

VERIFICATION REPORT OF “WASTEWATER TREATMENT WITH BIOGAS PRODUCTION (UASB) AND HEAT UTILIZATION AT GENERAL STARCH CO., LTD.” IN THAILAND



Document Prepared By: Germanischer Lloyd Certification GmbH

Project Title	Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co. Ltd.
Version	06

Report Title	Verification Report of Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co. Ltd.
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Summary:

Germanischer Lloyd Certification GmbH (GLC) has performed the VCS verification of the project "Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co., Ltd." with regard to the relevant requirements for VCS project activities.

The project was validated and registered with reference no. 082 under VCS (Verified Carbon Standard) program on 19-06-2007. This is the 5th verification of this project which covers the period from 01-09-2010 to 31-12-2011. The project is verified against the VCS Version 3^{/2/}.

The project activity involves treatment of wastewater produced in starch manufacturing process at General Starch Ltd. through UASB (Up-flow Anaerobic Sludge Blanket) technology. The use of UASB to treat the wastewater generated in the plant enables capturing of methane produced during the process as well as meets the effluent standards. The captured methane is utilized as fuel in existing heat generating devices in the plant replacing heavy fuel oil. Surplus methane, if any, is flared in an open flare.

The methodology applied for the project to estimate the GHG emission reduction is AM0022, version 04 – Avoided wastewater and onsite energy use emissions in the industrial sector^{/10/}.

A risk based approach has been followed in this verification. In the course of verification, 8 Corrective Action Requests (CAR) and 3 Clarification Request (CL) have been raised. All the CARs and CLs have been closed out successfully. The verification is based on the monitoring plan of registered VCS Project Description document (VCS PDD). The project document is found at VCS registry under the reference number 082 which can be accessible by below given link:
<https://vcsprojectdatabase2.apx.com/myModule/Interactive.asp?Tab=Projects&a=2&i=82&lat=14%2E3434&lon=102%2E636&bp=1>

Also Monitoring report (MR)^{/4/}, Project Description (VCS PDD)^{/3/}, and other supporting documents are made available to the verification team by project participants.

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

The GHG emission reduction in the verification period from 01-09-2010 to 31-12-2011, including both the days, is: **129,888 tCO₂e**.

Emission reductions in 2010:	35,515	t CO ₂ e
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Emission reductions in 2011:	94,373	t CO ₂ e
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Total Emission Reductions during monitoring period:	129,888	t CO ₂ e
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GLC does not assume any responsibility towards the issuance and utilization of VCU's hereby verified and certified. Request for issuance of VCU's shall be made by the project proponent to an approved VCS Program Registry based on the requirements set out under the most recent version of the VCS Program Guidelines clause on VCS Registration. The verification of reported emission reductions is based on the information made available to GLC and the engagement conditions detailed in this report. Hence, GLC cannot be held liable by any party for decisions made or not made based on this report.

Table of Contents

1	Introduction	6
1.1	Objective.....	6
1.2	Scope and Criteria	6
1.3	Level of assurance.....	7
1.4	Summary Description of the Project	7
2	Validation Process, Findings and Conclusion.....	9
2.1	Validation Process	9
2.2	Validation Findings.....	9
2.2.1	Gap Validation	9
2.2.2	Methodology Deviations.....	9
2.2.3	New Project Activity Instances	9
2.3	Validation Conclusion.....	9
3	Verification Process.....	10
3.1	Method and Criteria.....	10
3.2	Document Review	10
3.3	Interviews	11
3.4	Site Inspections.....	12
3.5	Resolution of Any Material Discrepancy	12
4	Verification Findings	13
4.1	Project Implementation Status.....	13
4.2	Accuracy of GHG Emission Reduction or Removal Calculations.....	41
4.3	Quality of Evidence to Determine GHG Emission Reductions or Removals.....	41

4.4	Management and Operational System.....	42
5	Verification conclusion	43
ANNEX 1: ABBREVIATIONS.....		43
ANNEX 2: REFERENCES.....		47
Annex 3: RESOLUTION OF CORRECTIVE ACTION AND CLARIFICATION REQUESTS (FINDINGS' LIST)		51

1 INTRODUCTION

South Pole Carbon Asset Management Ltd. has commissioned Germanischer Lloyd Certification GmbH (GLC) to carry out the 5th verification of the emission reductions reported for the VCS project activity “Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co., Ltd.” with regard to the relevant requirements for VCS program as per the VCS version 3^{2/}.

This verification report summarizes:

- (i) The findings from the VCS verification for the current monitoring period from 01-09-2010 to 31-12-2011; and
- (ii) VCU certification statement for the emission reductions.

1.1 Objective

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

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

The objective of this verification was to verify and certify emission reductions reported for the “Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co., Ltd.” for the monitoring period covering from 01-09-2010 to 31-12-2011.

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

1.2 Scope and Criteria

The scope of the verification is:

- To ensure that the project activity has been implemented and operated as per the latest version of the VCS PDD and that all physical features (technology, project equipment, and monitoring and metering equipment) of the project are in place.
- To verify that actual monitoring systems and procedures are in compliance with the monitoring systems and procedures described in the monitoring plan as per the latest version of the VCS PDD.
- To evaluate the GHG emission reduction data and express a conclusion with a reasonable level of assurance about whether the reported GHG emission reduction data is free from significant misstatement.
- To verify that the reported GHG emission data is sufficiently supported by evidence.

The verification shall ensure that reported emission reductions are complete and accurate in order to be certified.

The project design, its eligibility as project activity under VCS guidelines and the correct application of the approved CDM baseline and monitoring methodology AM0022, ver.04: Avoided Wastewater and Onsite

Energy Use Emissions in the Industrial Sector have already been validated and verified by the DOE “TUVNORD” (Report No. 8000349679-07/63 – V01 issued on 31-08-2007).^{/6/} As stated in the combined verification report (no separate validation), the verification opinion of “TUV-NORD” is that the project activity as described in the registered VCS PDD dated 19-06-2007 meets all VCS Program requirements as set out in the VCSA Rules (Voluntary Carbon Standard – 2007.1 and Voluntary Carbon Standard Program Guidelines 2007.1) and correctly applies the CDM approved baseline and monitoring methodology AM0022, ver.04: Avoided Wastewater and Onsite Energy Use Emissions in the Industrial Sector.

The verification team has focused on the identification of significant reporting risks and verifying the mitigation measures for these risks based on the recommendations in the “Validation and Verification Manual”^{/1/}, “ISO 14064-3 Greenhouse gases – Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions and employed a risk-based approach”^{/11/}.

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

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

1.3 Level of assurance

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

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

1.4 Summary Description of the Project

The project activity involves installation of an anaerobic wastewater treatment facility at General Starch Ltd., a starch manufacturing plant, which has been in operation since 1995.

The starch plant has a total production capacity of 600 tones of native starch per day generating approximately 5000 m³ of wastewater every production day. Prior to project implementation, the waste water was treated with an open lagoon based pond system with gravitational flow (cascading flow through 34 lagoons). The minimum depth of these ponds is about 10 m for first three lagoons and more than 3 m for rest of the lagoons. The average atmospheric temperature in the region is above 15°C and the wastewater temperature is also above the 15°C as required by the applied methodology. These conditions resulted in anaerobic environment within the ponds resulting in methane generation from the organic content of the wastewater, characterized by its COD, which is released into the atmosphere.

The use of UASB technology to treat wastewater enables not only the avoidance of methane into the atmosphere but also capturing of methane produced and meeting the effluent standards. The captured methane (biogas) is utilized as fuel in existing heat generating devices in the plant replacing heavy fuel oil and the surplus biogas, if any, is flared into the atmosphere, thereby contributing to green house gas (GHG) emission reduction.

As per the registered VCS PDD (VCS Ref. No: 082) of the VCS project, baseline emissions are calculated as the sum of fugitive methane emissions from lagoons in the baseline case and CO₂ emissions by replacing fossil fuel with biogas for onsite heat generation. Project emissions are calculated as the fugitive methane emissions from the project activity i.e. in present scenario. The emission reduction is calculated as the difference of baseline emissions and the project emissions as the leakage emissions are considered to be negligible for the project activity as per the applied methodology.

The total emission reduction for the current verification period from 01-09-2010 to 31-12-2011 is 129,888 tCO₂e. The emission reductions are calculated conservatively as per the applied methodology.

Further background information on the project activity can be found in the VCS Project Design Document (PD) as well as the combined Voluntary Validation and first Verification report which are available on the VCS website:

<https://vcsprojectdatabase2.apx.com/myModule/Interactive.asp?Tab=Projects&a=2&i=82&lat=14%2E3434&lon=102%2E636&bp=1>

The previous verifications correspond to the following monitoring periods:

- 1st Verification: monitoring period from 01-01-2004 to 31-05-2007.^{/6/}
- 2nd Verification: monitoring period from 01-06-2007 to 31-03-2008.^{/7/}
- 3rd verification: monitoring period from 01-04-2008 to 31-08-2009^{/8/}
- 4th Verification monitoring period from 01-09-2009 to 31-08-2010^{/9/}

All the previous Verification and Monitoring Reports are available on the VCS website at the link mentioned above.

The project activity is located at the industrial facility of General Starch Ltd., 99, Chok Chai – Kornburi Road, Ampur Kornburi, Nakhorn Ratchasima, Thailand.

Main components of the project activity include Equalization tanks (Acidification ponds), UASB (UASB-1: 13500 m³/day & UASB-2: 27000 m³/ day), Gas storage tanks, Hot oil & steam boilers, Cascading lagoons system (Evaporation ponds) and Flaring system.

