

“Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)”



By

Document Prepared By: KBS Certification Services Pvt. Ltd.

Project Title	Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)
Version	01
Report ID	VCS.19.VER.002

Report Title	Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)
Client	South Pole Carbon Asset Management Ltd.
Pages	59
Date of Issue	12-June-2019
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Summary:

KBS Certification Services Pvt. Ltd. has been contracted by, "South Pole Carbon Asset Management Ltd." to undertake independent 2nd periodic verification and certification for the greenhouse gas (GHG) emission reductions reported from 'Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)' for the monitoring period 01/01/2012 to 11/05/2016 in the initial monitoring report version 01 date 05/04/2019, with regard to the relevant requirements of VCS Standard Version 3.7.

The project was validated and registered with reference no. 427 under VCS (Verified Carbon Standard) program on 17/11/2009. The project was validated by TÜV NORD CERT GmbH (validation report Number 53208409-09/309 issued on 17-November-2009). This is the 2nd periodic verification of this project which covers the period from 01/01/2012 to 11/05/2016 (including both the days). The project is verified against the VCS Version 3. The verification is based on the monitoring plan of registered VCS Project Description document (VCS PD)/26/, requirements of VCS (VCS Standard Version 3.7 /33/ and VCS Program Guide Version 3.7 /32/), Validation and Verification Manual Version 3.2 /35/ and CDM Validation and Verification Standard for project activities /27/.

The methodologies applied for the project to estimate the GHG emission reduction are AMS-III.H., "Methane Recovery in Wastewater Treatment" (version 13), AMS-I.C. "Thermal energy production with or without electricity" (version 15) and AMS-I.D. "Grid connected renewable electricity generation" (version 14) /30/.

The verification is based on the VCS PD, proof of title, proof of right, additional documents related to baseline and monitoring methodology; the subsequent background investigation, follow-up interviews and supporting documents made available to the verification team by project proponent.

Monitoring report (MR)/02/, Emission reduction calculation spread sheet (ER sheet)/04/, Project Description document (VCS PD)/26/ and other supporting documents have also been made available to the verification team.

A risk based approach has been followed to perform the verification of the project activity. In the course of verification, 05 Corrective Action Requests (CAR) and 01 Clarification Request (CL) have been raised. All the CARs and CLs have been closed out successfully.

It is our responsibility to express an independent GHG verification opinion on the GHG emissions and on the calculation of GHG emission reductions from the project for the period 01/01/2012 to 11/05/2016 based on the reported emission reductions in the final monitoring report Version 03 dated 11/06/2019 for the same period.

Based on an understanding of the risks associated with reporting GHG emissions data and the controls in place to mitigate these, KBS planned and performed our work to obtain the information and explanations that we considered necessary to provide sufficient evidence for us to give reasonable assurance that this reported amount of GHG emission reductions for the period is fairly stated.

As a result of the verification, the verifiers confirm that the GHG emission reduction in the verification period from 01/01/2012 to 11/05/2016, including both the days, is **151,910 tCO₂e**.

KBS confirms the following;

Reporting period: 01/01/2012 to 11/05/2016

Year	Net GHG emission reductions or removals (tCO ₂ e)	
2012 (01/01/2012 to 31/12/2012)	67,622	
2013 (01/01/2013 to 31/12/2013)	25,087	
2014 (01/01/2014 to 31/12/2014)	32,792	
2015 (01/01/2015 to 31/12/2015)	12,508	
2016 (01/01/2016 to 11/05/2016)	13,901	
Total	151,910	

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1 INTRODUCTION

1.1 Objective

KBS has been commissioned by 'South Pole Carbon Asset Management Ltd.' to perform verification of its registered VCS project 'Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)', for the reported GHG emission reductions for the given monitoring period 01/01/2012 to 11/05/2016 (both dates included). The VCS projects must undergo an independent third party verification and certification of emission reductions as the basis for issuance of Voluntary Emission Reductions (VERs).

The objectives of this verification exercise are, by review of objective evidence, to establish that:

- The project activity has been implemented and operated as per the project description (PD) and that all physical features (technology, project equipment, and monitoring and metering equipment) of the project are in place;
- Monitoring report and other supporting documents are complete;
- The data is recorded and stored as per the monitoring methodology and approved monitoring plan.
- To confirm that the monitoring system is implemented and fully functional to generate Voluntary Emission Reductions (VERs/VCUs) without any double counting, and
- To establish that the data reported are accurate, complete, consistent, transparent and free of material error or omission by checking the monitoring records and the emissions reduction calculation.

1.2 Scope and Criteria

The verification scope is defined as an independent and objective review of monitoring report, VCS project description (VCS PD), including the monitored data and other relevant documents made available to verifier and information collected through performing interviews during on-site assessment of the project activity.

The project is assessed against the requirements of VCS standard version 3.7 and related rules and guidance. KBS has, based on the recommendations in the latest version of Verified Carbon standard, and employed a rule-based approach (as criteria) in the verification, focusing on the identification of significant reporting rules and the reliability of project monitoring.

The aspects to be covered under the purview of verification are:

- Ensure that the project activity has been implemented and operated as per the registered VCS PD and that all physical features (technology, project equipment, and monitoring and metering equipment) of the project are in place as per the documents provided by the client and on-site visit;
- Ensure that the monitoring report and other supporting documents provided are complete
- Ensure that the practiced monitoring system and procedures comply with the monitoring systems and procedures described in the monitoring plan and the approved CDM methodology;
- Evaluate the data recorded and stored are as per the monitoring methodology.

1.3 Level of Assurance

☒ Reasonable level of assurance

Verification team confirms that project has achieved reasonable level of assurance.

1.4 Summary Description of the Project

Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen), hereafter, 'the project activity', involves the installation and operation of a methane recovery and utilisation system (an open anaerobic effluent treatment system) at Kean Charoen Co., Ltd., a tapioca starch factory in Khonkaen, Thailand. The system has been in operation since 2nd October 2006 (project start date). The starch factory has a mean daily production capacity of 175 tonnes¹ of dried starch, generating 2,000 m³ of wastewater per operational day.

Summary of baseline and project conditions are as follows:

Project/Baseline Component	Brief Description
Lagoon system	11 lagoons commissioned along with the operation start date of starch plant in 1988. The approximate retention time of the open lagoon system is around 200 days
Covered lagoons	Two covered lagoons have been converted from existing open lagoons. Typically, the COD removal efficiency of this system is around 80%. The hydraulic retention time is approximately 90 days. The covered lagoon system started operation in October 2006 (first month of biogas usage).
Boiler	There are two dual-fired boilers with a thermal capacity of 4.070 MW _{th} and 3.78 MW _{th} respectively. The first boiler, which previously capacity of 3.488 MW _{th} , was replaced by the new one with capacity 4.070 MW _{th} in year 2010 ² . The reason for replacement was to increase the biogas utilization capacity of boiler. The new burner can operate with only biogas (100%) instead of oil-biogas mixed fuel.
Gas engines	There are two electricity generation sets; the first set (no.1 st and 2 nd) with 2 generators capacity of 952 kW _e ³ each. The second generator set (no.3 rd and 4 th) with 2 generators capacity of 450 kW _e each are not included in this project boundary.
Flare	An open flare system is available at the plant. This is an automatic flare system that will operate when pressure is higher than 3 mbar. There is also a flame arrester to ensure the safe operation of the flare system.
Capacity of auxiliary drives	Total capacity of the auxiliary drives is 458 kW; the same can be referred in the GHG calculation sheet as well as in the document submitted during validation.

Based on the document review and the site visit, Verification team confirms that the project activity has been fully commissioned and operating.

¹ Calculated by historical data

² This was occurred during the 1st verification

³ The technical specification document is provided.

The project activity is located in Kranuan district, Khonkaen province, situated in the northeast region of Thailand, approximately 450 km from Bangkok. Street address: 261 Moo 4, Huanakhum, Kranuan, Khonkaen, 40170, THAILAND. Geographical coordinates: 16° 48.498'N Latitude and 103° 05.148'E Longitude as verified during site visit.

Project 1st crediting period is from 15/07/2009 to 14/07/2019, Hence the monitoring period selected for this periodic verification i.e. 01/01/2012 to 11/05/2016 is within this crediting period.

The total emission reduction for this monitoring period from 01/01/2012 to 11/05/2016 is 151,910 tCO₂e. The emission reduction is calculated conservatively as per the applied methodology.

Project entity information is presented below:

Item	Data
Project Entities	Kean Charoen Co., Ltd.
	1004/201 Rama 3 Road, Bangpongpan, Yannawa, 10120
	South Pole Carbon Asset Management Ltd. (Responsible for development of emission reduction through the Voluntary Carbon Standard)
	Technoparkstrasse 1, Zurich, Switzerland, 8005

2 VERIFICATION PROCESS

2.1 Method and Criteria

The verification process was carried out inline with the requirements VCS Version 3. In addition, the verification team followed the guidelines of the CDM Validation and Verification Standard. Standard auditing techniques and KBS's CDM Procedures were also applied during the verification. A risk-based approach was followed to carry out verification and access all the factors and concerns that relate to the issuance of emission reductions from a project activity.

