	The electricity meter used to monitor electricity export was calibrated by Provincial Electricity Authority, Thailand ^{/19/} .
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes, the calibration confirms the proper functioning of the meter.
Is(are) calibration(s) valid for the whole reporting period?	As discussed above, there was a delay for the latest calibration and therefore, EB guidelines on calibration (EB 52, Annex 60) were applied for calculating emission reductions.
If applicable, has the reported data been cross-checked with other available data?	The reported data was crosschecked with the PEA reports ^{/21/} and the data was found to be correct.
How were the values in the monitoring report verified?	Please refer to section 5.4
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?	Please refer to the description at the end of the section

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	FE or $\eta_{\text{flare-h}}$ Flare efficiency (%)
Measuring frequency:	The parameter is calculated based on the temperature of the exhaust gases of the flare and number of minutes biogas sent to the flare. An enclosed flare was installed for the project system. The flare efficiency is calculated according to the 'Tool to determine project emissions from flaring gases containing methane', EB28, Annex 13^{/9/} As the temperature of the exhaust gases of flare was not recorded, the flare efficiency is assumed to be zero for the current monitoring period.

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Reporting frequency:	Not applicable for the current monitoring period.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	NA
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	NA
Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	NA
Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is(are) calibration(s) valid for the whole reporting period?	NA
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	Please refer to section 5.4
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?	Please refer to the description at the end of the section

Thus GLC confirms that

- the monitoring complies with the monitoring plan of the approved revised PDD.

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- all parameters that are baseline, project and leakage emission parameters are monitored as described in the revised monitoring plan.
- the frequency of monitoring, the accuracy of the measurement equipments and the calibration frequency are in line with the revised monitoring plan.

Monitoring management and Quality assurance:

All the roles and responsibilities for monitoring and reporting have been clearly defined. The organisation chart, QA/QC procedures and Roles & Responsibilities provided in the MR were checked during the verification site visit and found to be correct.

It was learnt that regular training programmes on safety, operation and maintenance of the wastewater treatment plant are conducted on-site ^{/23/}. The verification team interviewed the plant's operating team (i.e. staff of wastewater treatment plant) during the on-site assessment. The plant's team was found to be competent enough for effective monitoring of the data.

The monitoring procedures^{/27/} were verified during the site visit. It was understood from the monitoring procedures and the interview with the operating team that the data is collected by the trained operators and recorded in the operator log sheets under the supervision of respective heads of department. The recorded data is checked by the Plant Manager on a daily basis. The verified log sheets are filed and stored. The verified data is also transferred into electronic format (excel sheets). The electronic files are printed on a monthly basis by the Plant Manager and reported to the Project Manager. The Project Manager verifies the values and approves the monthly sheets. The approved monthly sheets are stored in separate files. The data is stored in both hard and soft formats. Both the files i.e. the printed excel sheets and the operator log sheets were made available to the verification team for crosschecking of the data reported in the MR and ER sheet.

As the totaliser value is recorded in the log sheets in case of wastewater flow, total biogas generation, biogas consumption, electricity generation and electricity consumption any doubtful reading could easily be crosschecked. It reduces scope of errors and facilitates improved accuracy level of data. Furthermore, all the measuring equipments possess good level of accuracy.

Hence, the verification team is of the opinion that the monitoring management system and QA/QC procedures reflect good practice.

5.4 Assessment of data and calculation of GHG Emission Reductions

The document review and the site visit revealed that a complete set of data for the specified monitoring period is available. The correctness of information provided in the monitoring report has been verified by crosschecks with other sources such as log books, calibration reports, test reports, equipment specifications etc. Default values (validated ex-ante parameters) are used as mentioned in the registered PDD. All the parameters required to calculate the baseline and project emissions are monitored as described in section 5.3 above.

The verification team has observed few errors in the calculation of GHG emission reductions and therefore requested for corrective actions (please refer CAR 3 and CAR 4 in Annex A) from the project participants.

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The CARs have been successfully closed upon addressing. GLC's verification team has raised CARs and CLs wherever corrective actions and clarifications, respectively, required in the reported data that was submitted in the form of monitoring report and emission reduction calculation sheet. Enclosed Annex A may please be referred for CARs and CLs in detail.

The formulae described in the applied methodology and the PDD are used to calculate the baseline and project emissions. The emission reductions are calculated as the difference of baseline emissions and project emissions as there are no leakage emissions associated with the project activity.