The project characteristics are as per below:

Item	Data
Title of the project activity	Wastewater Treatment with Biogas production (UASB) and heat utilization at General Starch Co. Ltd.
Project Location (specific Address, Country)	Address: No.99, Chok Chai – Kornburi Road, Amphur Kornburi, Nakhorn Ratchasima Province, Thailand Country: Thailand. Latitude: 14° 34' 48.7878" N (14.580219) Longitude: 102° 11' 12.4758" E (102.186799)

Project proponents	Papop Renewable Co., Ltd.
	South Pole Carbon Asset Management Ltd.
Project Entities	Papop Renewable Co., Ltd. 43 Soi Prasert-Manukitch, Prasert-Manukitch Rd., Jorakaebua, Latphrao, Bangkok 10230 Thailand
	South Pole Carbon Asset Management Ltd., Technoparkstrasse 1 Zurich -8005 Switzerland
Applied Methodology	AM0022, Version: 04: Avoided Wastewater and Onsite Energy Use Emissions in the Industrial Sector
Sectoral Scope	Sectoral Scope 13 : Waste handling and disposal
Project crediting period	From 01-01-2004 to 31-12-2013
Period verified in this verification	From 01-09-2010 to 31-12-2011

2 VALIDATION PROCESS, FINDINGS AND CONCLUSION

2.1 Validation Process

NA

2.2 Validation Findings

2.2.1 Gap Validation

NA

2.2.2 Methodology Deviations

NA

2.2.3 New Project Activity Instances

Not applicable since this is not a grouped project

2.3 Validation Conclusion

NA

3 VERIFICATION PROCESS

3.1 Method and Criteria

The verification process was carried out inline with the requirements VCS Version3 ^{/2/}. In addition, the verification team followed the guidelines of the latest version of the Validation and Verification Manual ^{/1/}. Standard auditing techniques were also applied during the verification. The verification team performed first a desk review, followed by an on-site visit to review the project realization.

The verification process was based on assessment of the validated VCS Project Description document (VCS PD) ^{/3/}, the monitoring report ^{/4/}, emission reduction calculation spreadsheet ^{/5/}, supporting documents made available to the verification team and information collected through performing interviews during the on-site assessment. Furthermore publicly available information was considered as far as available and required

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

- Requirements and guidance of VCS Version 3 ^{/2/}.
- Applicable CDM guidelines and requirements, including applicable relevant methodological decisions made by the CDM Executive Board.
- Other relevant rules, including the host country legislation,
- CDM Validation and Verification Manual ^{/1/},
- Monitoring plan as given in the registered VCS PDD ^{/3/},
- Approved CDM Methodology AM0022, version 04 – “Avoided Wastewater and On-site Energy Use Emissions in the Industrial Sector” ^{/10/}

3.2 Document Review

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

- The validated VCS PDD ^{/3/}, including the monitoring plan and the corresponding validation report ^{/6/};
- Monitoring Report ^{/4/} and Emission reduction calculation sheet ^{/5/};
- The applied monitoring methodology ^{/10/};
- Requirements and guidance of VCS ^{/2/} as well as applicable methodological relevant decisions, clarifications and guidance from the CDM Executive Board;

- Any other information and references relevant to the project activity's resulting emission reductions (e.g., IPCC reports, data on electricity generation in the national grid or laboratory analysis and national regulations).
- Addressing of FARs identified during previous verifications

3.3 Interviews

Representatives of GSL(General Starch Co. Ltd.) including the operational staff of the plant and South Pole Carbon Asset Management Ltd. (project consultant) were interviewed to confirm selected information and to resolve issues identified in the document review.

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

Interview Topic	Interviewed persons and source of information
• General aspects of the project • Technical equipment and operation • Changes since validation • Monitoring and measurement equipment • Remaining issues from validation • Calibration procedures • Quality management system • Involved personnel and responsibilities • Training and practice of the operational personnel • Implementation of the monitoring plan • Monitoring data management • Data uncertainty and residual risks • GHG calculation • Procedural aspects of the verification • Maintenance	Ms. Nattaya Lonawan, M&V Project Manager, South Pole Carbon Asset Management Ltd. Mr. Krittapak Srisook, Supervisor Biogas, General Starch Ltd. Ms. Ubonwan Utachkul, Project Participant, Papop Co., Ltd. Mr. Suchai Rattananadhekul, CDM Manager, Papop Co., Ltd. Mr. Paayut Vitthayanukorn, Vice President-Civil projects, General Starch Ltd. Ms. Natthiya Deeying, Anaylist, General Starch Ltd. Mr. Somkiert Korkaem, Chief Biogas operator, General Starch Ltd. Mr. Wissana Phetkasem, Biogas operator, General Starch Ltd.

Interview Topic	Interviewed persons and source of information
Environmental aspects	

3.4 Site Inspections

On 02-03-2012 GLC carried out an on-site visit to General Starch Ltd. (GSL) site where the project is implemented. During the visit, GLC verified that the actual implementation of the project was as described in the registered VCS PDD.

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

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

- Verified whether the project was implemented as per the description in the VCS PDD^{/3/}
- Confirmation that all monitoring equipments have been installed and operated as per the monitoring plan in the VCS PDD^{/3/}.
- The operating staff was interviewed and observed in order to check the risks of inappropriate operation and data collection procedures.
- Information processes for generating, aggregating and reporting the selected monitored parameters were reviewed.
- Calibration records of all metering equipment were checked.
- The monitored data was checked completely.

3.5 Resolution of Any Material Discrepancy

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

Findings established during the verification may be that:

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

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

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

Corrective Action Requests (CARs) are issued, if:

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

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

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

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

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

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

4 VERIFICATION FINDINGS

4.1 Project Implementation Status

On the basis of the on-site visit and the reviewed project documentation, the verification team confirms that the project was implemented as described in the registered VCS PDD. All the physical components and project boundary are in conformity with the description in registered VCS PDD.

The project activity involves capturing of methane generated from the wastewater treatment through UASB technology. The captured methane (biogas) is utilized as fuel in hot oil and steam boilers replacing heavy fuel oil.

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

As per the applied methodology AM0022 Ver.04 ^{/10/}, Project boundaries should be drawn encompassing (as appropriate):

- Methane emissions from the existing lagoon-based waste water treatment system up to, and including, the point at which organic material flows can be quantified or estimated into and out of the wastewater treatment facility;
- Potential methane emissions from the newly introduced anaerobic waste water treatment facility (or demonstration that they are negligible);
- CO₂ emissions from displaced fossil fuel use for on site heat and/or power generation;

- CO₂ emissions from displaced fossil fuel use for offsite/grid generation of electricity that would otherwise have been produced;
- Methane emissions from incomplete combustion of biogas in heat and/or power generation or in flare systems, or from leakage in piping.

It is confirmed that all the emission sources within the boundary have been considered appropriately.

Implementation status of the monitoring plan and the completeness of monitoring

The verification team has followed two steps to assess the completeness of the monitoring. The first step is document review and the second one is on-site interviews and observations. As a part of the step 1, the verification team has reviewed the submitted documents such as MR ^{/4/}, ER sheets ^{/5/} and supporting documents stated in Annex 2. The monitoring indicators have been monitored with calibrated energy meters as described in the monitoring plan of the registered VCS PDD ^{/3/}. It is confirmed that the monitoring mechanism is effective and reliable.

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

		Assessment/ Observation		
Data / Parameter: (as in monitoring plan of the VCS PDD):	AM0022 ID 1	Wastewater flows entering the project treatment facility (m ³ /year)		
Measuring frequency:	Continuously	The parameter is measured on a continuous basis and recorded by the flow meters (FM3 & FM5).		
Reporting frequency:	Daily	The measured data is logged in on a daily basis and reported to Biogas Supervisor. The verification team has checked the log books and found that the log book data is consistent with the data provided in the final ER sheet.		
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PDD. The verification also interviewed the plant's operating team and found that the team is competent enough to monitor the data as required by the monitoring plan and monitoring methodology.			
Type of monitoring equipment:	Type of meter	Magnetic flow meter (FM3)	Magnetic flow meter (FM5)	

	<table><tr><td>Serial number</td><td>6B00EB20000</td><td>6B00E920000</td></tr><tr><td>Accuracy</td><td>± 0.5% ^{/13/}</td><td>± 0.5% ^{/13/}</td></tr></table>	Serial number	6B00EB20000	6B00E920000	Accuracy	± 0.5% ^{/13/}	± 0.5% ^{/13/}						
Serial number	6B00EB20000	6B00E920000											
Accuracy	± 0.5% ^{/13/}	± 0.5% ^{/13/}											
Is accuracy of the monitoring equipment as stated in the VCS PDD? If the VCS PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	VCS PDD does not specify the accuracy of monitoring equipment. However, the PP has installed magnetic flow meter with an accuracy class of 0.5%. GLC, based on the experience of verifying similar other projects, understands that the accuracy of the meters represents good monitoring practice.												
Calibration frequency /interval:	<table><tr><td colspan="3">The flow meter is calibrated at least once every 3 years.</td></tr><tr><td>Meter</td><td>Latest Calibration ^{/12/}</td><td>Previous Calibration ^{/12/}</td></tr><tr><td>FM3</td><td>14-10-2011</td><td>26-10-2010 02-07-2009</td></tr><tr><td>FM5</td><td>14-10-2011</td><td>26-10-2010 02-07-2009</td></tr></table>	The flow meter is calibrated at least once every 3 years.			Meter	Latest Calibration ^{/12/}	Previous Calibration ^{/12/}	FM3	14-10-2011	26-10-2010 02-07-2009	FM5	14-10-2011	26-10-2010 02-07-2009
The flow meter is calibrated at least once every 3 years.													
Meter	Latest Calibration ^{/12/}	Previous Calibration ^{/12/}											
FM3	14-10-2011	26-10-2010 02-07-2009											
FM5	14-10-2011	26-10-2010 02-07-2009											
Is the calibration interval in line with the monitoring plan of the VCS PDD? If the VCS PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Yes. As per the registered VCS PDD, the flow meters would undergo calibration as per appropriate industry standards. During the onsite interviews, it was learnt that the PP has chosen a calibration frequency of 3 years since no industry standards are available in the host country. Based on GLC's experience it is confirmed that the chosen calibration frequency is appropriate. However, from the above mentioned calibration dates it is clear that the actual calibration gap is less than 2 years. Therefore, it is considered to be appropriate and it represents good practice.												
Company performing the calibration:	The calibration was carried out by "Endress + Hauser" ^{/12/}												
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration reports were checked and the meter was found functioning properly.												
Is (are) calibration(s) valid for the whole reporting period?	Yes. The calibration is valid for the whole reporting period.												
If applicable, has the reported data been cross-checked with other available data?	NA												
How were the values in the monitoring report verified?	The values mentioned in the monitoring report have been verified during the site visit with the log sheets ^{/14/} . The reported values in the MR and ER sheet were found to be consistent with the log sheet information.												
Does the data management (from monitoring	Yes, it is confirmed from document review and												

equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description.
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	Assessment/ Observation		
Data / Parameter: (as in monitoring plan of the VCS PDD):	AM0022 ID 2 Wastewater flow leaving the project treatment facility (m ³ /year)		
Measuring frequency:	Continuously Assumed hydrological balance i.e. wastewater leaving the project treatment facility is equal to the wastewater entering into the project treatment facility. Therefore, same values of ID1 i.e. measured by FM3 & FM5 are considered for wastewater leaving the project treatment facility.		
Reporting frequency:	Daily The measured data is logged in on a daily basis and reported to Biogas Supervisor. The verification team has checked the log books and found that the log book data is consistent with the data provided in the final ER sheet.		
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PDD. The verification also interviewed the plant's operating team and found that the team is competent enough to monitor the data as required by the monitoring plan and monitoring methodology		
Type of monitoring equipment:	Type of meter	Magnetic flow meter (FM3)	Magnetic flow meter (FM5)
	Serial number	6B00EB20000	6B00E920000
	Accuracy ^{/13/}	± 0.5%	± 0.5%
Is accuracy of the monitoring equipment as stated in the VCS PDD? If the VCS PDD does	VCS PDD does not specify the accuracy of monitoring equipment. However, the PP has		

not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	installed magnetic flow meter with an accuracy class of 0.5%. GLC, based on the experience of verifying similar other projects, understands that the accuracy of the meters represents good monitoring practice.		
Calibration frequency /interval:	The flow meter is calibrated at least once every 3 years.		
	Meter	Latest Calibration ^{/12/}	Previous Calibration ^{/12/}
	FM3	14-10-2011	26-10-2010 02-07-2009
	FM5	14-10-2011	26-10-2010 02-07-2009
Is the calibration interval in line with the monitoring plan of the VCS PDD? If the VCS PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Yes. As per the registered VCS PDD, the flow meters would undergo calibration as per appropriate industry standards. During the onsite interviews, it was learnt that the PP has chosen a calibration frequency of 3 years since no industry standards are available in the host country. Based on GLC's experience it is confirmed that the chosen calibration frequency is appropriate. However, from the above mentioned calibration dates it is clear that the actual calibration gap is less than 2 years. Therefore, it is considered to be appropriate and it represents good practice.		
Company performing the calibration:	The calibration was carried out by "Endress + Hauser" ^{/12/}		
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration reports were checked and the meter was found functioning properly.		
Is (are) calibration(s) valid for the whole reporting period?	Yes. The calibration is valid for the whole reporting period.		
If applicable, has the reported data been cross-checked with other available data?	NA		
How were the values in the monitoring report verified?	The values mentioned in the monitoring report have been verified during the site visit with the log sheets ^{/14/} . The reported values in the MR and ER sheet were found to be consistent with the log sheet information.		
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description		

		Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PDD):	AM0022 ID 3 Wastewater organic material concentration entering the project treatment facility (kg COD / m ³)	
Measuring frequency:	Daily. It is confirmed based on onsite verification that wastewater samples are collected from the wastewater inlet to the UASB and COD is determined during each shift (i.e. 3 times a day)., COD of the wastewater is analysed with the help of spectrometer and the average value of the 3 shifts is recorded in a daily log sheet.	
Reporting frequency:	Daily The measured data is logged in on a daily basis and reported to Biogas Supervisor. The verification team has checked the log books and found that the log book data is consistent with the data provided in the final ER sheet.	
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. The monitoring plan states that daily samples would be collected and COD would be analysed daily. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies comply with the monitoring plan of the registered VCS PDD. The verification also interviewed the plant's operating team and found that the team is competent enough to monitor the data as required by the monitoring plan and monitoring methodology	
Type of monitoring equipment:	Type of meter	Spectrophotometer (CS)
	Serial number	38397
	Accuracy ^{/13/}	± 3.5%
Is accuracy of the monitoring equipment as stated in the VCS PDD? If the VCS PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	VCS PDD does not specify the accuracy of monitoring equipment. However, it was observed during the verification site visit that the PP has a good monitoring system. The accuracy of spectrometer is ± 3.5%. GLC, based on the experience of verifying similar other projects, determines that the accuracy of the spectrometer is within the acceptable limits.	
Calibration frequency /interval:	The spectrometer is calibrated once every 3 years. It was calibrated on 22-05-2008 ^{/12/} and again on 01-11-2010 ^{/12/} . The verification team has verified the calibration reports and it was found that the	

	instrument error is within the limits.
Is the calibration interval in line with the monitoring plan of the VCS PDD? If the VCS PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	The VCS PDD does not specify the calibration interval of meters. It is learnt from the onsite interviews that the manufacturer also does not specify any information related to the required frequency of calibration. As there was no recommendation from the instrument supplier about the calibration frequency and no industry standard is available, the PP has chosen a calibration frequency of 3 years. Based on GLC's experience it is confirmed that the chosen calibration frequency is appropriate. Besides, from the above mentioned calibration dates it is clear that the actual calibration gap is less than 3 years. Therefore, it is considered to be appropriate and it represents good practice.
Company performing the calibration:	ILAB Fluid Control Co. Ltd., Bangkok ^{/12/}
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration certificates were checked and the meter was found functioning properly.
Is (are) calibration(s) valid for the whole reporting period?	Yes. As discussed above, the calibration certificates were verified and found valid for the whole monitoring period. As described in the MR, the instrument was calibrated within a period of 3 years.
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet were verified during the site visit with the log sheets ^{/14/} . The values were found to be correct.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PDD):	AM0022 ID 4 Wastewater organic material concentration leaving the project treatment facility (kg COD / m ³)
Measuring frequency:	Daily. It is confirmed based on onsite verification that

	wastewater samples are collected from the wastewater inlet to the UASB and COD is determined during each shift (i.e. 3 times a day)., COD of the wastewater is analysed with the help of spectrometer and the average value of the 3 shifts is recorded in a daily log sheet.	
Reporting frequency:	Daily The measured data is logged in on a daily basis and reported to Biogas Supervisor. The verification team has checked the log books and found that the log book data is consistent.	
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. The monitoring plan states that daily samples would be collected and COD would be analysed daily. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies comply with the monitoring plan of the registered VCS PDD. The verification also interviewed the plant's operating team and found that the team is competent enough to monitor the data as required by the monitoring plan and monitoring methodology	
Type of monitoring equipment:	Type of meter	Spectrophotometer (CS)
	Serial number	38397
	Accuracy ^{13/}	± 3.5%
Is accuracy of the monitoring equipment as stated in the VCS PDD? If the VCS PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	VCS PDD does not specify the accuracy of monitoring equipment. However, it was observed during the verification site visit that the PP has a good monitoring system. The accuracy of spectrometer is ± 3.5%. GLC, based on the experience of verifying similar other projects, determines that the accuracy of the spectrometer is within the acceptable limits.	
Calibration frequency /interval:	The spectrometer is calibrated once every 3 years. It was calibrated on 22-05-2008 ^{12/} and again on 01-11-2010 ^{12/} . The verification team has verified the calibration reports and it was found that the instrument error is within the limits.	
Is the calibration interval in line with the monitoring plan of the VCS PDD? If the VCS PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	The VCS PDD does not specify the calibration interval of meters. It is learnt from the onsite interviews that the manufacturer also does not specify any information related to the required frequency of calibration. As there was no recommendation from the instrument supplier about the calibration frequency and no industry standard is available, the PP has	

	chosen a calibration frequency of 3 years. Based on GLC's experience it is confirmed that the chosen calibration frequency is appropriate. Besides, from the above mentioned calibration dates it is clear that the actual calibration gap is less than 3 years. Therefore, it is considered to be appropriate and it represents good practice.
Company performing the calibration:	ILAB Fluid Control Co. Ltd., Bangkok ^{/12/}
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration certificates were checked and the meter was found functioning properly.
Is (are) calibration(s) valid for the whole reporting period?	Yes. As discussed above, the calibration certificates were verified and found valid for the whole monitoring period. As described in the MR, the instrument was calibrated within a period of 3 years and the error was also found within the permissible limits. Hence the observed measurement represents good quality.
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet were verified during the site visit with the log sheets ^{/14/} . The values were found to be correct.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PDD):	AM0022 ID 5 Volume of biogas sent to facility heaters (Nm³)
Measuring frequency:	Continuously The parameter is measured on a continuous basis and recorded by the gas flow meter (GM3).
Reporting frequency:	Daily The measured data is logged in on a daily basis and reported to Biogas Supervisor. The verification team has checked the log books and found that the log book data is consistent with