They include:

- Identification of all the sources contributing to the baseline emissions, project emissions and emission reductions.
- Authenticity of the provided data is checked.
- A risk based analysis is carried out to ensure a clear and transparent assessment. The risks involved in this process are mainly with the informational flows and data recording.

KBS follows a risk based verification approach, wherein a desk review of the project documentation is undertaken, which is followed by an onsite visit by the members of verification team. The verification protocol is filled by the verification team that is based on standard auditing practices and VCS requirements. The verification protocol provides transparent means to record the observations by the verification team members and the non-conformities, if any. The verification protocol is an internal document, and available on request.

Duration of Verification:

Verification Contract	25/03/2019
On site verification	11/04/2019
Findings raised	29/04/2019
Draft Verification Report	12/06/2019
Final Verification Report	12/06/2019

2.2 Document Review

A desk review is undertaken, involving but not limited to,

- A review of the data and information presented to verify their completeness;
- A review of the monitoring plan and monitoring methodology, paying particular attention to the frequency of measurements, the quality of metering equipment including calibration requirements, and the quality assurance and quality control procedures;
- An evaluation of data management and the quality assurance and quality control system in the context of their influence on the generation and reporting of emission reductions.

The list of document reviewed is included in the Appendix 2: 'References'

2.3 Interviews

The site visit for this verification assessment was undertaken by Chetan Swaroop Sharma (Team Leader and Technical Expert (TA 1.1, 13.1)). Summary of on-site activities are mentioned below;

Location	Kean Charoen Co., Ltd., 261 Moo 4, Huanakhum, Kranuan, Khonkaen, 40170, THAILAND
Dates	11/04/2019
Key points discussed	Name of persons interviewed, Designation, Organization
• General aspects of the project • Project equipment operation and technical details • Changes since validation • Monitoring and measurement equipment • Remaining issues from previous verification • Calibration procedures • Quality management system • Involved personnel and responsibilities • Training and practice of the operational personnel • Implementation of the monitoring plan • Monitoring data management • Data uncertainty and residual risks • GHG calculation • Maintenance	Miss Suwipa Rukwongtrakool, Project Manager, South Pole Carbon Asset Management Ltd. Kwanruean Somchob, Head of Department Biogas, Kean Charoen Co., Ltd. Preecha Suwannasim, Manager, Kean Charoen Co., Ltd. Sao Pinijmontree, 175/1, Moo1, Ban Huiyang-Kranuan, Khonkaen Aon Setraksa, 120 Moo11, Tungkhumsup, Kranuan, Khonkaen Somchai Chaonuea, 153 Moo6, Ban Nhongwangkoo, Ban Fang, Kranuan, Khonkaen

2.4 Site Inspections

A site visit is undertaken by members of verification team, involving but not limited to,

- An assessment of the implementation and operation of the project activity as per the registered VCS PD;
- A review of information flows for generating, aggregating and reporting the monitoring parameters;
- Interviews with relevant personnel to confirm that the operational and data collection procedures are implemented in accordance with the approved monitoring plan;
- A cross-check between information provided in the monitoring report and data from other sources such as plant log books, inventories, purchase records or similar data sources;
- A check of the monitoring equipments including calibration performance and observations of monitoring practices against the requirements of the registered VCS PD and the selected methodology/30/;
- A review of calculations and assumptions made in determining the GHG data and emission reductions;
- An identification of quality control and quality assurance procedures in place to prevent or identify and correct any errors or omissions in the reported monitoring parameters.

2.5 Resolution of Findings

KBS applies the risk based approach aimed at focusing on high risk issues to the verification results whilst not omitting any part of the mandatory processes. A few discrepancies were found during the verification and the verification report was submitted to the project proponent, indicated under the titles corrective action requests (CARs) and clarification requests (CLs). CARs and CLs require the PP to take relevant actions. Criteria for judging items as CAR or CL are as follows:

Corrective action request (CAR):

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

Clarification request (CL):

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

FARs is to be raised to highlight issues related to project implementation that require review during the first verification of the project activity. FARs does not relate to VCS requirements for registration.

CARs and CLs are to be resolved or closed out if the PP modifies the project description, rectifies the PD or provides adequate additional explanations or evidence that satisfies the concerns. If this is not completed, the project activity cannot be recommended for registration under VCS registry.

The Monitoring report was revised addressing the CARs & CLs issued by KBS. After reviewing the revised and resubmitted Monitoring report /02/ and ER sheet /04/; resolving the CARs & CLs raised and outstanding concerns, KBS issues this final verification report and opinion.

05 CAR and 01 CL were found during verification and closed satisfactorily. The list of CARs/CLs raised and the response provided, the means of verification, reasons for their closure and references to correction in the MR are provided in appendix 4 of this report. The revised MR with changes incorporated as per the issues raised were rechecked with the documentary evidences and found to be inline.

2.5.1 Forward Action Requests

No FAR was raised during this monitoring period.

2.6 Eligibility for Validation Activities

KBS conducts the verification activity; the validation was performed by the other VVB and the separate validation report issued and approved by the VCS association. KBS has a valid UNFCCC accreditation in the sectoral scope from UNFCCC.

3 VALIDATION FINDINGS

Refer above section.

3.1 Participation under Other GHG Programs

PP does not apply for other GHG program as declared in the registered VCS PD/26/.

3.2 Methodology Deviations

There are two deviations from the methodology applied. Description of the deviations and the assessment on conservativeness of the deviation is provided below.

Description of the deviation	Assessment by the verification team
Deviation-1: <u>Background</u> This approach is deviated paragraph 15 of the methodology AMS I.C version 15. It was proposed and validated by the validation and verification body during the validation of the project activity. The deviation was accepted and the detail was addressed in section 4.1 of the registered PD. <u>Explanation of the deviation</u> Since the complete monitoring mechanism was not available for the measurement of baseline input/output thermal energy, a conservative approach has been adopted as explained in the registered PD. <u>Period of deviation</u> Whole monitoring period <u>Compliance with the deviation</u> For verification, with a quantity of dry starch that is produced during a particular year, a minimum required quantity of fossil fuel (fuel oil) can be estimated from quantity of fossil fuel used per unit of dry starch historically. For the same year, if the data for fossil fuel consumed is available, then the remaining energy must be supplied by biogas. This is a conservative approach to estimate the fuel oil that, in the absence of the project activity, would be used in the starch drying process. The deviation takes into account the baseline efficiencies. A simplified approach is explained here to estimate the baseline emissions. The approach is based on historical consumption of fuel oil per tonne of starch generation. The deviation addresses the coherence with §15	The deviation has been transparently described in section 2.2.1 of the MR. The verification team is of the opinion that the approach followed by the PP is appropriately described and justified and the project remains in compliance with the VCS rules. The deviation does not overestimate the emission reduction and hence accepted to the verification team. Hence the deviation is accepted.

and 10 of the methodology.

It must be noted that the efficiency of the boiler when used in dual-fuel mode is lower than at regular, single-fuel conditions (HFO only). This drop-in efficiency leads to a lower biogas to HFO displacement rate. Based on the arguments listed below (provided by technical experts on the subject) and energy balance comparisons based on data available before and after implementation of the dual-fuel mode in such boiler systems, an efficiency drop resulting in 10% less HFO displacement (than under theoretical conditions) is a conservative approximation. This can be substantiated based on following arguments:

- **Higher hydro/moisture loss makes boiler efficiency lower with biogas** - The efficiency of heating equipment depends on several factors; one of the important ones being the C:H ratio in the fuel, which is higher for fuel oil and lower for biogas. Lower C:H ratio leads to higher quantity of H₂O as combustion product, which decreases the thermal efficiency of the boiler. This is typically called "hydrogen loss". In addition, the biogas has a much higher moisture percentage as compared to fuel oil, thus increasing the moisture losses from the equipment, making it a less efficient fuel for burning. The hydrogen sulphide content in the biogas adds to the hydrogen loss.
- **Higher dry flue gas loss reduces boiler efficiency in dual fuel firing mode** - Air in excess of the theoretical calculations (called excess air) is always added for proper and complete combustion. In case of dual fuel firing, due to the different mixing properties of the fuel with the air, this quantity of excess air added is always higher due to the reduced probability of achieving proper air-fuel mixing due to varying fuel properties. At the end of the combustion process, the quantity of unused air is exhausted through the flue gases thus

removing away unusable heat in the boiler, such a loss being partly accounted in the dry flue gas loss (the rest is the unusable heat from the high temperature flue gas itself). This can be understood by the fact that the air enters the furnace at ambient temperature, but the flue gases are typically at a much higher temperature, 200-300 deg C for most low-pressure boiler systems. Thus, if the quantity of excess air pumped into the furnace is higher, which is the case for most dual fuel fired systems, the dry flue gas loss is also higher, bringing down the efficiency of the boiler. The excess air quantity adjustment is a matter of experience, and over a period of time boiler operators do understand how to do this and achieve better efficiencies than what they start with. Thus, it is expected that during the initial stages of operation, this loss is higher. • Variation in biogas quality and quantity influences the air regulation mechanism, thus lowering the efficiency of the system - The varying quantity and quality of biogas influences the air regulation mechanism continuously, never allowing it to achieve a steady state operation, thus lowering the efficiency of the system. The statements above can be confirmed through interview with technical experts and details of same can be provided. In addition, the energy balance for a particular year, considering amount of biogas and fossil fuel used, would easily justify the assumption that energy input required in a dual fuel system is higher than in the baseline system. Based on this, the deviation can be considered as justifiable as it conforms with the requirements of VCS version 3 that it does not impact negatively the conservativeness of the quantification of the emission reduction calculation or the additionality of the project. Starch production are multiplied by this default	
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factor (39.6 litres per tonne) to get minimum fuel oil consumption for each year. For the same year, subtracting actual amount of fuel oil used, the project estimates the amount of thermal energy supplied by biogas and consequently amount of GHG emission reductions made from the project as per AMS I.C., version 15, component.	
Deviation-2: <u>Background</u> This approach is deviated according to the answers to authors of query by the SSC WG⁴. It was proposed and validated by the validation and verification body during the validation of the project activity. The deviation was accepted and the detail was addressed in section 4.1 of the registered PD. <u>Explanation of the deviation</u> As per answers to authors of query by the SSC WG “<i>in the case that the biogas is combusted for a gainful use of the released energy as in an engine or a power plant, a destruction efficiency of 100% can be used for the portion of biogas that is combusted when applying AMS III. H. i.e. use a value of 100% for FE in equation 16 in paragraph 32 for the portion of biogas that is combusted for a gainful use</i>”. Based on this, the calculation approach of MD_y has been deviated from the methodology as justified and accepted in the validation report. <u>Period of deviation</u> Whole monitoring period <u>Compliance with the deviation</u> A destruction efficiency of 100% is used for the	The deviation has been transparently described in section 2.2.1 of the MR. The verification team is of the opinion that the approach followed by the PP is appropriately described and justified and the project remains in compliance with the VCS rules. The deviation does not overestimate the emission reduction and hence accepted to the verification team. The deviation leads to conservative emission reduction. Hence the deviation is accepted.

4

https://cdm.unfccc.int/filestorage/V/NW/VNWAGY8MS92ZDXDUHEF5LB07QICT1P/Response%20WG%20provided.pdf?t=cU58cHNiNXZyfDD3-2TKkt_d5dRRvjI6klhm

portion of biogas that is combusted for gainful use i.e. in boiler and gas engines. For the portion of biogas that is sent to flare, a flare efficiency of 0% has been adopted for the current monitoring period to account for non-operation of the flare system due to unavailability of excess biogas.	
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3.3 Project Description Deviations

There is one project description deviation applied. Description of the deviation and the assessment on conservativeness of the deviation is provided below.

Description of the deviation	Assessment by the verification team																																				
Deviation-1: <u>Background</u> This approach is deviated according to the FAR M3 of the validation report. Since the replacement of first boiler (boiler 1) was addressed during the validation of the project activity, the FAR M3 was raised in the validation report. The first boiler was replaced during the first verification and has been used since then, therefore, the same deviation from the first verification is also applied for this verification. <u>Explanation of the deviation</u> The boiler 1 was replaced by the new bigger one. The capacity of thermal energy output was changed from 3.488 to 4.070 MW_{th}. As per description in FAR M3 of the validation report, if existing boiler is replaced with a new one during any verification no emission reduction shall be granted for heat displacement. Hence the heat displacement at this boiler was neglected from the emission reductions. <u>Compliance with the deviation</u> The deviated approach was adopted by considering only the thermal energy supplied from the second hot oil boiler (boiler 2) for the thermal energy displacement of AMS I.C. This is the conservative approach as per VCS guidelines because the emission reductions achieved from AMS I.C was reduced. <u>Description of deviation</u> The thermal energy supplied and displacement at the boiler 2 was calculated as per steps below; 1. Determine the fuel oil consumption of each boilers in litres <table><tr><th>Fuel oil usage</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th></tr><tr><td>Boiler 1</td><td>0</td><td>84,680</td><td>49,050</td><td>76,170</td><td>69,190</td></tr><tr><td>Boiler 2</td><td>144,260</td><td>41,730</td><td>26,790</td><td>118,307</td><td>94,286</td></tr></table> 2. Determine the biogas consumption of each boilers in Nm³ <table><tr><th>Biogas usage</th><th>2012</th><th>2013</th><th>2014</th><th>2015</th><th>2016</th></tr><tr><td>Boiler 1</td><td>0</td><td>1,208,663</td><td>1,700,132</td><td>705,352</td><td>708,551</td></tr><tr><td>Boiler 2</td><td>1,739,295</td><td>805,869</td><td>1,158,079</td><td>1,435,053</td><td>580,787</td></tr></table>	Fuel oil usage	2012	2013	2014	2015	2016	Boiler 1	0	84,680	49,050	76,170	69,190	Boiler 2	144,260	41,730	26,790	118,307	94,286	Biogas usage	2012	2013	2014	2015	2016	Boiler 1	0	1,208,663	1,700,132	705,352	708,551	Boiler 2	1,739,295	805,869	1,158,079	1,435,053	580,787	The deviation has been transparently described in section 2.2.2 of the MR. The verification team is of the opinion that the approach followed by the PP is appropriately described and justified and the project remains in compliance with the VCS rules. The deviation does not overestimate the emission reduction and hence accepted to the verification team. Hence the deviation is accepted.
Fuel oil usage	2012	2013	2014	2015	2016																																
Boiler 1	0	84,680	49,050	76,170	69,190																																
Boiler 2	144,260	41,730	26,790	118,307	94,286																																
Biogas usage	2012	2013	2014	2015	2016																																
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Boiler 2	1,739,295	805,869	1,158,079	1,435,053	580,787																																

3. Calculate the thermal energy supplied from each boiler in GJ

Thermal energy	2012	2013	2014	2015	2016
Boiler 1	0	28,665	37,534	17,792	17,581
Boiler 2	42,140	18,526	25,304	34,740	15,905
Total	42,140	47,191	62,838	52,532	33,487

4. Calculate the percentage of thermal energy supplied from each boiler

Percentage	2012	2013	2014	2015	2016
Boiler 1	0.00	0.61	0.60	0.34	0.53
Boiler 2	1.00	0.39	0.40	0.66	0.47

5. The $BE_{thermal}$ calculation as per description in Deviation 1 of the registered PD was considered only the fuel oil displacement in the boiler 2. Then the equation for Deviation 1 was revised to,

$$BE_{thermal,CO2y} = (Q_{starch} * Q_{FO,starch} * \%B2 - q_{FO,y,Boiler2}) * D_{FO} * NCV_{FO} * EF_{CO2}/10^6$$

Parameter	Description
$Q_{starch,y}$	Quantity of dry starch produced in year “y” (tonnes)
$Q_{FO,starch}$	Quantity of fossil fuel per unit of dry starch (liter/tonne)
$q_{FO,y,boiler2}$	Quantity of fossil fuel consumed by hot oil boiler no.2 in year “y” (litres)
D_{FO}	Density of fossil fuel (kg/litre)
NCV_{FO}	Net Calorific value of the fuel oil (TJ/ton)
$\%B2$	The percentage of thermal energy supplied from the boiler 2 from step 4 above

3.4 Grouped Project

The project is not a grouped project. Therefore this section is not applicable.

4 VERIFICATION FINDINGS

4.1 Project Implementation Status

The project activity is in operation stage as evidenced by the physical verification of the site. All the physical components and project boundary are in conformity with the description in registered VCS PD. The capacity of project equipments have been cross-checked during the on-site visit and found in-compliance with the registered VCS-PD/26/. On the basis of the on-site visit and the reviewed project

documentation, the verification team confirms that the project was implemented and operated as described in the registered VCS PD/26/.

Ownership and other programs:

The PP declared that the project is not registered any other mechanism apart VCS. Thus emission reductions generated by project will be solely claimed by PP and PP has right of use and hence accepted. Net GHG emission reductions or removals generated by this project will not be used for compliance with an emissions trading program or to meet binding limits on GHG emissions as the host country i.e. Thailand is not a participant in any emission trading programs or nor does it have any binding limits.

PP will not claim the carbon credits under any other GHG emission reduction scheme for the crediting period under VCS and PP has provided declaration on the same during the validation. Hence there is no possibility of double counting. Apart from VCS, it has neither applied nor been rejected under any other GHG program.