By checking publicly available sources it was verified that the applied emission factors, IPCC default values^{29/} and other reference values were applied correctly.

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6. VERIFICATION STATEMENT

Germanischer Lloyd Certification GmbH (GLC) has performed the first verification of the project: **"Bangna Starch Wastewater Treatment and Biogas Utilization Project"**, with regard to the relevant requirements for CDM project activity. The project reduces GHG emissions due to capturing of methane from wastewater treatment through UASB technology and utilising it as a fuel in onsite electricity generators.

This verification covers the period from 2009-11-10 to 2010-12-31 (including both days).

P & Papop Renewable Co. Ltd. is responsible for the collection of data in accordance with the approved revised 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 PDD.

GLC conducted the verification on the basis of the monitoring methodologies (AMS III.H., version 09 and AMS I.D., version 13), the registered PDD, the approved revised PDD of the project and the monitoring report of "version 02.1, dated 2012-02-03". The verification included:

- i) Checking whether the design of the project is implemented and installed as planned and described in the registered PDD
- ii) Checking whether the provisions of the monitoring methodology and the monitoring plan in the PDD were consistently and appropriately applied
- iii) The collection of evidence supporting the reported data
- iv) Checking whether the installed monitoring equipment are 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.

The GHG emission reductions were correctly calculated on the basis of the approved monitoring methodologies of "AMS III.H.", version 09 and "AMS I.D.", version 13 and the revised monitoring plan of the project activity.

In GLC's opinion, the GHG emission reductions for the "Bangna Starch Wastewater Treatment and Biogas Utilization Project" project as reported in the Monitoring Report issued on 2012-02-03 are calculated in a conservative and appropriate manner.

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

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Emission reductions in 2009:	1,325	t CO ₂ e
Emission reductions in 2010:	25,582	t CO ₂ e
Total emission reductions during 1 st monitoring period	26,907	t CO ₂ e

<Shanghai>, 2012-02-13

Yanwei Chen

Verification Team Leader

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7. REFERENCES

Reference	Author: Title, version, date of issue
/1/	CDM EB: Clean Development Mechanism Validation and Verification Manual, Version 01.2
/2/	Registered Project Design Document for CDM project: "Bangna Starch Wastewater Treatment and Biogas Utilization Project" version 3.1, dated 2009-09-25
/3/	Revised Project Design Document of "Bangna Starch Wastewater Treatment and Biogas Utilization Project" (version 4, dated 2011-08-11) approved on 2011-09-23
/4/	Draft Monitoring Report (webhosted) of "Bangna Starch Wastewater Treatment and Biogas Utilization Project", Version 1 dated 2011-02-28 Final MR of "Bangna Starch Wastewater Treatment and Biogas Utilization Project", Version 2.1 dated 2012-02-03
/5/	Draft Emission reduction calculation spreadsheet, "Bangna_GS CERs_sr_110228" Final Emission reduction calculation spreadsheet, "Bangna_GS CERs_111111_sr.xls"
/6/	UNFCCC: Kyoto Protocol to the United Nations Framework Convention on Climate Change (1998)
/7/	UNFCCC: Decision 3/CMP. 1 (Marrakesh – Accords)
/8/	CDM-EB: Approved CDM small-scale baseline and monitoring methodology AMS III.H, Version 09: "Methane Recovery in Wastewater Treatment" CDM-EB: Approved CDM small-scale baseline and monitoring methodology AMS I.D, Version 13: "Grid connected renewable electricity generation"
/9/	CDM-EB: Methodological "Tool to determine project emissions from flaring gases containing methane" (EB 28, Annex 13)

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Reference	Author: Title, version, date of issue
/10/	CDM-EB: General Guidelines to CDM SSC methodologies, version 17 (EB 61, Annex 21)
/11/	CDM-EB: Guidelines for Assessing Compliance with the Calibration Frequency Requirements, version 01 (EB 52, Annex 60)
/12/	Technical specifications of UASB and Gas engines GUASCOR S.A.: Engine and Alternator characteristics, February 2006 PAPOP: Portfolio of CDM project
/13/	TUV NORD CERT GmbH: Validation report of "Bangna Starch Wastewater Treatment and Biogas Utilization Project" (report no. 8000353483– 07/168), dated 2009-11-10
/14/	P & Papop Renewable Co., Ltd. (PAPOP): Commissioning Certificate of UASB, October 2007
/15/	GUASCOR S.A.: Commissioning Test Report of Gas engine, dated 2007-12-21
/16/	BKE: Specifications of Biogas flaring system, dated 2007-10-09 BKE: Operation & Maintenance manual for biogas flare
/17/	Geotechnical Instruments: Biogas Operating Manual
/18/	<u>Specifications of monitoring equipment</u> Endress+Hauser Ltd: Technical Information of Electromagnetic Flow Measuring System – Flow measurement of liquids in wastewater applications HACH: Key Specifications of Spectrometers and Colorimeters Endress+Hauser Ltd: Technical Information of "Proline t-mass 65F, 65I" – Mass flow measurement of Gases