	the data provided in the ER sheet.	
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PDD. The verification also interviewed the plant's operating team and found that the team is competent enough to monitor the data as required by the monitoring plan and monitoring methodology	
Type of monitoring equipment:	Type of meter	Thermal mass flow Meter (GM3)
	Serial number	9B09BD02000
	Accuracy ^{/13/}	± 1.0% of reading plus ± 0.5% of full scale
Is accuracy of the monitoring equipment as stated in the VCS PDD? If the VCS PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	VCS PDD does not specify the accuracy of monitoring equipment. However, it was observed during the verification site visit that the PP has a good monitoring practice and the accuracy of ±0.5% on full scale. GLC, based on the experience of verifying similar other projects, understands that the accuracy of the meters represents good monitoring practice.	
Calibration frequency /interval:	The gas flow meter is calibrated at least once every 3 years. GM3 was calibrated on 06-08-2010 and again on 24-06-2011^{/12/}. The calibration frequency is within the specified period.	
Is the calibration interval in line with the monitoring plan of the VCS PDD? If the VCS PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Yes. As per the registered VCS PDD, the flow meters would undergo calibration as per appropriate industry standards. During the onsite interviews, it was learnt that the PP has chosen a calibration frequency of 3 years since no industry standards are available in the host country. GLC, based on verifying the similar projects in host country it is considered to be appropriate. Moreover, from the above mentioned calibration dates it is clear that the actual calibration gap is less than 1 year. Therefore, it represents good practice.	
Company performing the calibration:	The latest calibration of gas flow meter was calibrated by "Endress + Hauser" on 24-06-2011 & 06-08-2010^{/12/} The gas flow meter was calibrated internally by Papop with the help of master calibrator in 2010. It was checked that the master calibrator was calibrated by PTT Public Company Limited, Chornburi, Thailand which is an external agency. It was calibrated on 14-01-2010.^{/12/}	

Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration certificates were checked and the meter was found functioning properly.
Is (are) calibration(s) valid for the whole reporting period?	Yes. Calibration is valid for the whole reporting period.
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet have been verified during the site visit with the log sheets ^{/14/} . The reported values in the MR and ER sheet were found to be consistent with the log sheet information.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PDD):	AM022 ID 8 Fossil fuel volume equivalent to generate the same amount of heat generated from the biogas collected in the anaerobic treatment facility (Litres per year)
Measuring frequency:	Calculated value It is calculated from the measured volume of biogas sent to facility heaters (ID 5), calorific value of biogas (ID 19) and calorific value of fuel oil (IPCC default value).
Reporting frequency:	NA
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	NA
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the VCS PDD? If the VCS PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	NA
Calibration frequency /interval:	NA
Is the calibration interval in line with the	NA

monitoring plan of the VCS PDD? If the VCS PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	
Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is (are) calibration(s) valid for the whole reporting period?	NA
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	The values in the MR were verified based on the biogas consumption for boilers (facility heaters), calorific value of biogas and calorific value of fuel oil.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PDD):	AM0022 ID 9 Biogas sent to flare (Nm ³ biogas)
Measuring frequency:	Continuously The parameter is measured on a continuous basis and recorded by the gas flow meter (GM4).
Reporting frequency:	Daily The measured data is logged in on a daily basis and reported to Biogas Supervisor. The verification team has checked the log books and found that the log book data is consistent with the data provided in the final ER sheet.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	As per the registered VCS PDD, the parameter is calculated as the difference of gas production and gas consumption of boilers. However, a gas flow meter (GM-4) was installed during the 2 nd verification period to measure the biogas consumption for flare which is more appropriate.

	The approach is inline with the applied monitoring methodology. The verification also interviewed the plant's operating team and found that the team is competent enough to monitor the data as required by the monitoring plan and monitoring methodology	
Type of monitoring equipment:	Type of meter	Thermal mass flow Meter (GM4)
	Serial number	AA083102000
	Accuracy ^{/13/}	± 1.0% of reading plus ± 0.5% of full scale
Is accuracy of the monitoring equipment as stated in the VCS PDD? If the VCS PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	VCS PDD does not specify the accuracy of monitoring equipment. However, it was observed during the verification site visit that the PP has a good monitoring practice and the accuracy of ±0.5% on full scale. GLC, based on the experience of verifying similar other projects, understands that the accuracy of the meters represents good monitoring practice.	
Calibration frequency /interval:	The gas flow meter is calibrated at least once every 3 years. GM4 was calibrated on 04-08-2010^{/12/} and again on 23-06-2011^{/12/}. The calibration frequency is within the specified period.	
Is the calibration interval in line with the monitoring plan of the VCS PDD? If the VCS PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	The monitoring plan of the VCS PDD does not specify the calibration frequency. However, from the calibration reports verified during the site visit, the calibration frequency (dates mentioned above) represents good practice.	
Company performing the calibration:	The latest calibration of gas flow meter (GM4) was calibrated by "Endress + Hauser" on 23-06-2011 & 04-08-2010.^{/12/} The gas flow meter (GM4) was calibrated internally by Papop with the help of master calibrator in 2010. Master calibrator was calibrated by PTT Public Company Limited, Chornburi, Thailand which is an external agency. It was calibrated on 14-01-2010^{/12/}	
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration certificates were checked and the meter was found functioning properly.	
Is (are) calibration(s) valid for the whole reporting period?	Yes. Calibration is valid for the whole reporting period.	
If applicable, has the reported data been cross-checked with other available data?	NA	
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet have been verified during the site visit with the log sheets ^{/14/} . The reported values in the MR	

	and ER sheet were found to be consistent with the log sheet information.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

Assessment/ Observation													
Data / Parameter: (as in monitoring plan of the VCS PDD):	AM0022 ID 11 Biogas methane concentration (%)												
Measuring frequency:	Continuous The parameter is measured on a continuous basis by an inline gas analyzer.												
Reporting frequency:	Daily The monitored value is logged in on a daily basis and reported to Biogas Supervisor. The verification team has checked the log books and found that the log book data is consistent with the data provided in the ER sheet.												
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	The monitoring plan in the VCS PDD does not specify any monitoring frequency. However, as per the applied monitoring methodology, the parameter has to be monitored on a continuous basis. Therefore, the monitoring frequency of biogas concentration is inline with the monitoring methodology.												
Type of monitoring equipment:	<table border="1"> <tr> <th>Type of meter</th><th>Infrared gas analyzer</th></tr> <tr> <td>Serial number</td><td>ABB EL 1020 IR 3.241376.5</td></tr> <tr> <td>Accuracy^{/13/}</td><td>± 2%</td></tr> <tr> <th>Type Meter</th><th>Gas analyzer</th></tr> <tr> <td>Serial number</td><td>VISIT 04 0505</td></tr> <tr> <td>Accuracy^{/13/}</td><td>± 2%</td></tr> </table> It was observed during the onsite verification that	Type of meter	Infrared gas analyzer	Serial number	ABB EL 1020 IR 3.241376.5	Accuracy ^{/13/}	± 2%	Type Meter	Gas analyzer	Serial number	VISIT 04 0505	Accuracy ^{/13/}	± 2%
Type of meter	Infrared gas analyzer												
Serial number	ABB EL 1020 IR 3.241376.5												
Accuracy ^{/13/}	± 2%												
Type Meter	Gas analyzer												
Serial number	VISIT 04 0505												
Accuracy ^{/13/}	± 2%												

	the plant's team had two inline gas analysers. Though ABB meter was used predominantly, it was revealed during the interviews with the operating team that both the meters were used for %CH₄ measurement during the monitoring period i.e. when one had a problem the other was used. Therefore, a CAR was raised (please refer to CAR 6). In response to the CAR 6, the MR was revised to include the details of both the analysers in the MR. Both the analysers were calibrated frequently and the calibration reports of both the meters were provided to the verification team.									
Is accuracy of the monitoring equipment as stated in the VCS PDD? If the VCS PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	VCS PDD does not specify the accuracy of monitoring equipment. However, the PP has installed Gas Analyzer with an accuracy of ± 2%. GLC based on its experience confirms that the accuracy of the meter represents good monitoring practice.									
Calibration frequency /interval:	At least once every 3 years <table><tr><td>Gas Analyser</td><td>Latest Calibration^{/12/}</td><td>Previous Calibration^{/12/}</td></tr><tr><td>Gas Analyser (MS) – ABB</td><td>21-12-2011</td><td>19-11-2010 04-06-2010</td></tr><tr><td>Gas Analyser (MS) - VISIT</td><td>21-12-2011</td><td>04-11-2010</td></tr></table> Calibration report of VISIT meter prior to 04-11-2010 was not available since it was not used before. It is confirmed based on the onsite interviews with the operating team that ABB meter was primarily used.	Gas Analyser	Latest Calibration ^{/12/}	Previous Calibration ^{/12/}	Gas Analyser (MS) – ABB	21-12-2011	19-11-2010 04-06-2010	Gas Analyser (MS) - VISIT	21-12-2011	04-11-2010
Gas Analyser	Latest Calibration ^{/12/}	Previous Calibration ^{/12/}								
Gas Analyser (MS) – ABB	21-12-2011	19-11-2010 04-06-2010								
Gas Analyser (MS) - VISIT	21-12-2011	04-11-2010								
Is the calibration interval in line with the monitoring plan of the VCS PDD? If the VCS PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	As per the registered VCS PDD, it was mentioned that the gas analyzer would undergo calibration as per appropriate industry standards. During the onsite interviews, it was learnt that the PP has chosen a calibration frequency of 3 years since no industry standards are available in the host country. Based on GLC's experience it is confirmed that the chosen calibration frequency is appropriate. However, from the above mentioned calibration dates it is clear that the actual calibration gap is approximately 1 year. Therefore, it is considered to be appropriate and it represents good practice.									
Company performing the calibration:	The gas analyser was calibrated by "Thai Steam Service & Supply Co. Ltd., Bangkok"^{/12/} in 2010 and 2011.									
Did calibration confirm proper functioning of	Yes. The calibration certificates were checked and									