Management and operational system:

Verification team 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 01/01/2012 to 11/05/2016.

The allocation of the responsibilities is documented in a written form and is followed as described in the registered VCS PD/26/. 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/02/ and ER sheets/04/.

The monitoring plan described in section 3.3 of the MR is confirmed to be correct. All the parameters of the monitoring plan are monitored using appropriate metering system.

The 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.

Implementation status of the monitoring plan:

Verification team confirms through on-site verification and from the document review, the actual monitoring system complies with the monitoring plan mentioned in the registered VCS-PD/26/.

During the verification, all relevant monitoring parameters of the registered monitoring plan have been verified with regard to the appropriateness of the verification method; the correctness of the values applied for ER calculation, the accuracy and applied QA/QC measures. All monitoring parameters have been measured / determined without material misstatements and are in line with all applicable standards and relevant requirements. It is confirmed that the monitoring mechanism is effective and reliable.

Therefore, from the document review and onsite verification, it is confirmed that all the parameters were monitored in accordance with the registered monitoring plan during the monitoring period. Following are the details of monitoring in accordance with the monitoring plan of the registered VCS PD/26/:

Monitored Parameter	Assessment/Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	$Q_{y,ww}$ Volume of wastewater treated in the year y (m^3)
Measuring/Reading/Recording	Continuous monitoring and daily recording

frequency	Measurement are undertaken using flow meter (FM 1 and FM 2) The measured data is logged in on a daily basis. The monitoring practice is consistent with registered monitoring plan. Parameter is recorded by the operators once every shift in the log sheets. The biogas supervisor collects the log sheet data from the operators on a daily basis. The supervisor checks the value recorded by the operators, calculate daily quantity of wastewater treated and enters into excel 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 PD.																																		
Type of monitoring equipment:	The monitoring equipment details have been checked during the site visit and found consistent. <u>FM1 at pump sump</u> <table border="1"> <tr> <th>Period of usage</th><th>Beginning – 10/03/2013</th></tr> <tr> <td>Meter name</td><td>FM1</td></tr> <tr> <td>Serial Number</td><td>ZAP0573</td></tr> <tr> <td>Brand</td><td>Euromag</td></tr> <tr> <td>Type</td><td>MUT 1000EL</td></tr> <tr> <td>Accuracy</td><td>±0.20%</td></tr> <tr> <td>Calibration Frequency</td><td>Once in 3 years</td></tr> <tr> <td>Calibration Date</td><td>29/11/2011</td></tr> <tr> <td>Validity</td><td>28/11/2014</td></tr> </table> <table border="1"> <tr> <th>Period of usage</th><th>11/03/2013 – 23/09/2013</th></tr> <tr> <td>Serial Number</td><td>LA020720000</td></tr> <tr> <td>Brand</td><td>Endress Hauser</td></tr> <tr> <td>Type</td><td>PROMAG 10L</td></tr> <tr> <td>Accuracy</td><td>±0.50%</td></tr> <tr> <td>Calibration Frequency</td><td>Once in 3 years</td></tr> <tr> <td>Calibration Date</td><td>23/10/2012 10/06/2014</td></tr> <tr> <td>Validity</td><td>09/06/2017</td></tr> </table> <u>From 24/09/2013 onwards, one additional meter (FM2) was installed at covered lagoon 2 (CL2) as well as FM1 was relocated from pump</u>	Period of usage	Beginning – 10/03/2013	Meter name	FM1	Serial Number	ZAP0573	Brand	Euromag	Type	MUT 1000EL	Accuracy	±0.20%	Calibration Frequency	Once in 3 years	Calibration Date	29/11/2011	Validity	28/11/2014	Period of usage	11/03/2013 – 23/09/2013	Serial Number	LA020720000	Brand	Endress Hauser	Type	PROMAG 10L	Accuracy	±0.50%	Calibration Frequency	Once in 3 years	Calibration Date	23/10/2012 10/06/2014	Validity	09/06/2017
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Calibration Date	23/10/2012 10/06/2014																																		
Validity	09/06/2017																																		

	<u>sump to covered lagoon 1 (CL1)</u>	
	Meter name	FM1
	Serial Number	LA020720000
	Brand	Endress Hauser
	Type	PROMAG 10L
	Accuracy	±0.50%
	Calibration Frequency	Once in 3 years
	Calibration Date	23/10/2012 10/06/2014
	Validity	09/06/2017
	Meter name	FM2
	Serial Number	M102FC20000
	Brand	Endress Hauser
	Type	PROMAG 10L
	Accuracy	±0.50%
	Calibration Frequency	Once in 3 years
	Calibration Date	30/01/2013 10/06/2014
	Validity	09/06/2017
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Verification team has checked the accuracy class of the flow meters and found as per industry standard.	
Calibration frequency /interval:	The defined calibration frequency by the PP is at least once every 3 years which is in compliance with the registered VCS PD.	
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Yes, it is conformed that the calibration frequency represents a good monitoring practice	
Company performing the calibration:	The calibrations were carried out by “Miracle International Technology Co Ltd” and “Endress+Hauser” /08/. Both are accredited laboratories to do the calibration.	
Did calibration confirm proper functioning of monitoring	Yes, Verification team has checked the calibration certificates and meters were found functioning properly.	

equipment? (Yes / No):																													
Is (are) calibration(s) valid for the whole reporting period?	Yes																												
If applicable, has the reported data been crosschecked with other available data?	NA																												
How were the values in the monitoring report verified?	FM1 at pump sump <table><tr><th>Monitoring Period</th><th colspan="2">Value (m³)</th></tr><tr><td>01/01/2012 to 31/12/2012</td><td colspan="2">1,077,712</td></tr><tr><td>01/01/2013 to 23/09/2013</td><td colspan="2">310,282</td></tr></table> FM1 and FM2 at covered lagoon 1 (CL1) and covered lagoon 2 (CL2) <table><tr><th rowspan="2">Monitoring Period</th><th colspan="2">Value (m³)</th></tr><tr><th>FM1</th><th>FM2</th></tr><tr><td>24/09/2013 to 31/12/2013</td><td>94,442</td><td>84,439</td></tr><tr><td>01/01/2014 to 31/12/2014</td><td>274,889</td><td>393,265</td></tr><tr><td>01/01/2015 to 31/12/2015</td><td>82,955</td><td>49,532</td></tr><tr><td>01/01/2016 to 11/05/2016</td><td>184,840</td><td>83,296</td></tr></table> The values mentioned in the monitoring report and ER sheet were verified with the operator log sheets/05/. The reported values in the MR and ER sheet were found to be consistent with the operator log sheet information.			Monitoring Period	Value (m ³)		01/01/2012 to 31/12/2012	1,077,712		01/01/2013 to 23/09/2013	310,282		Monitoring Period	Value (m ³)		FM1	FM2	24/09/2013 to 31/12/2013	94,442	84,439	01/01/2014 to 31/12/2014	274,889	393,265	01/01/2015 to 31/12/2015	82,955	49,532	01/01/2016 to 11/05/2016	184,840	83,296
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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?	The data management procedure is transparent; which ensure correct transfer of data and reporting of emission reductions.																												

Monitored Parameter	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	COD _{ww,untreated,y} COD of wastewater entering the covered lagoon reactor system (mg/l)
Measuring/Reading/Recording frequency:	Daily COD analysis is carried out every operational day by the laboratory in-charge and the values are reported to the biogas supervisor on a daily basis. The biogas supervisor checks the values and transfers the data into electronic format (Excel sheets) and stores. The COD content is analyzed using a colorimetric method in the on-site laboratory of the treatment plant. The COD sampling points are before

	covered lagoons.																
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, The measuring and reporting frequency is inline with the monitoring plan.																
Type of monitoring equipment:	The monitoring equipment details have been checked during the site visit and found consistent. <table border="1"> <tr> <td>Meter name</td><td>Spectrophotometer</td></tr> <tr> <td>Serial Number</td><td>HI19945I</td></tr> <tr> <td>Brand</td><td>Hanna</td></tr> <tr> <td>Type</td><td>HI 83214</td></tr> <tr> <td>Accuracy</td><td>10 mg/l (HR) 1 mg/l (LR)</td></tr> <tr> <td>Calibration Frequency</td><td>Once in 3 years</td></tr> <tr> <td>Calibration Date</td><td>14/07/2010 16/08/2012 27/09/2013</td></tr> <tr> <td>Validity</td><td>26/09/2016</td></tr> </table>	Meter name	Spectrophotometer	Serial Number	HI19945I	Brand	Hanna	Type	HI 83214	Accuracy	10 mg/l (HR) 1 mg/l (LR)	Calibration Frequency	Once in 3 years	Calibration Date	14/07/2010 16/08/2012 27/09/2013	Validity	26/09/2016
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Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Verification team has checked the accuracy class of the Spectrophotometer and found as per industry standard.																
Calibration frequency /interval:	The defined calibration frequency by the PP is at least once every 3 years.																
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Yes, it is conformed that the calibration frequency represents a good monitoring practice																
Company performing the calibration:	The calibrations were carried out by "Hanna Instruments (Thailand) Ltd." /08/ which is an accredited laboratory to do the calibration.																
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes, Verification team has checked the calibration certificates and meters were found functioning properly.																
Is (are) calibration(s) valid for the whole reporting period?	Yes																
If applicable, has the reported data been crosschecked with other available data?	The wastewater samples are sent to an external laboratory /06/ once in a year as per the monitoring plan. The verification team confirms that the COD values determined by the internal laboratory are close to that of																