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Reference	Author: Title, version, date of issue
	Geotech: Product Specifications of Portable Gas Analyser Tyco Electronics: Integra 1630 - Installation guide and Specifications (Power meter)
/19/	<u>Calibration Reports</u> 1. Wastewater flow meter (FM1), Serial No. 93120819000 Endress & Hauser (Thailand) Ltd: Flowmeter Verification Certificate with certificate no. EH10/204-1/7, dated 2010-09-23 (Verification date: 2010-09-21) Endress & Hauser (Thailand) Ltd: Flowmeter Verification Certificate with certificate no. BN9-095-1/3, dated 2009-12-30 (Verification date: 2009-11-30) Endress & Hauser (Thailand) Ltd: Flowmeter Verification Certificate with certificate no. BN-064-01/02, dated 2008-07-24 (Verification date: 2008-07-24) 2. Colorimeter for COD measurement, Serial No. 070290C62433 Monthly calibration reports of Colorimeter carried out internally by PAPOP EnviScience Company Limited: Test Report of Preventive Maintenance, Date of test: 2011-05-31 3. Gas flow meter – Biogas generation (GM1), Serial No. 9502C002000 Endress & Hauser (Thailand) Ltd: Certificate of Calibration with certificate no. EH10/204-4/7, date of calibration: 2010-09-21 PAPOP: Certificate of Calibration with certificate no. GM1 01/2009, calibration date: 2009-11-16 PAPOP: Certificate of Calibration with certificate no. GM1 01/2008, calibration date: 2008-08-05 4. Gas flow meter – Biogas sent for Electricity generators (GM2), Serial No. 9502C102000 Endress & Hauser (Thailand) Ltd: Certificate of Calibration with certificate no. EH10/204-4/7, date of calibration: 2010-09-21 PAPOP: Certificate of Calibration with certificate no. GM2 01/2009, calibration date: 2009-

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Reference	Author: Title, version, date of issue
	11-18 PAPOP: Certificate of Calibration with certificate no. GM2 01/2008, calibration date: 2008-08-03 5. Gas flow meter – Biogas to flare (GM3), Serial No. 9A070502000 Endress & Hauser (Thailand) Ltd: Certificate of Calibration with certificate no. EH10/204-5/7, date of calibration: 2010-09-21 PAPOP: Certificate of Calibration with certificate no. GM3 01/2009, calibration date: 2009-11-20 PAPOP: Certificate of Calibration with certificate no. GM3 01/2008, calibration date: 2008-08-02 6. Portable gas analyser, Serial No. BM 11452 Calibration reports of internal calibration carried out by PAPOP Entech Associate Co., Ltd.: Calibration Certificate with Certificate No. G/O 540225, dated 2011-06-27; date of calibration: 2011-06-15 7. Export power meter to monitor EG_y with Serial No. 205055798 and PEA No. 20963040 PEA: Test report , Calibration date: 2009-02-27 PEA: Tested Report Energy Meter, Calibrated date: 2011-06-27 8. Import power meter to monitor EC_y with Serial No. 205055772 and PEA No. 20963014 PEA: Tested Report Energy Meter, Calibrated date: 2011-06-27
/20/	<u>Manufacturer recommendations for Calibration of monitoring equipment</u> 1. Endress + Hauser: Recommendations for Calibration and Maintenance intervals, dated 2004-03-25 2. Envi Science Co., Ltd.: Maintenance for Colorimeter DR890, dated 2011-05-11
/21/	PEA: Monthly energy reports of export and import for the verification period