monitoring equipment? (Yes / No):	the meter was found functioning properly.
Is (are) calibration(s) valid for the whole reporting period?	Yes. Calibration is valid for the whole reporting period.
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet have been verified during the site visit with the log sheets ^{/14/} . The reported values in the MR and ER sheet were found to be consistent with the log sheet information.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PDD):	AM0022 ID 12 Project emissions from flaring of the residual gas stream (PEflare, t CO ₂ e)
Measuring frequency:	Calculated value It is calculated from the flared gas quantity measured by GM4 (refer to ID9) and considering 0% flare efficiency.
Reporting frequency:	NA
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	The parameter is monitored inline with the approach described in the monitoring plan of the VCS PDD. An open flare system is employed and the flare efficiency has been considered as 0% which is more conservative according to "Tool to determine project emissions from flaring gases containing methane".
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the VCS PDD? If the VCS PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	NA
Calibration frequency /interval:	NA
Is the calibration interval in line with the	NA

monitoring plan of the VCS PDD? If the VCS PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	
Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is (are) calibration(s) valid for the whole reporting period?	NA
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	The calculation and the values in the MR were verified based on the measured value of biogas consumption for flare and 0% combustion efficiency.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PDD):	AM0022 ID 13 Amount of chemical oxidizing agents entering system boundary (Tons/m ³)
Measuring frequency:	No oxidizing agents were used during the monitoring period. Therefore, the parameter was not monitored. This is confirmed based on the onsite interviews.
Reporting frequency:	NA
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	NA
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the VCS PDD? If the VCS PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	NA
Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan of the VCS PDD? If the VCS	NA

PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	
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 the VCS PDD):	AM0022 ID 15 Heating system combustion efficiency (%)
Measuring frequency:	The parameter was assumed to be 98.5% due to unavailability of manufacturer's data on combustion efficiency of boilers. However, this value is considered to be conservative compared to the ex-ante value of 100%. Besides, the CDM EB has also accepted to use 100% destruction efficiency when the biogas is utilized for gainful use of energy with small scale methodology, AMS III.H.
Reporting frequency:	NA
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	NA
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the VCS PDD? If the VCS PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	NA
Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan of the VCS PDD? If the VCS	NA

PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	
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?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PDD):	AM0022 ID 16 Flow of wastewater directly to the current wastewater treatment system (m³)
Measuring frequency:	No wastewater was directly sent to the current wastewater treatment system (existing system) bypassing the new wastewater treatment facility (project system). Therefore, the parameter was not monitored during the monitoring period. This is confirmed based on interviews with the operating team during onsite verification.
Reporting frequency:	NA
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	The monitoring plan of the VCS PDD also states that the value of the parameter is zero from 2006 onwards.
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the VCS PDD? If the VCS PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	NA

Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan of the VCS PDD? If the VCS PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	NA
Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is (are) calibration(s) valid for the whole reporting period?	NA
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	Onsite interviews
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 the VCS PDD):	AM0022 ID 17 Loss of biogas from pipeline (%)
Measuring frequency:	Calculated value It is calculated as the difference between total biogas generation and total biogas consumption. Total biogas generation is measured by gas flow meters GM1 and GM2 on a continuous basis. Biogas consumption for facility heaters is measured by GM3 and biogas consumption for flaring is measured by GM4 continuously as described above.
Reporting frequency:	The biogas generation and biogas consumption are recorded in log sheets daily by the operators. The data is reported to the biogas supervisor on a daily basis.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	As per the registered VCS PDD, the value is estimated based on spot checks using a mobile leak detector. However, the approach followed during the

	monitoring period is more accurate and results in conservative estimation of emission reduction compared to the measurement method provided in monitoring plan of the VCS PDD.																	
Type of monitoring equipment:	<table><tr><td>Gas flow meter</td><td>Serial Number</td><td>Accuracy ^{/13/}</td></tr><tr><td>GM1</td><td>C3010D02000</td><td>± 1.0% of reading plus ± 0.5% of full scale</td></tr><tr><td>GM2</td><td>A9059602000</td><td>± 1.0% of reading plus ± 0.5% of full scale</td></tr><tr><td>GM3</td><td>9B09BD02000</td><td>± 1.0% of reading plus ± 0.5% of full scale</td></tr><tr><td>GM4</td><td>AA083102000</td><td>± 1.0% of reading plus ± 0.5% of full scale</td></tr></table>			Gas flow meter	Serial Number	Accuracy ^{/13/}	GM1	C3010D02000	± 1.0% of reading plus ± 0.5% of full scale	GM2	A9059602000	± 1.0% of reading plus ± 0.5% of full scale	GM3	9B09BD02000	± 1.0% of reading plus ± 0.5% of full scale	GM4	AA083102000	± 1.0% of reading plus ± 0.5% of full scale
Gas flow meter	Serial Number	Accuracy ^{/13/}																
GM1	C3010D02000	± 1.0% of reading plus ± 0.5% of full scale																
GM2	A9059602000	± 1.0% of reading plus ± 0.5% of full scale																
GM3	9B09BD02000	± 1.0% of reading plus ± 0.5% of full scale																
GM4	AA083102000	± 1.0% of reading plus ± 0.5% of full scale																
Is accuracy of the monitoring equipment as stated in the VCS PDD? If the VCS PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	VCS PDD does not specify the accuracy of monitoring equipment. However, it was observed during the verification site visit that the PP has a good monitoring practice and the accuracy of ±0.5% on full scale represents good monitoring practice.																	
Calibration frequency /interval:	The gas flow meters are calibrated at least once every 3 years. <table><tr><td>Gas flow meter</td><td>Latest Calibration ^{/12/}</td><td>Previous Calibration ^{/12/}</td></tr><tr><td>GM1</td><td>24-06-2011</td><td>04-08-2010</td></tr><tr><td>GM2</td><td>24-06-2011</td><td>05-08-2010</td></tr><tr><td>GM3</td><td>24-06-2011</td><td>06-08-2010</td></tr><tr><td>GM4</td><td>23-06-2011</td><td>04-08-2010</td></tr></table> Above table shows that the calibration frequency is within the specified period.			Gas flow meter	Latest Calibration ^{/12/}	Previous Calibration ^{/12/}	GM1	24-06-2011	04-08-2010	GM2	24-06-2011	05-08-2010	GM3	24-06-2011	06-08-2010	GM4	23-06-2011	04-08-2010
Gas flow meter	Latest Calibration ^{/12/}	Previous Calibration ^{/12/}																
GM1	24-06-2011	04-08-2010																
GM2	24-06-2011	05-08-2010																
GM3	24-06-2011	06-08-2010																
GM4	23-06-2011	04-08-2010																
Is the calibration interval in line with the monitoring plan of the VCS PDD? If the VCS PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	The monitoring plan of the VCS PDD does not specify the calibration frequency. However, from the calibration reports verified during the site visit, the calibration frequency (dates mentioned above) represents good practice.																	
Company performing the calibration:	The latest calibration of gas flow meters were calibrated by “Endress + Hauser”																	
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration certificates were checked and the meters were found functioning properly.																	

Is (are) calibration(s) valid for the whole reporting period?	Yes. Calibration is valid for the whole reporting period.
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	The reported values in the MR and ER sheet were verified with the daily log sheets of biogas generation and consumption.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PDD):	AM0022 ID 18 Organic material removed from wastewater facility (t COD)
Measuring frequency:	The parameter is measured by weigh bridge available at project site whenever the organic material is removed from the system. However, no organic material was removed from the system during the current verification period.
Reporting frequency:	Not applicable for the verification period
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	NA
Type of monitoring equipment:	Weigh bridge available at project site
Is accuracy of the monitoring equipment as stated in the VCS PDD? If the VCS PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	No information is provided about the accuracy of the measuring system in the Monitoring Plan.
Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan of the VCS PDD? If the VCS PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	NA

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

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PDD):	AM0022 ID 19 Biogas calorific value (MJ / Nm ³)
Measuring frequency:	Calculated value. It is calculated from the theoretical calorific value of methane and methane content in biogas. Methane content in biogas is monitored as described under parameter ID 11.
Reporting frequency:	NA
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	NA
Type of monitoring equipment:	NA
Is accuracy of the monitoring equipment as stated in the VCS PDD? If the VCS PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	NA
Calibration frequency /interval:	NA
Is the calibration interval in line with the monitoring plan of the VCS PDD? If the VCS PDD does not specify the frequency of	NA

calibration, does the selected frequency represent good monitoring practice?	
Company performing the calibration:	NA
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	NA
Is (are) calibration(s) valid for the whole reporting period?	NA
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	The calorific values of the biogas were verified based on the measured methane content of biogas and theoretical value of calorific value of methane. The calorific value of methane is 36.73 MJ/Nm ³
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place. Please refer to sections 4.2 to 4.4 for further description

Thus GLC confirms that

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

Remaining Issues from Validation or Previous Verification

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

<https://vcsprojectdatabase2.apx.com/myModule/Interactive.asp?Tab=Projects&a=2&i=82&lat=14%2E3434&lon=102%2E636&bp=1>

Based on the last verification (4th verification) report dated 06-05-2011 by Germanischer Lloyd Certification GmbH with report No. VCS-024 / rev. 02, the verification team identified 1 FAR as mentioned below:

FAR raised during the 4th Verification	Assessment of the verification team
The boilers are retrofitted. The operational conditions of the dual fuel boiler need to be verified during the subsequent verifications. In case it is found that the existing boiler is replaced with new boiler during any monitoring period, no emission reduction shall be claimed for heat displacement.	There were two steam boilers, no. 6 & 9, installed during the monitoring period. Verification team has verified ER calculation and confirms that the biogas used into the new boilers is excluded from the claim of emission reduction on account of heat displacement in the corresponding boilers. The description has been provided transparently in section 2.2 of the MR as a deviation from the monitoring plan.