	external laboratory results.												
How were the values in the monitoring report verified?	<table border="1"> <thead> <tr> <th>Monitoring Period</th><th>Average Value (mg/l)</th></tr> </thead> <tbody> <tr> <td>01/01/2012 to 31/12/2012</td><td>20,236</td></tr> <tr> <td>01/01/2013 to 31/12/2013</td><td>18,417</td></tr> <tr> <td>01/01/2014 to 31/12/2014</td><td>17,211</td></tr> <tr> <td>01/01/2015 to 31/12/2015</td><td>22,685</td></tr> <tr> <td>01/01/2016 to 11/05/2016</td><td>30,824</td></tr> </tbody> </table> The values mentioned in the monitoring report and ER sheet were verified with the operator log sheets/05/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.	Monitoring Period	Average Value (mg/l)	01/01/2012 to 31/12/2012	20,236	01/01/2013 to 31/12/2013	18,417	01/01/2014 to 31/12/2014	17,211	01/01/2015 to 31/12/2015	22,685	01/01/2016 to 11/05/2016	30,824
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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.												

Monitored Parameter	Assessment/ Observation				
Data / Parameter: (as in monitoring plan of the VCS PD):	COD _{out,lagoon,PJ,y} COD of water coming out of the last lagoon (tonnes/m ³)				
Measuring/Reading/Recording frequency:	Daily, COD analysis is carried out every operational day by the laboratory in-charge and the values are reported to the biogas supervisor on a daily basis. The biogas supervisor checks the values and transfers the data into electronic format (Excel sheets) and stores. The COD content is analyzed using a colorimetric method in the on-site laboratory of the treatment plant. The COD sampling points are after the last lagoons.				
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, The measuring and reporting frequency is inline with the monitoring plan.				
Type of monitoring equipment:	The monitoring equipment details have been checked during the site visit and found consistent. <table border="1"> <tbody> <tr> <td>Meter name</td><td>Spectrophotometer</td></tr> <tr> <td>Serial Number</td><td>HI19945I</td></tr> </tbody> </table>	Meter name	Spectrophotometer	Serial Number	HI19945I
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Serial Number	HI19945I				

	Brand	Hanna													
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	Calibration Frequency	Once in 3 years													
	Calibration Date	14/07/2010 16/08/2012 27/09/2013													
	Validity	26/09/2016													
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Verification team has checked the accuracy class of the Spectrophotometer and found as per industry standard.														
Calibration frequency /interval:	The defined calibration frequency by the PP is at least once every 3 years.														
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Yes, it is conformed that the calibration frequency represents a good monitoring practice														
Company performing the calibration:	The calibrations were carried out by "Hanna Instruments (Thailand) Ltd." /08/ which is an accredited laboratory to do the calibration.														
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes, Verification team has checked the calibration certificates and meters were found functioning properly.														
Is (are) calibration(s) valid for the whole reporting period?	Yes														
If applicable, has the reported data been crosschecked with other available data?	The wastewater samples are sent to an external laboratory /06/ once in a year as per the monitoring plan. The verification team confirms that the COD values determined by the internal laboratory are close to that of external laboratory results.														
How were the values in the monitoring report verified?	<table border="1"> <thead> <tr> <th>Monitoring Period</th><th>Value (tonnes/m³)</th></tr> </thead> <tbody> <tr> <td>01/01/2012 to 31/12/2012</td><td>0.000514</td></tr> <tr> <td>01/01/2013 to 31/12/2013</td><td>0.000518</td></tr> <tr> <td>01/01/2014 to 31/12/2014</td><td>0.000819</td></tr> <tr> <td>01/01/2015 to 31/12/2015</td><td>0.000875</td></tr> <tr> <td>01/01/2016 to 11/05/2016</td><td>0.000434</td></tr> </tbody> </table> The values mentioned in the monitoring report and ER sheet were			Monitoring Period	Value (tonnes/m ³)	01/01/2012 to 31/12/2012	0.000514	01/01/2013 to 31/12/2013	0.000518	01/01/2014 to 31/12/2014	0.000819	01/01/2015 to 31/12/2015	0.000875	01/01/2016 to 11/05/2016	0.000434
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	verified with the operator log sheets/05/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place.

Monitored Parameter	Assessment/ Observation																
Data / Parameter: (as in monitoring plan of the VCS PD):	COD _{out,CL,y} COD of water coming out of the covered lagoon (tonnes/m ³)																
Measuring/Reading/Recording frequency:	Daily, COD analysis is carried out every operational day by the laboratory in-charge and the values are reported to the biogas supervisor on a daily basis. The biogas supervisor checks the values and transfers the data into electronic format (Excel sheets) and stores. The COD content is analyzed using a colorimetric method in the on-site laboratory of the treatment plant. The COD sampling points are after covered lagoons.																
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, The measuring and reporting frequency is inline with the monitoring plan.																
Type of monitoring equipment:	The monitoring equipment details have been checked during the site visit and found consistent. <table border="1"> <tr> <td>Meter name</td><td>Spectrophotometer</td></tr> <tr> <td>Serial Number</td><td>HI19945I</td></tr> <tr> <td>Brand</td><td>Hanna</td></tr> <tr> <td>Type</td><td>HI 83214</td></tr> <tr> <td>Accuracy</td><td>10 mg/l (HR) 1 mg/l (LR)</td></tr> <tr> <td>Calibration Frequency</td><td>Once in 3 years</td></tr> <tr> <td>Calibration Date</td><td>14/07/2010 16/08/2012 27/09/2013</td></tr> <tr> <td>Validity</td><td>26/09/2016</td></tr> </table>	Meter name	Spectrophotometer	Serial Number	HI19945I	Brand	Hanna	Type	HI 83214	Accuracy	10 mg/l (HR) 1 mg/l (LR)	Calibration Frequency	Once in 3 years	Calibration Date	14/07/2010 16/08/2012 27/09/2013	Validity	26/09/2016
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Validity	26/09/2016																
Is accuracy of the monitoring equipment as stated in the	Verification team has checked the accuracy class of the Spectrophotometer and found as per industry standard.																

VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?																					
Calibration frequency /interval:	The defined calibration frequency by the PP is at least once every 3 years.																				
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Yes, it is conformed that the calibration frequency represents a good monitoring practice.																				
Company performing the calibration:	The calibrations were carried out by “Hanna Instruments (Thailand) Ltd.” /08/ which is an accredited laboratory to do the calibration.																				
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes, Verification team has checked the calibration certificates and meters were found functioning properly.																				
Is (are) calibration(s) valid for the whole reporting period?	Yes																				
If applicable, has the reported data been crosschecked with other available data?	The wastewater samples are sent to an external laboratory /06/ once in a year as per the monitoring plan. The verification team confirms that the COD values determined by the internal laboratory are close to that of external laboratory results.																				
How were the values in the monitoring report verified?	<table><tr><th rowspan="2">Monitoring Period</th><th colspan="2">Value (tonnes/m³)</th></tr><tr><th>CL1</th><th>CL2</th></tr><tr><td>01/01/2012 to 31/12/2012</td><td>0.001431</td><td>0.001704</td></tr><tr><td>01/01/2013 to 31/12/2013</td><td>0.001307</td><td>0.001691</td></tr><tr><td>01/01/2014 to 31/12/2014</td><td>0.001459</td><td>0.001730</td></tr><tr><td>01/01/2015 to 31/12/2015</td><td>0.001437</td><td>0.001876</td></tr><tr><td>01/01/2016 to 11/05/2016</td><td colspan="2">0.001446*</td></tr></table> *From 01/01/2016 to 12/05/2016, the collected samples from both CLs was mixed for conducting one analysis. The values mentioned in the monitoring report and ER sheet were verified with the operator log sheets/05/. The reported values in the MR and ER sheet were found to be consistent with the daily reports and the operator log sheet information.	Monitoring Period	Value (tonnes/m³)		CL1	CL2	01/01/2012 to 31/12/2012	0.001431	0.001704	01/01/2013 to 31/12/2013	0.001307	0.001691	01/01/2014 to 31/12/2014	0.001459	0.001730	01/01/2015 to 31/12/2015	0.001437	0.001876	01/01/2016 to 11/05/2016	0.001446*	
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01/01/2016 to 11/05/2016	0.001446*																				
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC	Yes, it is confirmed from document review and onsite verification that the data management ensures correct transfer of data and reporting of emission reductions and the necessary QA/QC procedures are in place.																				