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Reference	Author: Title, version, date of issue
/22/	COD Analysis Reports of wastewater from last lagoon (or final discharge) by Environmental Engineering Laboratory Faculty of Engineering, KKU for the months from December 2009 to November 2010
/23/	PAPOP: Training records on operation, maintenance and safety
/24/	PAPOP: Procedure document for COD analysis at on-site laboratory
/25/	PAPOP: Daily log sheet records of • COD analysis of wastewater at inlet and outlet of UASB • Wastewater flow • Biogas generation • Biogas consumption in electricity generators • Biogas consumption for flare • Methane concentration in biogas
/26/	Bangna Tapioca Co., Ltd: Starch production details, 2010-03-09
/27/	Other documents verified during site visit • Purchase Order for 'Construction of the project activity' • List of employees • Monitoring procedure
/28/	Germanischer Lloyd Certification GmbH CDM procedures
/29/	IPCC: 1996 IPCC Guidelines for National Greenhouse Gas Inventories: work book IPCC: 2006 IPCC Guidelines for National Greenhouse Gas Inventories: work book

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

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

Description of Finding (CAR, CL; FAR) <i>Describe the finding in a transparent manner i.e. state clearly what required and why; address the context (e.g. section)</i>	Date (yyyy-mm-dd)	Project Participants Response <i>This section shall be filled by the PP. It shall address the finding with suitable argument and evidence.</i>	Date (yyyy-mm-dd)	GLC Assessment <i>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.</i>	Date (yyyy-mm-dd)
CAR 1 Implementation of the project activity was verified with respect to the registered project design document (PDD). Implementation of the project activity complies with the description of project activity provided in section A.2 of the PDD. However, there are few differences from the project boundary diagram provided in section B.3 of the PDD. 1. There is no mentioning of the gas storage system in the PDD. However, there is a gas storage tank of 3000 m ³	2011-04-08	The corresponding sections in the PDD shall be revised and the notification be sent to UNFCCC in line with EB 48, Annex – 66. The difference between PDD and the project boundary can be summarized as below: 1. The biogas storage system was built to create a buffer and ensure smooth supply of biogas to gas engines. This has no impact on the IRR / additionality of the project as the additionality assessment was based on assumption that all biogas generated would be used in gas engines at design efficiency	2011-05-23	OK. The PDD has been revised by the PPs to reflect the actual scenario at the site. A notification of changes in the PDD has been submitted to the UNFCCC along with the revised PDD. The revised PDD was approved by the EB on 2011-09-23. Therefore, the CAR is closed.	2011-10-03

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Description of Finding (CAR, CL; FAR) <i>Describe the finding in a transparent manner i.e. state clearly what required and why; address the context (e.g. section)</i>	Date (yyyy-mm-dd)	Project Participants Response <i>This section shall be filled by the PP. It shall address the finding with suitable argument and evidence.</i>	Date (yyyy-mm-dd)	GLC Assessment <i>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.</i>	Date (yyyy-mm-dd)
capacity at site and two additional storage tanks are also provided. 2. A bypass wastewater line is mentioned with a flow meter in the PDD. There is no bypass line at site. 3. Actual representation of measuring equipment is not inline with the diagram in PDD. Project Participants (PPs) shall address the changes in the project activity.		irrespective of availability of storage. The storage cost was considered in the IRR estimations, however not represented in the layout of the project site. 2. In case there is a problem in biogas digesters the waste would be bypassed directly to lagoons. The piping system for the bypass is not a permanent structure but shall be put in place in case of required emergency situation. However this event is highly unlikely. This can be referred to the revised PDD as per accepted notification for changes in the registered PDD.			

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Description of Finding (CAR, CL; FAR) <i>Describe the finding in a transparent manner i.e. state clearly what required and why; address the context (e.g. section)</i>	Date (yyyy-mm-dd)	Project Participants Response <i>This section shall be filled by the PP. It shall address the finding with suitable argument and evidence.</i>	Date (yyyy-mm-dd)	GLC Assessment <i>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.</i>	Date (yyyy-mm-dd)
		3. The representation of measuring system in PDD is not in line with the actual situation at project site and is thereby is included in the revised PDD to be sent for notification. This change has no affect on the monitoring principle as per the registered monitoring plan. The notification in line with the EB 48 Annex 66 shall be submitted to UNFCCC EB.			
CAR 2 Implementation of the registered monitoring plan (MP) was verified during the course of the verification. As per the registered MP, majority of the parameters are continuously monitored, recorded	2011-04-08	A revision of the monitoring plan is already in process in line with EB 49, Annex-28.	2011-05-23	OK. The PPs have revised the monitoring plan and the revised monitoring plan has been submitted to the UNFCCC along with the notification of changes in the PDD. The EB approved the revised monitoring plan on 2011-	2011-10-03