Previously Validated Methodology Deviations ^{/6/}

Data / Parameters / Variables	Reference of Methodology	Description of Deviations	Assessment by validation team
EF _{CH₄} (kg CH ₄ /kg COD)	Meth Pg # 3, Eq # (2)	As the tapioca starch wastewater contains polysaccharides, the different from default emission factor, ie, 0.21 can be applied. The project specific applied value is 0.241.	The theoretical value of methane conversion factor is 0.25. Applying the formula presented in the B.6.2 and Annex-3 of PDD and the actual data log of 2006 (12 months), the project specific value is correctly calculated as 0.241 kg CH ₄ /kg COD. The same is applied as fixed for the entire monitoring period.
E _{CH₄_NAWTF} (tCO ₂ e)	Meth Pg #2,Pg # 5, Eq # (1)	Zero value is applied in absence of project specific data.	As registered CDM project no 1040 "Korat waste to energy" being on tapioca starch wastewater project plant (located 50 KM away to this project site) considers this factor as zero, the registered PDD serves as

			documentary evidence (in absence of project specific measurements, technology supplier data, expert estimate) for neglecting this parameter.
M _{lagoon_chemical_ox} (kg COD)	Meth Pg # 3, # 32, Eq # (3), Appendix -2	Zero value is applied.	The test reports of wastewater confirm that sulphate (oxidative species) concentration is not detectable. Hence the parameter can be considered as zero.
R _{lagoon} (ratio)	Meth Pg #4, Eq # (5), Appendix 2	87.88 % in absence of preproject series of test as per Appendix 2	Value of CDM project no 1040 "Korat waste to energy" is applied in absence of pre-project series of test as per Appendix 2 of AM0022. This is a realistic value as the "Korat waste to energy" project is of comparable in nature.
R _{NAWTF} (ratio)	Meth Pg #4, Eq # (4)	95.92 % in absence of both the options in hierarchy, ie, pilot plant study before the project implementation and estimates by manufacturer.	Based on the actual operational data of representative period 16 months period covering monitored COD in and out for UASB1 and UASB2 in 2006, plus Jan to April of 2007 (ref B.6.2 of the PDD). The applied value is OK.
R _{deposition} (ratio)	Meth Pg #4, Eq # (6), Appendix 3	Zero value is applied in absence of project specific data.	Value of CDM project no 1040 "Korat waste to energy" is applied in absence of pre-project sampling based analysis as per Appendix 3 of AM0022. This is a realistic value as the "Korat waste to energy"project is of comparable in nature.
M _{lagoon_input} (kg of COD)	Meth Pg #4, Eq # (5), Pg # 19 (parameter #16)	As 100 % wastewater is not being treated by the project plant during 2004-2005, the	As monitoring parameter # 16 of page 19 of AM0022 identifies this bypass parameter,

		Mlaggon_input is equated with Mlaggon_input + Mlaggonp- inputbypass for this project activity.	this substitution is appropriate for 2004 - 2005. The bypass water quantity during 2004 - 2005 is calculated using water balance approach using bench mark value of specific consumption of water use per kg root, ie, 2.52 l/kg of root and measured data of water input (= water output) from UASB1. This approach of calculation is OK. The basic data and calculation presented in the PDD and MR were verified and found OK.
Biogas Methane Concentration (% by Vol)	Meth monitoring parameter # 11 (pg 18) Flaring Tool pg 9	65% by volume throughout the monitoring period in absence of continuously monitored data.	The application of this fixed value of methane concentration is conservative compared to actual value measured on balloon samples by an independent laboratory. Moreover, the same vol% value can be considered as dry basis in applying flaring tool for PEflare calculation (Cp Eq 7 of AM0022).
E _{CH₄} -leaks (tCO ₂ e)	Meth pg 5	Zero in absence of project specific measurement.	Value of CDM project no 1040 "Korat waste to energy" is applied in absence of project specific data on bioreactor leak as per pg 5 of AM0022. This is a realistic value as the "Korat waste to energy" project is of comparable in nature. As the delivery pipeline (confirming to API standard) is less than 2 km in length, the pipeline leakage can be considered as zero.
PE _{flare,y} , ñ _{flare,h}	Flare Tool (Eq No 15)	As the flare is of open type and the temperature is 850 °C for more than 40 minutes during the hour	The selection of default value of efficiency of the open flare is OK. The hourly averaging of annual figures of

		h, the 50% default is selected. Considering that the volumetric flow of gas to the flare is not measured directly and other parameter are not measured on an hourly basis, the figures in these equations are based on hourly averages using annual reported data and using the simplifications and default values provided by the flaring tool.	volumetric flow of gas to the flare can be considered as an adjusted value.
F, NCV	Meth Pg #11, Eq # (9), g # 17 (parameter #8)	Based on the approach given under Pg # 17 (parameter #8) of AM0022 the amount of heavy fuel oil is calculated from energy equivalent approach. 1m ³ biogas = 0.0005743 tons of heavy fuel oil In establishing this relationship, 65% by Vol methane in biogas and IPCC 2006 NCV value of heavy fuel oil is considered in absence of site specific local NCV value.	The approach and calculation is accurate.
Biogas sent to flare (Nm ³)	Meth Pg # 17 (parameter #9)	Calculated in place of measured.	Difference of two direct gas flow meter readings can be considered as good as measured.
Biogas production data		Calculation of gas production data for 113 days in 2004 and 73 days in 2005 from COD load information and average gas production per unit of COD load to compensate for a broken gas meter that did not provide meter readings on those days.	The approach of compensation of missing data can be considered as an adjusted value.

4.2 Accuracy of GHG Emission Reduction or Removal Calculations

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

The emission reduction due to methane capturing and utilisation in onsite boilers was estimated by measuring the required parameters using appropriate monitoring equipment and using the formulae described in the methodology, AM0022, version 04 and the VCS PDD. All the monitored parameters are described above in section 4.1. All the ex-ante parameters which are used in the calculation of emission reduction are presented in section 3.1 of the MR transparently. According to the applied methodology, the conservativeness of the achieved emission reduction was checked and the calculation has been transparently provided in the ER sheet.

The detailed emission reduction calculation is presented in the ER spread sheet. All the formulae and the calculation procedure were checked by the verification team. It was observed that the emission reduction was determined in a conservative manner. The emission reduction being claimed during the period from 01-09-2010 to 31-12-2011 is approximately 2.54% lesser than the estimated emission reductions in the registered VCS PDD, as given in the table below.

Table: Emission Reductions

Period	Estimated VCUs as per VCS PDD	Achieved VCUs as per Monitoring Report
Emission Reductions	133,273	129,888
% Deviation (+/-)	0	(-) 2.54 %

The small variation in achieved emission reduction is considered as nominal and the achieved emission reduction during the monitoring period is slightly lower than the estimated value.

4.3 Quality of Evidence to Determine GHG Emission Reductions or Removals

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

Inlet and outlet COD of UASB, quantity of wastewater through UASB, biogas consumption for boilers, biogas consumption for flaring, methane concentration of biogas, etc. were verified with the log book values to ensure that there is no over estimation of the VCUs. The provided data was found to be of adequate quality.

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

The project owner had contracted a BOT entity for developing the project activity and monitoring its performance. Papop Renewable Energy Co. Ltd is the BOT entity for the project at General Starch Ltd. They had set up a well defined system at the project activity site. The quality management system of the BOT was certified by ISO 9001:2000.^{/20/} The ISO system also outlines proper monitoring plan in terms of

monitoring frequency as well as accuracy. It was understood that the contract the contract between PP and the BOT was expired in May 2010. Therefore, the operation of the wastewater treatment plant is handled by the GSL team since May 2010 following the same monitoring procedures laid by the BOT entity. Moreover, the wastewater treatment system of GSL was also certified under ISO 14001:2004.^{/20/} Monitoring of parameters, data recording and data archiving are required to be well managed as per the ISO 14001^{/20/} requirements.

All the meters (wastewater flow meter, biogas flow meters, COD meter, and gas analyzer) were calibrated at appropriate calibration frequency (described in section 4.1) to ensure the quality of the data. Hence the verification team confirms that the quality of data is good. The plant's team has also developed an annual calibration plan.

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

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

4.4 Management and Operational System

GLC was able to verify that authorities and responsibilities for monitoring and reporting of all data related to the emission reductions were clearly defined for the monitoring period from 01-09-2010 to 31-12-2011. Moreover, all project related equipments were confirmed to be operated by qualified and trained staff. The frequency of monitoring measurement, as well as applicable calibrations and reporting details were conducted as outlined in the monitoring plan available in the latest version of the VCS PDD.

The allocation of the responsibilities is documented in a written form and is followed as described in the registered PD. Routines for the archiving of data are defined and documented. During the site visit all the required plant records were verified and found that the data is consistent with the provided in the final MR and ER sheets^{/5/}. Hence, the DOE confirms that the calculations laid down in the monitoring report are inline with the PDD.

Majority of the parameters as described in section 4.1 are recorded by the operators once every shift (3 times a day) in log sheets. Operators submit the daily log sheets to the Chief Operator. The chief operator checks the values and inputs the data into electronic format i.e. Excel sheets. Chief operator submits the excel files to Biogas Supervisor on a daily basis. The Biogas Supervisor verifies the data, prepares a daily summary report and submits it to the plant's management. The biogas supervisor also enters the data in ER sheet format and submits to the project consultant i.e. South Pole Carbon Asset Management Ltd. on a monthly basis.

The verification team has crosschecked the data with daily sheets and monthly reports. The reported data has been found to be consistent. The verification team has interviewed the plant personnel who are involved in the monitoring of the parameters that are used to determine the emission reductions of the VER project. It is confirmed based on the interviews that the plant's team is competent enough to monitor the parameters as described in the monitoring plan.