processes in place?																																	
Monitored Parameter	Assessment/ Observation																																
Data / Parameter: (as in monitoring plan of the VCS PD):	BG_{combusted,y} Amount of biogas combusted for gainful use (Nm³)																																
Measuring/Reading/Recording frequency:	Continuous monitoring, recorded on the daily basis. The monitored data was recorded into the log sheet on daily basis. Calculated from a summation of total biogas utilized in boilers, generation sets																																
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes																																
Type of monitoring equipment:	The monitoring equipment details have been checked during the site visit and found consistent. <u>Boiler 1</u> <table border="1"> <tr><td>Meter name</td><td>GM1</td></tr> <tr><td>Serial Number</td><td>N1-TD02-9544598</td></tr> <tr><td>Brand</td><td>Siemens</td></tr> <tr><td>Type</td><td>7MF4433-1BA22-1AC96-Z</td></tr> <tr><td>Accuracy</td><td>±0.075%</td></tr> <tr><td>Calibration Frequency</td><td>Once in 3 years</td></tr> <tr><td>Calibration Date</td><td>30/11/2011 12/01/2014</td></tr> <tr><td>Validity</td><td>11/01/2017</td></tr> </table> <u>Boiler 2</u> <table border="1"> <tr><td>Meter name</td><td>GM4</td></tr> <tr><td>Serial Number</td><td>N1-V905-9663007</td></tr> <tr><td>Brand</td><td>Siemens</td></tr> <tr><td>Type</td><td>7MF4433-1BA22-1AC96-Z</td></tr> <tr><td>Accuracy</td><td>±0.075%</td></tr> <tr><td>Calibration Frequency</td><td>Once in 3 years</td></tr> <tr><td>Calibration Date</td><td>29/11/2011 11/01/2014</td></tr> <tr><td>Validity</td><td>10/01/2017</td></tr> </table>	Meter name	GM1	Serial Number	N1-TD02-9544598	Brand	Siemens	Type	7MF4433-1BA22-1AC96-Z	Accuracy	±0.075%	Calibration Frequency	Once in 3 years	Calibration Date	30/11/2011 12/01/2014	Validity	11/01/2017	Meter name	GM4	Serial Number	N1-V905-9663007	Brand	Siemens	Type	7MF4433-1BA22-1AC96-Z	Accuracy	±0.075%	Calibration Frequency	Once in 3 years	Calibration Date	29/11/2011 11/01/2014	Validity	10/01/2017
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Validity	11/01/2017																																
Meter name	GM4																																
Serial Number	N1-V905-9663007																																
Brand	Siemens																																
Type	7MF4433-1BA22-1AC96-Z																																
Accuracy	±0.075%																																
Calibration Frequency	Once in 3 years																																
Calibration Date	29/11/2011 11/01/2014																																
Validity	10/01/2017																																

	<u>Generator</u>	
	Period of usage	Beginning – 25/07/2015
	Meter name	GM3
	Serial Number	7569
	Brand	FOX
	Type	FT2
	Accuracy	1%R + 0.2%FS
	Calibration Frequency	Once in 3 years
	Calibration Date	29/11/2011 22/01/2014
	Validity	21/01/2017
	Period of usage	26/07/2015 – 11/05/2016
	Meter name	GM3
	Serial Number	5314
	Brand	FOX
	Type	FT2
	Accuracy	1%R + 0.2%FS
	Calibration Frequency	Once in 3 years
	Calibration Date	13/05/2015
	Validity	12/05/2018
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	The accuracy of the meters is as per standard industry practice.	
Calibration frequency /interval:	Once in 3 years which is found in compliance with the registered monitoring plan/26/.	
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	From the verified calibration reports, it is conformed that the calibration frequency is inline with the VCS PD and represents good monitoring practice	
Company performing the calibration:	The calibration was carried out by “Miracle International Technology Co Ltd” /08/. (MIT) is accredited calibration laboratory for flow measurement in accordance with ISO/IEC17025 No. 0147 issued by the Thai Industrial Standards Institute (TISI).	

Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration certificates were checked and the meter was found functioning properly.												
If applicable, has the reported data been crosschecked with other available data?	NA												
How were the values in the monitoring report verified?	There are 3 gas meters installed for measurement of biogas combusted (GM1 – boiler1, GM4 – boiler 2, and GM3 - generator). However, as per the deviation 1 of the project description deviation, the biogas value from boiler 1 (GM1) was excluded from the biogas combusted for a conservative estimation of baseline emissions. <table border="1"> <thead> <tr> <th>Monitoring Period</th><th>Value (Nm³)</th></tr> </thead> <tbody> <tr> <td>01/01/2012 to 31/12/2012</td><td>8,286,814</td></tr> <tr> <td>01/01/2013 to 31/12/2013</td><td>4,392,271</td></tr> <tr> <td>01/01/2014 to 31/12/2014</td><td>5,931,050</td></tr> <tr> <td>01/01/2015 to 31/12/2015</td><td>9,214,407</td></tr> <tr> <td>01/01/2016 to 11/05/2016</td><td>1,478,273</td></tr> </tbody> </table> The values mentioned in the monitoring report and ER sheet were verified with the operator log sheets/05/. The reported values in the MR and ER sheet were found to be consistent with the operator log sheet information.	Monitoring Period	Value (Nm ³)	01/01/2012 to 31/12/2012	8,286,814	01/01/2013 to 31/12/2013	4,392,271	01/01/2014 to 31/12/2014	5,931,050	01/01/2015 to 31/12/2015	9,214,407	01/01/2016 to 11/05/2016	1,478,273
Monitoring Period	Value (Nm ³)												
01/01/2012 to 31/12/2012	8,286,814												
01/01/2013 to 31/12/2013	4,392,271												
01/01/2014 to 31/12/2014	5,931,050												
01/01/2015 to 31/12/2015	9,214,407												
01/01/2016 to 11/05/2016	1,478,273												
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?	The data management procedure is transparent; which will ensure correct transfer of data and reporting of emission reductions.												

Monitored Parameter	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	W _{CH4} Methane content in biogas (%)
Measuring/Reading/Recording frequency:	During the monitoring period, as the online monitoring equipment was not available for continuous measurement, the portable gas analyzer was used for periodic measurement (on every shift) and the measured values were applied 95% confidence level. The lower and upper values were used for calculation of baseline and project emissions in a conservative manner which is accepted to the verification team.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	During the monitoring period, as the online monitoring equipment was not available for continuous measurement, the portable gas analyzer was used for periodic measurement (on every shift) and the measured values were applied 95% confidence level. The lower and upper values were used for calculation of baseline and project emissions in a conservative manner which is accepted to the verification team.
Type of monitoring equipment:	The monitoring equipment details have been checked during the site

	visit and found consistent. The equipment information of portable gas analyzers can be found at the table below. <table border="1"> <tr> <td>Period of usage</td><td>01/01/2012 – present</td></tr> <tr> <td>Meter name</td><td>MS</td></tr> <tr> <td>Serial Number</td><td>G503004</td></tr> <tr> <td>Brand</td><td>Geotech</td></tr> <tr> <td>Type</td><td>BIOGAS 5000</td></tr> <tr> <td>Accuracy</td><td>0.5%</td></tr> <tr> <td>Calibration Frequency</td><td>Once in 3 years</td></tr> <tr> <td>Calibration Date</td><td>16/11/2011 22/01/2014</td></tr> <tr> <td>Validity</td><td>21/01/2017</td></tr> </table>	Period of usage	01/01/2012 – present	Meter name	MS	Serial Number	G503004	Brand	Geotech	Type	BIOGAS 5000	Accuracy	0.5%	Calibration Frequency	Once in 3 years	Calibration Date	16/11/2011 22/01/2014	Validity	21/01/2017
Period of usage	01/01/2012 – present																		
Meter name	MS																		
Serial Number	G503004																		
Brand	Geotech																		
Type	BIOGAS 5000																		
Accuracy	0.5%																		
Calibration Frequency	Once in 3 years																		
Calibration Date	16/11/2011 22/01/2014																		
Validity	21/01/2017																		
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Verification team has checked the accuracy class of the portable gas analyzer and found as per industry standard.																		
Calibration frequency /interval:	The defined calibration frequency by the PP is at least once every 3 years which is in compliance with the registered VCS PD.																		
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Yes																		
Company performing the calibration:	The calibration was carried out by “Geotechnical Instruments (UK) Limited” and “QED Environmental Systems Ltd.” /08/ which are accredited institutions to perform such calibrations.																		
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																		
If applicable, has the reported data been crosschecked with other available data?	NA																		
How were the values in the monitoring report verified?	<table border="1"> <tr> <th rowspan="2">Monitoring Period</th><th colspan="2">Value (%)</th></tr> <tr> <th>Lower</th><th>Upper</th></tr> </table>	Monitoring Period	Value (%)		Lower	Upper													
Monitoring Period	Value (%)																		
	Lower	Upper																	

	01/01/2012 to 31/12/2012	52.7	53.9
	01/01/2013 to 31/12/2013	53.1	54.6
	01/01/2014 to 31/12/2014	50.4	50.9
	01/01/2015 to 31/12/2015	50.0	51.4
	01/01/2016 to 11/05/2016	49.6	51.1
	The values mentioned in the monitoring report and ER sheet were verified with the operator log sheets/05/. The reported values in the MR and ER sheet were found to be consistent with the operator log sheet information.		
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The data management procedure is transparent; which will ensure correct transfer of data and reporting of emission reductions.		