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Description of Finding (CAR, CL; FAR) <i>Describe the finding in a transparent manner i.e. state clearly what required and why; address the context (e.g. section)</i>	Date (yyyy-mm-dd)	Project Participants Response <i>This section shall be filled by the PP. It shall address the finding with suitable argument and evidence.</i>	Date (yyyy-mm-dd)	GLC Assessment <i>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.</i>	Date (yyyy-mm-dd)
and stored electronically. However, the actual monitoring procedure differs from the registered monitoring plan. All the parameters are monitored using appropriate measuring instruments and recorded manually on a daily basis. The adopted procedure is inline with the requirements of monitoring methodology but differs from monitoring plan. Project Participants (PPs) are required to address the changes in the implementation of the monitoring plan.				09-23. Therefore, the CAR is closed.	
CAR 3 Methane content (%CH ₄) in biogas was monitored using portable gas analyser during the verification period. As per the	2011-04-08	The emission reductions sheet is re-calculated conservatively by using the 95% confidence level applied for the measured values of %CH ₄ for the monitoring period.	2011-05-23	OK. The ER sheet has been revised applying 95% confidence level. The emission reductions have been calculated conservatively. Therefore, the	2011-10-03

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Description of Finding (CAR, CL; FAR) <i>Describe the finding in a transparent manner i.e. state clearly what required and why; address the context (e.g. section)</i>	Date (yyyy-mm-dd)	Project Participants Response <i>This section shall be filled by the PP. It shall address the finding with suitable argument and evidence.</i>	Date (yyyy-mm-dd)	GLC Assessment <i>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.</i>	Date (yyyy-mm-dd)
applied methodology (AMS III.H./ Version 9, Para-36), "the fraction of methane in the gas should be measured with a continuous analyser or, alternatively, with periodical measurements at 95% confidence level." Therefore, PPs to justify how methodological requirements are met.				CAR is closed.	
CAR 4 PPs have calculated the emission reductions by applying the average values of COD during the vintage. As there is significant variation in COD of wastewater and the flow rate is also not constant, it is not appropriate to use the simple average of COD for whole quantity of wastewater treated. Though it is not explicitly	2011-04-08	The estimation of incoming and outgoing COD load is considered on daily basis in the revised excel sheet.	2011-05-23	OK. The COD load has been calculated on a daily basis, which is more appropriate, in the revised ER sheet. Therefore, the CAR is closed.	2011-10-03

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Description of Finding (CAR, CL; FAR) <i>Describe the finding in a transparent manner i.e. state clearly what required and why; address the context (e.g. section)</i>	Date (yyyy-mm-dd)	Project Participants Response <i>This section shall be filled by the PP. It shall address the finding with suitable argument and evidence.</i>	Date (yyyy-mm-dd)	GLC Assessment <i>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.</i>	Date (yyyy-mm-dd)
mentioned in the methodology, in order to guarantee a high level of accuracy, the weighted average of COD values or calculation of the kg COD reduction on a daily basis shall be applied.					
CAR 5 The data provided in emission reduction spread sheet (ER sheet) was verified with the log sheet values during the verification site visit. It was observed that some of the %CH ₄ and COD values are different from the log sheets. Therefore, it is required to correct the data values in the ER sheet.	2011-04-08	The %CH ₄ and COD values in the ER sheet are corrected.	2011-05-23	OK. The %CH ₄ and the COD values have been corrected in the revised ER sheet. The revised emission reductions have been updated in the MR. Hence, the CAR is closed.	2011-10-03
CAR 6 The verification team has reviewed all the submitted documents.	2011-04-08	The MR is revised as follows: 1. The section A.1 and A.4 in the	2011-05-23	OK. The MR has been revised with the required information. Therefore, the CAR is closed.	2011-10-03