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

5 VERIFICATION CONCLUSION

Germanischer Lloyd Certification GmbH (GLC) has performed the 5th verification of the project: “Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co. Ltd.” with regard to the applicable relevant requirements for VCS project activity.

The project activity involves treatment of wastewater produced in a starch manufacturing process at General Starch Ltd. through UASB technology. The use of UASB to treat the wastewater enables capturing of methane produced during the process which would otherwise be released into the atmosphere. The captured methane is utilised as fuel in existing boilers in the plant replacing heavy fuel oil and the surplus methane, if any, is flared into the atmosphere.

This verification covers the period from 01-09-2010 to 31-12-2011 (including both days).

South Pole Carbon Asset Management Ltd. and General Starch Co., Ltd. (GSL) are responsible for the collection of data in accordance with the validated monitoring plan and the reporting of GHG emissions reductions from the project.

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

GLC conducted the verification on the basis of the monitoring methodology AM0022, version 4 (Avoided wastewater and on-site energy use emissions in the industrial sector – version-4), the monitoring plan included in the VCS PDD of the project and the monitoring report of dated “09-May-2012”.

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

In GLC’s opinion, the GHG emissions reduction for the “Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co., Ltd.” as reported in the Monitoring Report issued on “09-May-2012, version 04” are calculated without material misstatements in a conservative and appropriate manner. The GHG emission reductions were correctly calculated on the basis of the approved monitoring methodology of AM0022, version 4 (Avoided wastewater and on-site energy use emissions in the industrial sector – version-4), and the monitoring plan contained in the validated Project Design Document for the project.

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

GHG Emission Reductions or Removals	Unit	2010	2011	Total during the 5 th verification period
Baseline Emissions	tCO ₂ e	37,063	98,287	135,350
Project Emissions	tCO ₂ e	1,548	3,914	5,462
Leakage	tCO ₂ e	0	0	0
Net GHG emission reductions or removals	tCO₂e	35,515	94,373	129,888

It is confirmed that the project activity has achieved total emission reduction of **129,888 tCO₂e** during the monitoring period from 01-09-2010 to 31-12-2011.

<Hamburg>, 2012-05-21



Markus Weber

Verification Team Leader

ANNEX 1: ABBREVIATIONS

BOT	Built Operate and Transfer
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CH ₄	Methane
CL	Clarification Request
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
COD	Chemical Oxygen Demand
DOE	Designated Operational Entity
ER	Emission Reduction
ER sheet	Emission Reduction calculation spread sheet
FAR	Forward Action Request
GSL	General Starch Co. Ltd.
GHG	Greenhouse gas(es)
HFO	Heavy Fuel Oil
ISO	International Organisation for Standardization
MP	Monitoring Plan
MR	Monitoring Report
NA	Not Applicable
PDD	Project Design Document
PP	Project Participant
QA/QC	Quality Assurance / Quality Control
t CO ₂ e	Ton of Carbon dioxide equivalent
UASB	Up-flow Anaerobic Sludge Blanket
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Verified Carbon Standard
VCSA	VCS Association

VCS PDD	VCS Project Design Document
VCU	Verified Carbon Unit
VVM	Validation & Verification Manual

ANNEX 2: REFERENCES

Reference	Author: Title, version, date of issue
/1/	CDM-EB: Clean Development Mechanism Validation and Verification Manual (Version 1.2)
/2/	VCS: VCS Version 3 Requirements Document 01-02-2012, v3.2 • VCS Standard • VCS Program Guide
/3/	VCS registered Project Description document for project : “Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co. Ltd.”, (VCS PDD version 1 dated 19-06-2007)
/4/	Draft Monitoring Report of “Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co. Ltd”, Version 1, 26-01-2012 Final Monitoring Report of “Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co. Ltd”, Version 4 dated 09-05-2012
/5/	Draft Emission reduction calculation spreadsheet <“GHG cal _5th_rev01_26-01-2012.xlsx”> Final Emission reduction calculation spreadsheet <“GHG cal _5th_rev02_22-03-2012.xlsx”>
/6/	Combined Verification Report (validation & verification) for the project “Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co Ltd.”, dated 31-08-2007 for the 1 st verification period: 01-01-2004 to 31-05-2007.
/7/	Verification report of the project “Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co Ltd.”, for the 2 nd verification: 01-06-2007 to 31-03-2008.
/8/	Verification report of the project “Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co Ltd.”, for the 3 rd verification: 01-04-2008 to 31-08-2009.

Reference	Author: Title, version, date of issue
/9/	Verification report of the project “Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co Ltd.”, for the 4 th verification: 01-09-2009 to 31-08-2010.
/10/	Approved CDM Methodology AM0022, version 04 – “Avoided Wastewater and On-site Energy Use Emissions in the Industrial Sector
/11/	ISO 14064-3:2006; Greenhouse gases -- Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions; http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=38700 ; (25-09-2009)
/12/	<u>Calibration Reports:</u> 1. Wastewater Flow meter to UASB-1 (FM3) : Serial Number : 6B00EB20000 Endress + Hauser, Calibration Certificate issued on 19-10-2011 (Calibration Date : 14-10-2011) Endress + Hauser, Calibration Certificate issued on 01-11-2010 (Calibration Date : 26-10-2010) 2. Wastewater Flow meter to UASB-2 (FM5) : Serial Number : 6B00E920000 Endress + Hauser, Calibration Certificate issued on 19-10-2011 (Calibration Date : 14-10-2011) Endress + Hauser, Calibration Certificate issued on 01-11-2010 (Calibration Date : 26-10-2010) 3. Biogas from UASB-1 (GM1) : Serial Number: C3010D02000 Endress + Hauser, Calibration Certificate issued on 24-06-2011 (Calibration Date : 24-06-2011) Papop (Internal Calibration) , Calibration Certificate issued on 04-08-2010 (Calibration Date : 04-08-2010) 4. Biogas from UASB-2 (GM2) : Serial Number: A9059602000 Endress + Hauser, Calibration Certificate issued on 24-06-2011 (Calibration Date : 24-06-2011) Papop (Internal Calibration) , Calibration Certificate issued on 05-08-2010 (Calibration Date : 05 - 08-2010) 5. Biogas to Boiler (GM3): Serial Number: 9B09BD02000 Endress + Hauser, Calibration Certificate issued on 24-06-2011 (Calibration Date : 24-06-2011)

Reference	Author: Title, version, date of issue
	Papop (Internal Calibration) , Calibration Certificate issued on 06-08-2010 (Calibration Date : 06 - 08- 2010) 6. Biogas to Flare (GM4): Serial Number: AA083102000 Endress + Hauser, Calibration Certificate issued on 23-06-2011 (Calibration Date : 23-06-2011) Papop (Internal Calibration) , Calibration Certificate issued on 04-08-2010 (Calibration Date : 04 - 08- 2010) 7. Gas Analyser ABB (MS) : Serial Number: 3.241376.5 Thai Steam & Supply Co. Ltd., Calibration Certificate issued on 21-12-2011 (Calibration Date : 21 -12- 2011) Thai Steam & Supply Co. Ltd., Calibration Certificate issued on 19-11-2010 (Calibration Date : 19 -11- 2010) 8. Gas Analyser VISIT (MS): Serial Number: 0505 Thai Steam & Supply Co. Ltd., Calibration Certificate issued on 21-12-2011(Calibration Date : 21 -12- 2011) Thai Steam & Supply Co. Ltd., Calibration Certificate issued on 04-11-2010 (Calibration Date : 04 -11-2010) 9. Spectrometer (CS): Serial Number: 38397 ILab Fluid Control Co., Ltd., Bangkok, Calibration Certificate with certificate number : 483/2010 issued on 01-11-2010 (Calibration Date : 01-11-2010) 10. Calibration Meter Master : Serial Number: 69193622 PTT Public Company Ltd., Calibration Certificate with certificate number :GMCL 004/53 issued on 19-01-2010 (Calibration Date: 14-01-2010)
/13/	<u>Monitoring Equipment specifications:</u> ENDRESS + HAUSER: Technical Information of Proline Promag 10W (Electromagnetic Flow Measuring system, Flow Measurement of liquids in water or wastewater applications.) ENDRESS + HAUSER: Technical Information of Proline t-mass 65F, 65I (Thermal Mass Flow Measuring System, Direct Mass Flow Measurement of Gases)

Reference	Author: Title, version, date of issue
	ABB: Operator Manual of EL1020 (Continuous Gas Analyzer) No.: 42/27-10 Rev.02 LOVIBOND: General Catalogue of COD setups COD Vario & COD Photometer.
/14/	Daily log sheets of General Starch Co. Ltd. • Wastewater flow meter readings • Methane content (% CH₄) in biogas • COD measurement of wastewater • Biogas consumption for facility heaters • Biogas consumption for flare
/15/	CDM-EB: Guidelines for assessing compliance with the calibration frequency requirements (EB 52, Annex 60)
/16/	CDM-EB: General Guidelines to SSC CDM methodologies, Version 17 (EB 61, Annex 21)
/17/	GLC GmbH: Germanischer Lloyd CDM Procedures
/18/	IPCC: 1996 IPCC Guidelines for National Greenhouse Gas Inventories: work book IPCC: 2006 IPCC Guidelines for National Greenhouse Gas Inventories: work book
/19/	GSL Organization Chart
/20/	<u>ISO Certificates:</u> 1. ISO 9001-2000 (Quality management systems) 2. ISO 14001:2004 (Environmental management systems)