Monitored Parameter	Assessment/ Observation														
Data / Parameter: (as in monitoring plan of the VCS PD):	BG _{TOFlare, y} Amount of biogas flared (Nm ³)														
Measuring/Reading/Recording frequency:	Continuous monitoring, recorded on the daily basis. The parameter is measured on a continuous basis by gas flow meter (GM2). The measured data by the flow meter is logged in on a daily basis by the operators. The biogas supervisor collects the log sheets on a daily basis, calculates the daily consumption of biogas and enters the data in Excel sheet.														
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, The measuring and reporting frequency is inline with the monitoring plan.														
Type of monitoring equipment:	The monitoring equipment details have been checked during the site visit and found consistent. <table border="1"> <tr> <td>Meter name</td><td>GM2</td></tr> <tr> <td>Serial Number</td><td>7568</td></tr> <tr> <td>Brand</td><td>FOX</td></tr> <tr> <td>Type</td><td>FT2-12I</td></tr> <tr> <td>Accuracy</td><td>1%R + 0.2%FS</td></tr> <tr> <td>Calibration Frequency</td><td>Once in 3 years</td></tr> <tr> <td>Calibration Date</td><td>29/11/2011</td></tr> </table>	Meter name	GM2	Serial Number	7568	Brand	FOX	Type	FT2-12I	Accuracy	1%R + 0.2%FS	Calibration Frequency	Once in 3 years	Calibration Date	29/11/2011
Meter name	GM2														
Serial Number	7568														
Brand	FOX														
Type	FT2-12I														
Accuracy	1%R + 0.2%FS														
Calibration Frequency	Once in 3 years														
Calibration Date	29/11/2011														

		28/04/2016												
	Validity	27/04/2019												
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Verification team has checked the accuracy class of the gas flow meter and found as per industry standard.													
Calibration frequency /interval:	The defined calibration frequency by the PP is at least once every 3 years which is in compliance with the registered VCS PD.													
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	No. Though there were calibration gap during 28/11/2014 – 27/04/2016. There was no biogas flared during this monitoring period. Thus, no error had been applied to the emission reduction.													
Company performing the calibration:	The calibration was carried out by “Miracle International Technology Co Ltd” /08/. (MIT) is accredited calibration laboratory for flow measurement in accordance with ISO/IEC17025 No. 0147 issued by the Thai Industrial Standards Institute (TISI).													
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?	No. Though there were calibration gap during 28/11/2014 – 27/04/2016. There was no biogas flared during this monitoring period. Thus, no error had been applied to the emission reduction.													
If applicable, has the reported data been crosschecked with other available data?	NA													
How were the values in the monitoring report verified?	There was no biogas flared during this monitoring period. The values mentioned in the monitoring report and ER sheet have been verified with the log books/05/ and found consistent. <table><tr><th>Monitoring Period</th><th>Value (Nm³)</th></tr><tr><td>01/01/2012 to 31/12/2012</td><td>0</td></tr><tr><td>01/01/2013 to 31/12/2013</td><td>0</td></tr><tr><td>01/01/2014 to 31/12/2014</td><td>0</td></tr><tr><td>01/01/2015 to 31/12/2015</td><td>0</td></tr><tr><td>01/01/2016 to 11/05/2016</td><td>0</td></tr></table>		Monitoring Period	Value (Nm ³)	01/01/2012 to 31/12/2012	0	01/01/2013 to 31/12/2013	0	01/01/2014 to 31/12/2014	0	01/01/2015 to 31/12/2015	0	01/01/2016 to 11/05/2016	0
Monitoring Period	Value (Nm ³)													
01/01/2012 to 31/12/2012	0													
01/01/2013 to 31/12/2013	0													
01/01/2014 to 31/12/2014	0													
01/01/2015 to 31/12/2015	0													
01/01/2016 to 11/05/2016	0													
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and	The data management procedure is transparent; which will ensure correct transfer of data and reporting of emission reductions.													

are necessary QA/QC processes in place?	
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Monitored Parameter	Assessment/ Observation																														
Data / Parameter: (as in monitoring plan of the VCS PD):	$q_{FO, y}$ Quantity of fossil fuel used in boiler in year y. (Litres)																														
Measuring/Reading/Recording frequency:	Continuously monitored using flow meter and daily recording. The parameter is recorded in log sheets on a shift basis and reported to Supervisor on a daily basis. The supervisor after checking the value, transfers the daily quantity of fuel oil into electronic files. The practice found to be followed during site visit and consistent with registered monitoring plan.																														
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. The measuring and reporting frequency of the parameter is inline with the monitoring plan and also with the monitoring methodology. There are 2 boilers at the starch factory. However, as per the deviation 1 of the project description deviation, the oil meter value of boiler 1 was excluded in a conservative manner which is accepted to the verification team.																														
Type of monitoring equipment:	The monitoring equipment details have been checked during the site visit and found consistent. <u>Boiler 1</u> <table border="1"> <tr><td>Meter name</td><td>OM1</td></tr> <tr><td>Serial Number</td><td>4546871</td></tr> <tr><td>Brand</td><td>CONTOIL</td></tr> <tr><td>Type</td><td>VZO 20FL 130/25</td></tr> <tr><td>Accuracy</td><td>1%</td></tr> <tr><td>Calibration Frequency</td><td>Once in 3 years</td></tr> <tr><td>Calibration Date</td><td>29/11/2011 22/01/2014</td></tr> <tr><td>Validity</td><td>21/01/2017</td></tr> </table> <u>Boiler 2</u> <table border="1"> <tr><td>Period of usage</td><td>Beginning – 31/07/2015</td></tr> <tr><td>Meter name</td><td>OM2</td></tr> <tr><td>Serial Number</td><td>4126168</td></tr> <tr><td>Brand</td><td>CONTOIL</td></tr> <tr><td>Type</td><td>VZO 20FL 130/25</td></tr> <tr><td>Accuracy</td><td>1%</td></tr> <tr><td>Calibration Frequency</td><td>Once in 3 years</td></tr> </table>	Meter name	OM1	Serial Number	4546871	Brand	CONTOIL	Type	VZO 20FL 130/25	Accuracy	1%	Calibration Frequency	Once in 3 years	Calibration Date	29/11/2011 22/01/2014	Validity	21/01/2017	Period of usage	Beginning – 31/07/2015	Meter name	OM2	Serial Number	4126168	Brand	CONTOIL	Type	VZO 20FL 130/25	Accuracy	1%	Calibration Frequency	Once in 3 years
Meter name	OM1																														
Serial Number	4546871																														
Brand	CONTOIL																														
Type	VZO 20FL 130/25																														
Accuracy	1%																														
Calibration Frequency	Once in 3 years																														
Calibration Date	29/11/2011 22/01/2014																														
Validity	21/01/2017																														
Period of usage	Beginning – 31/07/2015																														
Meter name	OM2																														
Serial Number	4126168																														
Brand	CONTOIL																														
Type	VZO 20FL 130/25																														
Accuracy	1%																														
Calibration Frequency	Once in 3 years																														

	Calibration Date	29/11/2011 26/08/2014					
	Validity	25/08/2017					
	Period of usage	01/08/2015 - present					
	Meter name	OM2					
	Serial Number	5449943					
	Brand	CONTOIL					
	Type	VZF20RC 130/16					
	Accuracy	1%					
	Calibration Frequency	Once in 3 years					
	Calibration Date	05/05/2015 07/05/2016					
	Validity	06/05/2019					
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Verification team has checked the accuracy class of the flow meter and found as per industry standard.						
Calibration frequency /interval:	The defined calibration frequency by the PP is at least once every 3 years.						
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Yes, it is conformed that the calibration frequency represents a good monitoring practice.						
Company performing the calibration:	The calibration was carried out by "Miracle International Technology Co Ltd" /08/. (MIT) is accredited calibration laboratory for flow measurement in accordance with ISO/IEC17025 No. 0147 issued by the Thai Industrial Standards Institute (TISI).						
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						
If applicable, has the reported data been crosschecked with other available data?	NA						
How were the values in the monitoring report verified?	<table border="1"> <thead> <tr> <th>Monitoring Period</th><th>Value (litres)</th></tr> </thead> <tbody> <tr> <td>01/01/2012 to 31/12/2012</td><td>144,260</td></tr> </tbody> </table>			Monitoring Period	Value (litres)	01/01/2012 to 31/12/2012	144,260
Monitoring Period	Value (litres)						
01/01/2012 to 31/12/2012	144,260						

	01/01/2013 to 31/12/2013	41,730
	01/01/2014 to 31/12/2014	26,790
	01/01/2015 to 31/12/2015	118,307
	01/01/2016 to 11/05/2016	94,286
	The values mentioned in the monitoring report and ER sheet were verified with the operator log sheets/05/. The reported values in the MR and ER sheet were found to be consistent with the operator log sheet information.	
	There are two boilers and each boiler has been provided with a flow meter. As per the deviation 1 of the project description deviation, the oil meter value of boiler 1 was excluded in a conservative manner.	
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?	The data management procedure is transparent; which will ensure correct transfer of data and reporting of emission reductions.	