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Description of Finding (CAR, CL; FAR) <i>Describe the finding in a transparent manner i.e. state clearly what required and why; address the context (e.g. section)</i>	Date (yyyy-mm-dd)	Project Participants Response <i>This section shall be filled by the PP. It shall address the finding with suitable argument and evidence.</i>	Date (yyyy-mm-dd)	GLC Assessment <i>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.</i>	Date (yyyy-mm-dd)
Based on the document review and the site visit, few mistakes have been identified in the monitoring report (MR). 1. In section A.1 and A.4 of the MR, sentences such as 'the proposed project will be implemented ' are used. These kinds of sentences may lead to confusion for the stakeholders who can read the report. 2. There is only one PEA (Provincial Electricity Authority) meter in the 'flow diagram of the project activity' in section C of the MR. However, there are two power meters at site; one for		MR are revised. 2. The description for all the monitoring instruments is detailed out for clarity in the updated MR and also the second power meter is included. 3. The date of previous calibration of wastewater flow meter in section D.2 of the MR is corrected.			

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Description of Finding (CAR, CL; FAR) <i>Describe the finding in a transparent manner i.e. state clearly what required and why; address the context (e.g. section)</i>	Date (yyyy-mm-dd)	Project Participants Response <i>This section shall be filled by the PP. It shall address the finding with suitable argument and evidence.</i>	Date (yyyy-mm-dd)	GLC Assessment <i>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.</i>	Date (yyyy-mm-dd)
import and the other for export. It is also required to provide the description of FM, GM, PM, TT, etc. below the diagram for the sake of accuracy, clarity and understanding. 3. Date of previous calibration of wastewater flow meter was mentioned as 2007-03-28 in section D.2 of the MR, which is actually 2008-07-24.					
CAR 7 The power meter used to monitor the energy consumption of project activity was not calibrated since the installation. Similarly, the	2011-04-08	The calibration of the power meters is being conducted. The emission reductions shall be calculated conservatively based on calibration report.	2011-05-23	PPs are requested to submit the calibration reports and revise the emission reduction calculation.	2011-10-03

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Description of Finding (CAR, CL; FAR) <i>Describe the finding in a transparent manner i.e. state clearly what required and why; address the context (e.g. section)</i>	Date (yyyy-mm-dd)	Project Participants Response <i>This section shall be filled by the PP. It shall address the finding with suitable argument and evidence.</i>	Date (yyyy-mm-dd)	GLC Assessment <i>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.</i>	Date (yyyy-mm-dd)
export power meter was calibrated on 2009-02-27 and there was no latest calibration. Therefore, PPs to provide the calibration reports of the electricity meters and apply the calibration guidelines as per EB 52, Annex 60.					
CAR 7 continues...		The calibration reports of the power meters are provided along. The maximum error according to the calibration reports is applied to the emission reductions calculation.	2011-10-20	OK. The latest calibration reports have been provided to the verification team. The emission reductions have been calculated by applying the maximum error as per the latest calibration reports. Calibration of both the power meters was carried out on 2011-06-27 by PEA. As per the calibration reports, the observed error during the calibration test for	2011-11-14

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				import power meter was 0.5% and for export power was 0.27%. The maximum permissible error according to the specifications of the meter is 0.2%. Therefore, the PPs have applied the maximum error as per the latest calibration report for the whole monitoring period in the revised calculation. The calibration guidelines of EB (EB 52, Annex 60) have been applied in order to result in conservative emission reductions. Therefore, the CAR is closed.	
CAR 8 As per the revised monitoring plan, power consumed by the wastewater treatment facility (ECy) is monitored by PEA meter.	2011-10-03	The reported values in the ER sheet are revised by applying the values monitored by PEA meter.	2011-10-20	OK. The revised values of power consumption in the ER sheet are inline with the monthly reports of PEA. Therefore, the CAR is closed.	2011-11-14

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However, the reported values in the ER sheet are of internal power meter. PPs are required to justify.					
CAR 9 Electricity generated (EG _y) is measured by PEA meter. The values reported in the ER sheet are inline with the monthly reports of PEA. However, as the monitoring period starts from 2009-11-10, the total value of energy generation as indicated in the monthly report of PEA for November 2009 cannot be applied. The same is applicable for EC _y also.	2011-10-03	The EG _y and EC _y for the month of November is not available for a period of 21 days from PEA meters, however same has been estimated conservatively as follows. Values available: Daily values: Power export (at internal meter), Power import (at internal meter). Monthly values: EG _y (PEA meter) EC _y (PEA meter) As observed Power export (at internal meter) >	2011-10-20	OK. It was observed during the verification site visit that energy generation and consumption values are recorded on a daily bases from the internal power meters. Under normal operating conditions, a part of the power generated is consumed for project activity and the rest is exported to the grid. In case of any stoppage of gas engines, electricity is drawn from the grid. The internal generation meter records the total generation whereas the PEA generation meter records the exported power. Similarly, the internal consumption meter	2011-11-14