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

Description of Finding (CAR, CL, FAR)	Date (yyyy-mm-dd)	Project Participants Response	Date (yyyy-mm-dd)	GLC Assessment	Date (yyyy-mm-dd)
CAR 1 Complete contact information has not been included in the first page of the monitoring report (MR) which is a requirement as per the VCS MR template.	2012-03-09	The required information according to VCS v.3 template is provided in the first page of MR rev.02.	2012-03-22	OK. In the MR (version 02), complete contact details have been included as per VCS MR template. Therefore, CAR 1 is closed.	2012-04-02
CAR 2 It has been mentioned in section 1.1 of the MR, " <i>As per the VCS's guideline, the project is verified against the VCS 2007.1</i> ". However, as per the latest requirements of VCS, the project shall be verified against Version 3.	2012-03-09	The version of VCS guideline is updated in section 1.1 of MR rev.02.	2012-03-22	OK. In section 1.1 of the MR (version 02), the VCS guidelines version has been updated. Therefore, CAR 2 is closed.	2012-04-02
CAR 3 Serial no. of the monitoring equipment, GM1, mentioned in Table 6 of the MR does not match with the onsite monitoring equipment and also calibration	2012-03-09	- The serial number of GM1 is corrected in both emission reduction calculation file and MR. - The full model number is provided.	2012-03-22	OK. The serial number of GM1 has been corrected in the revised MR from C300D02000 to C3010D02000. It is confirmed that the revised serial number of the monitoring equipment matches with the calibration certificate and also the serial number of the	2012-04-02

Description of Finding (CAR, CL, FAR)	Date (yyyy-mm-dd)	Project Participants Response	Date (yyyy-mm-dd)	GLC Assessment	Date (yyyy-mm-dd)
certificate. Besides, model no. of the monitoring equipments specified in the table does not matched with the supporting documents.				equipment observed during the site visit. Besides, the model numbers mentioned in Table 6 of the MR have been updated and the revised model numbers of the monitoring equipments are inline with the calibration certificates. Therefore, CAR 3 is closed.	
CAR 4 Calibration dates have not been clearly mentioned in Table-6 of the MR. Further, calibration dates of FM3 & FM5 do not match with calibration certificates.	2012-03-09	- The table 6 of MR is revised mentioning clearly the calibration dates. - The calibration dates of FM3 and FM5 are corrected in line with the calibration certificates.	2012-03-22	OK. The calibration dates have been clearly mentioned in table-6 of the revised MR. Also, the calibration dates of FM3 and FM5 now have been corrected from 2010-11-01 and 2011-11-19 to 2010-10-26 and 2010-10-14 respectively. It is confirmed that the calibration dates in the MR match with the calibration certificates. Therefore, CAR 4 is closed.	2012-04-02
CAR 5 Implementation status of the project activity has not been described sufficiently in section 2.1 of the MR in accordance with the VCS MR template.	2012-03-09	Section 2.1 of MR rev.02 is revised for more information has been provided on the implementation status of the project activity,	2012-03-22	Not OK. Section 2.1 of the MR has been revised. It has been mentioned, "The increasing in starch production quantity reflects the higher emission reductions achieved in this monitoring period". However, the information has not been justified properly. Besides, the achieved emission reduction as	2012-04-02

Description of Finding (CAR, CL, FAR)	Date (yyyy-mm-dd)	Project Participants Response	Date (yyyy-mm-dd)	GLC Assessment	Date (yyyy-mm-dd)
				per the MR (version 02) is 129,888 tCO₂e during the monitoring period corresponding to 16 months and the estimated annual emission reduction as per the PDD is 99,955 tCO₂e. It has not been explained properly how the project activity achieved higher emission reductions during the monitoring period. Therefore, CAR 5 continues.	
CAR 5 continues...	2012-04-02	The first paragraph about the increasing of ERs in section 2.1 of MR rev0.03 is erased. Since in the registered PD, the estimated ERs is 99,955 tCO₂e/y or 133,273.33 tCO₂e per 16 months. Then the achieved ERs in this monitoring period at 129,888 is lower than that figure.	2012-04-07	OK. The implementation status of the project activity has been revised in section 2.1 of the MR. The project was fully implemented and operated as per the description in the VCS PD. The project's operation was transferred to General Starch from Papop after termination BOOT contract. The achieved emission reduction during the monitoring period is marginally lower than the estimated emission reduction. This variation is considered to be appropriate as the emission reduction depends upon the amount of wastewater generation and its COD level which in turns depends on the starch production. Therefore, CAR 5 closed.	2012-04-18

Description of Finding (CAR, CL, FAR)	Date (yyyy-mm-dd)	Project Participants Response	Date (yyyy-mm-dd)	GLC Assessment	Date (yyyy-mm-dd)
CAR 6 It was observed during the onsite verification that the plant's team has two inline gas analysers. Further, it was revealed during the interviews with the operating team that both the meters were used for %CH ₄ measurement during the monitoring period i.e. when one had a problem the other was used. However, the MR contains the information of only one gas analyser.	2012-03-09	The monitoring description of two gas analysers is added in the monitoring table of parameter ID11 in section 3.2 and table 6 of MR rev.02.	2012-03-22	OK. The monitoring description of both gas analysers has been included under parameter of ID 11 in section 3.2 of the revised MR. Details of both the monitoring equipment has been provided in table 6 of the MR (version 02). The updated information is found to be consistent with the onsite observations. Therefore, CAR 6 is closed.	2012-04-02
CAR 7 Description of the monitoring plan in section 3.3 is incomplete with reference to the requirements of the MR template.	2012-03-09	The description of monitoring plan in section 3.3 of MR is revised.	2012-03-22	OK. The description of the monitoring plan in section 3.3 of the MR has been revised. The revised monitoring plan description contains the sufficient information such as Organisation structure, Data collection and management system and Data storage and back up. Therefore, CAR 7 is closed.	2012-04-02
CAR 8 The provided information under section 1.3 of the MR is not inline with the VCS MR template	2012-04-02	The table in section 1.3 of MR rev.03 is corrected.	2012-04-07	OK. Section 1.3 of the MR has been revised. Complete contact information of project proponent has been provided as per the requirement of the MR template. Therefore, CAR 8 is	2012-04-18

Description of Finding (CAR, CL, FAR)	Date (yyyy-mm-dd)	Project Participants Response	Date (yyyy-mm-dd)	GLC Assessment	Date (yyyy-mm-dd)
requirements.				closed.	
CL 1 As per the monitoring plan of the registered PDD, "Biogas sent to flare" is <i>calculated from gas production meters for UASB 1 and UASB 2 (GM 1 plus GM 2) minus gas meter to boiler (GM 3) and pipe leakage assumption, adjusted for dry gas conditions.</i> However, it was observed that the parameter was actually measured with a gas flow meter during the monitoring period.	2012-03-09	As per the methodology, the amount of biogas sent to flare should be 100% continuously monitored by electronic equipment in Nm ³ unit. Although the monitoring description in MR is against the PD but it is according to the methodology. Additionally, this can be considered as the improvement of monitoring program, by installation of extra monitoring equipment.	2012-03-22	OK. The parameter, "Biogas sent to flare" has been measured with a continuous flow meter. Though the approach is different from the registered monitoring plan, it represents more appropriate way of monitoring. Besides, it is inline with the applied methodological requirements. Therefore, the CL 1 is closed.	2012-04-02
CL 2 It was mentioned in section 3.2 of the MR that the pipeline leakage is estimated based on the difference of gas production and gas consumption and since the difference is negative, the leakage is considered to be zero. However, it is not clear how the production of gas can be lower than the consumption.	2012-03-09	From the manufacturer's specification of the biogas flow meter, the accuracy for this type of flow meter is +/-1.5%. The difference in production and consumption of biogas are -2.16% (for 2010) and -0.06% (for 2011). For 2011, the difference is still within the accuracy range. For 2010, the difference should be considered reasonable as this may happen due to the following reason.	2012-03-22	Not OK. It is understood that the minor difference of 0.06% could be due to error in monitoring equipment which is within the maximum permissible error of the meters (1.5%). However, the provided explanation is not clear how the difference could be 2.16% during 2010.	2012-04-02

Description of Finding (CAR, CL, FAR)	Date (yyyy-mm-dd)	Project Participants Response	Date (yyyy-mm-dd)	GLC Assessment	Date (yyyy-mm-dd)
		The biogas pipe from UASB1 and UASB2 to the junction point during May'2010 was modified. The pipe's diameter was extended from 280 to 315 mm to accommodate fluctuations in biogas flow. This action can have some effects in the reading of GM1 and GM2.			
CL 2 continues...	2012-04-02	Since the maximum error of meter is $\pm 1.5\%$. In case of the error of meters at boiler and flare is -1.5% while the error of meters at UASB1,2 is $+1.5\%$. Then it is possible that the difference range between biogas supplied and utilized is 3%. The difference of 2.16% is possible and acceptable.	2012-04-07	OK. It is understood that the maximum permissible error on account of two meters (each meter having $\pm 1.5\%$) could be upto $\pm 3\%$. Since the difference between biogas generation and biogas consumption is 2.16%, it is considered to be within the limits of maximum permissible error of the meters. Therefore, CL 2 is closed.	2012-04-18
CL 3 It is stated in section 3.3 of the MR, "the operation of the wastewater treatment system has been	2012-03-09	The PP is still Papop. GSL handovers only the operation and monitoring part of biogas plant.	2012-04-07	OK. It is learnt that the project's operation was transferred to General Starch from Papop after termination BOOT contract in May 2010. However, the project proponent would	2012-04-18

Description of Finding (CAR, CL, FAR)	Date (yyyy-mm-dd)	Project Participants Response	Date (yyyy-mm-dd)	GLC Assessment	Date (yyyy-mm-dd)
transferred from Papop to General Starch (GSL) since May 2010 due to the expiration of the BOT contract". It is not clear if this would also mean the change of PP from Papop Renewable Co., Ltd. to General Starch Co., Ltd.				still be Papop Renewable Co., Ltd. Therefore, CL 3 is closed.	