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		EG_y Power import (at internal meter) > EC_y (estimated for same time period); thereby it can be safely assumed that power export (internal meter) ^{1Nov} 2009 to 9 Nov 2009 > respective export at PEA meter (which is same as EG_y (1 Nov 2009 to 9 Nov 2009)) and power import (internal meter) ^{1Nov} 2009 to 9 Nov 2009 > respective import at PEA meter (which is same as EC_y (1 Nov 2009 to 9 Nov 2009)) Mathematically at PEA meter EG_y – EC_y (10 Nov 2009 to 30 Nov 2009) = [EG_y – EC_y](1 Nov 2009 to 30 Nov 2009) – [EG_y – EC_y] (1 Nov 2009 to 9 Nov 2009)		records the total consumption where as the PEA consumption meter records only the electricity drawn from grid. Therefore, the values recorded by the internal meters are higher than the values recorded by the PEA meters. For a conservative estimation, PPs have deducted the power recorded by the internal meters for the first 9 days in the month of November 2009 from the monthly readings of PEA meters. This is a conservative approach and therefore the CAR is closed.	

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		Can conservatively be calculated from; $EG_y \text{ (10 Nov 2009 to 30 Nov 2009)} = EG_y \text{ (1 Nov 2009 to 30 Nov 2009)} - \text{Power export (at internal meter)}_{1 \text{ Nov 2009 to 9 Nov 2009}}$ $EC_y \text{ (10 Nov 2009 to 30 Nov 2009)} = EC_y \text{ (1 Nov 2009 to 30 Nov 2009)} - \text{Power import (at internal meter)}_{1 \text{ Nov 2009 to 9 Nov 2009}}$ The internal meter values were already a part of previous version of monitoring report and available at time of verification site visit.			
CAR 10 As the EB has approved the revised monitoring plan on 2011-09-23, PPs are requested to update the section D.2 of the MR inline with the approved revised	2011-10-03	The section D.2 of the MR is revised in line with the approved revised monitoring plan.	2011-10-20	OK. The section D.2 of the MR has been updated inline with the approved revised monitoring plan. Therefore, the CAR is closed.	2011-11-14

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monitoring plan					
CL 1 The organisation chart provided in section C of the MR is different from the organisation chart presented to the verification team during the verification site visit. Moreover, the role of 'house keeper' appears to be not relevant to the project activity. PPs to clarify the same	2011-04-08	The organization chart in the MR is revised not including the role of housekeeper. The changes in organizational structure as explained at the project site during verification visit were implemented in January 2011. This is after the monitoring period for this monitoring report. Therefore, the change in the organization structure doesn't affect the monitoring principle or the additionality assessment of the project activity.	2011-05-23	OK. The organisation chart in the MR has been revised. Furthermore, it is learnt that there is a small change in the organisation structure since January 2011. The revised organisation structure has been included in the revised PDD submitted for notification of changes. However, the change in organisation structure does not have any impact on the monitoring of the project activity. Therefore, the CL is closed.	2011-10-03
CL 2 It was observed that gas flow meters were calibrated by an external laboratory in 2010. They	2011-04-08	The recommendations for the calibration are provided as follows - The gas flow meters should be recalibrated every 3 – 5 years as	2011-05-23	The PPs have submitted the manufacturer's recommendation for calibration requirements of gas flow meters, colorimeter and CH4	2011-10-03

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were calibrated internally in 2008 and 2009. Similarly, methane (CH₄) gas analyser and colorimeter were calibrated internally only; no external calibration was carried out. PPs are required to submit the manufacturer's recommendation of calibration and justify that the internal calibration procedure is inline with the acceptable international calibration standards.		per the recommendation from the manufacturer. - The portable gas analyzer should be serviced and recalibrated every 6 months to ensure correct and accurate operation as per the Biogas Operating Manual Section 6 Service, page 19. - The colorimeter should be checked and tested at least once a year as per the recommendation from the supplier. As the manufacturer's recommendation for the calibration of gas flow meter, the project has conducted the calibration by the manufacturer in 2007 and 2010, which is in line with the recommendation. The calibration is		analyser. PPs are requested to submit the latest calibration reports of CH₄ analyser and Colorimeter provided by an external laboratory. The error shall be applied conservatively inline with the guidelines provided in EB 52, Annex 60.	

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		done in house using a master gas meter, for which the relevant certificate and calibration is submitted along.			
CL 2 continues...		The latest calibration reports of the following equipment are submitted to DOE. - Colorimeter - Portable gas analyzer The maximum permissible errors of the equipment are applied conservatively in the ER sheet in line with the guidelines of EB 52, Annex 60.	2011-10-20	OK. The latest calibration reports have been provided to the verification team. The calibration of colorimeter was carried out by EnviScience Company Limited, Bangkok on 2011-05-31. From the calibration test results, it was observed that the error of the instrument before calibration was varying from 0.6% to 5.1% with different standard absorbance at different wave lengths. The PPs have applied the maximum error of 5.1% on a conservative basis for the whole	2011-11-14

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				monitoring period. The calibration of CH₄ analyser was carried out by Entech Associate Co., Ltd., Bangkok on 2011-06-15 ^{/19/}. The maximum error observed from the calibration test report was 2.16%. Therefore, PPs have applied the maximum permissible error of 3% for the whole monitoring period. The error has been applied conservatively to the measured values in accordance with the guidelines provided in EB 52, Annex 60 and the emission reductions have been recalculated. Therefore, the CL is closed.	

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CL 3 The total biogas generation in 2009 was 216,152 Nm ³ and the total consumption was 227,439 Nm ³ . The reason understood from the discussion with the plant's team is that oxygen is injected into the bio scrubber. As the generation meter (GM1) is located before the scrubber, the meter is likely to record lower value than the consumption. However, in the year 2010, the total gas generation was 3,086,045 Nm ³ and the total consumption was 3,069,427 Nm ³ . It indicates that the generation is about 0.5% higher than the consumption without considering oxygen injection quantity. PPs are required to justify the different	2011-04-08	The higher volume of biogas consumed as compared to the biogas generated is accounted to the possible oxygen induction at scrubber unit. Whereas the comparison of volume over the year 2010 shows that volume combusted is lower than the volume generated. As per the AMS III.H ver 9, the PE _{y,fugitive,ww} is considered to take into account the Capture and utilization/combustion/flare efficiency of the methane recovery and combustion/utilization equipment in the wastewater treatment. This factor is approximately 10% of the total methane potential of the project. Project proponent believes that this project emission already accounted	2011-10-20	OK. The total generation during the monitoring period is 0.16% more than the total consumption. It is understood that in order to take such minor volumetric differences into account, the project emissions due to fugitive emissions are calculated by assuming the capture and utilization/combustion/ flare efficiency of the methane recovery and combustion system as 90%. Furthermore, the emission reductions calculated through COD approach is 13% less compared to Biogas approach. The emission reductions calculated through COD approach are considered to be the achieved emission reductions during the monitoring	2011-11-14

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scenario in 2010 and clarify where the difference amount is accounted.		for in the calculation approach shall account for minor volumetric balances in the biogas.		period. Therefore, such differences in volumes of biogas generation and biogas consumption would not have any impact on the achieved emission reductions. Therefore, the CL is closed.	
FAR 1 It was observed during the site visit that labelling was wrongly mentioned on wastewater and gas pipelines. For example, 'recycled water' was mentioned on wastewater inlet pipe and 'wastewater' was mentioned on a gas pipeline. It was also observed that the identification tags were not provided at some of the meters.	2011-04-08	The labelling is corrected and the identification tags for all meters are provided. This can be verified by the DOE during the next verification.	2011-05-23	The labelling and identification tags shall be verified during the next verification	2011-10-03

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In order to enhance the transparency and to avoid any misunderstandings during upcoming verifications the labelling shall be corrected and for all meters identification tags shall be provided.					
FAR 2 Based on verbal information the BOT (Built Operate and Transfer) contract between Papop and Bangna is currently under revision. In case a new contract will be established at the time of the next verification, the DOE shall review if the revised modalities affect the additionality.	2011-04-08	In case Papop will have a new BOT contract, it shall be provided the DOE at the time of the next verification.	2011-05-23	If the BOT contract is revised, it shall be verified during the next verification that reviewed modalities would affect the additionality.	2011-10-03