Monitored Parameter	Assessment/ Observation								
Data / Parameter: (as in monitoring plan of the VCS PD):	Qstarch, y Quantity of dry starch produced (Tonnes)								
Measuring/Reading/Recording frequency:	Daily production is recorded in log sheets. The starch production details are reported to the plant manager on a daily basis. The practice found to be followed during site visit and consistent with registered monitoring plan.								
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. The measuring and reporting frequency of the parameter is inline with the monitoring plan and also with the monitoring methodology.								
Type of monitoring equipment:	The monitoring equipment details have been checked during the site visit and found consistent. <table border="1"> <tr> <td>Meter name</td><td>Indicators for floor scale</td></tr> <tr> <td>Serial Number</td><td>B406274156 B406274200 B301690263 B315226070 B316230849</td></tr> <tr> <td>Brand</td><td>Ohaus</td></tr> <tr> <td>Model</td><td>T32XW</td></tr> </table>	Meter name	Indicators for floor scale	Serial Number	B406274156 B406274200 B301690263 B315226070 B316230849	Brand	Ohaus	Model	T32XW
Meter name	Indicators for floor scale								
Serial Number	B406274156 B406274200 B301690263 B315226070 B316230849								
Brand	Ohaus								
Model	T32XW								

	Accuracy	±2%													
	Calibration Frequency	Once a year													
	Calibration Date	06/09/2011 02/09/2012 29/08/2013 29/08/2014 15/08/2015													
	Validity	15/08/2016													
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	It is as per standard industry practice.														
Calibration frequency /interval:	Once in an year														
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Yes														
Company performing the calibration:	The calibration was carried out by the relevant department of the industry with the help of the standard weights and hence the same is accepted to the verification team.														
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes. The calibration certificates were checked and the scale was found functioning properly.														
If applicable, has the reported data been crosschecked with other available data?	NA														
How were the values in the monitoring report verified?	<table border="1"> <thead> <tr> <th>Monitoring Period</th><th>Value (tonnes)</th></tr> </thead> <tbody> <tr> <td>01/01/2012 to 31/12/2012</td><td>63,670</td></tr> <tr> <td>01/01/2013 to 31/12/2013</td><td>52,634</td></tr> <tr> <td>01/01/2014 to 31/12/2014</td><td>75,978</td></tr> <tr> <td>01/01/2015 to 31/12/2015</td><td>73,239</td></tr> <tr> <td>01/01/2016 to 11/05/2016</td><td>34,388</td></tr> </tbody> </table> The values mentioned in the monitoring report and ER sheet were verified with the operator log sheets/05/. The reported values in the MR and ER sheet were found to be consistent with the operator log sheet information.			Monitoring Period	Value (tonnes)	01/01/2012 to 31/12/2012	63,670	01/01/2013 to 31/12/2013	52,634	01/01/2014 to 31/12/2014	75,978	01/01/2015 to 31/12/2015	73,239	01/01/2016 to 11/05/2016	34,388
Monitoring Period	Value (tonnes)														
01/01/2012 to 31/12/2012	63,670														
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01/01/2015 to 31/12/2015	73,239														
01/01/2016 to 11/05/2016	34,388														
Does the data management (from monitoring equipment to	The data management procedure is transparent; which will ensure correct transfer of data and reporting of emission reductions.														

emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	
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Monitored Parameter	Assessment/ Observation																												
Data / Parameter: (as in monitoring plan of the VCS PD):	EGy Net electricity production by the generators during year y (MWh/y)																												
Measuring/Reading/Recording frequency:	Continuous monitoring with daily recording The practice found to be followed during site visit and consistent with registered monitoring plan.																												
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. The measuring and reporting frequency of the parameter is inline with the monitoring plan and also with the monitoring methodology.																												
Type of monitoring equipment:	The monitoring equipment details have been checked during the site visit and found consistent. <table border="1"> <tr><td>Meter name</td><td>EM1</td></tr> <tr><td>Serial Number</td><td>62560 1 00N0030</td></tr> <tr><td>Brand</td><td>CARLO GAVAZZI</td></tr> <tr><td>Type</td><td>WM3-06</td></tr> <tr><td>Accuracy</td><td>±0.5%</td></tr> <tr><td>Calibration Frequency</td><td>Once in 3 years</td></tr> <tr><td>Calibration Date</td><td>Not available</td></tr> </table> <table border="1"> <tr><td>Meter name</td><td>EM2</td></tr> <tr><td>Serial Number</td><td>62560 1 00N0034</td></tr> <tr><td>Brand</td><td>CARLO GAVAZZI</td></tr> <tr><td>Type</td><td>WM3-06</td></tr> <tr><td>Accuracy</td><td>±0.5%</td></tr> <tr><td>Calibration Frequency</td><td>Once in 3 years</td></tr> <tr><td>Calibration Date</td><td>Not available</td></tr> </table>	Meter name	EM1	Serial Number	62560 1 00N0030	Brand	CARLO GAVAZZI	Type	WM3-06	Accuracy	±0.5%	Calibration Frequency	Once in 3 years	Calibration Date	Not available	Meter name	EM2	Serial Number	62560 1 00N0034	Brand	CARLO GAVAZZI	Type	WM3-06	Accuracy	±0.5%	Calibration Frequency	Once in 3 years	Calibration Date	Not available
Meter name	EM1																												
Serial Number	62560 1 00N0030																												
Brand	CARLO GAVAZZI																												
Type	WM3-06																												
Accuracy	±0.5%																												
Calibration Frequency	Once in 3 years																												
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Serial Number	62560 1 00N0034																												
Brand	CARLO GAVAZZI																												
Type	WM3-06																												
Accuracy	±0.5%																												
Calibration Frequency	Once in 3 years																												
Calibration Date	Not available																												
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring	Verification team has checked the accuracy class of the energy meters and found as per industry standard.																												

practice?	
Calibration frequency /interval:	The defined calibration frequency by the PP is at least once every 3 years.
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	As there was no calibration conducted for the electricity meters, the values were not included in baseline emission calculation for conservative.
Company performing the calibration:	As there was no calibration conducted for the electricity meters, the values were not included in baseline emission calculation for conservative.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	As there was no calibration conducted for the electricity meters, the values were not included in baseline emission calculation for conservative.
If applicable, has the reported data been crosschecked with other available data?	NA
How were the values in the monitoring report verified?	As there was no calibration conducted for the electricity meters, the values were not included in baseline emission calculation for conservative.
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?	The data management procedure is transparent; which will ensure correct transfer of data and reporting of emission reductions.

Monitored Parameter	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	ECy Electricity consumption by wastewater treatment plant in year y (MWh/y)
Measuring/Reading/Recording frequency:	Yearly calculated. Maximum rated consumption is calculated by multiplying total electrical capacity with operational hours with 10% additional factor to be conservative. The total electrical capacity of the equipment installed in the project activity was updated to 485 kW which has been checked by the verification team from the instruments list /11/. The practice found to be followed during site visit and consistent with registered monitoring plan.
Is measuring and reporting frequency in accordance with	Yes. The reporting frequency of the parameter is inline with the monitoring plan and also with the monitoring methodology.

the monitoring plan and monitoring methodology? (Yes / No)													
Type of monitoring equipment:	N/A												
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	N/A												
Calibration frequency /interval:	N/A												
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	N/A												
Company performing the calibration:	N/A												
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	N/A												
If applicable, has the reported data been crosschecked with other available data?	NA												
How were the values in the monitoring report verified?	<table border="1"> <thead> <tr> <th>Monitoring Period</th><th>Value (MWh)</th></tr> </thead> <tbody> <tr> <td>01/01/2012 to 31/12/2012</td><td>4,413</td></tr> <tr> <td>01/01/2013 to 31/12/2013</td><td>4,413</td></tr> <tr> <td>01/01/2014 to 31/12/2014</td><td>4,413</td></tr> <tr> <td>01/01/2015 to 31/12/2015</td><td>4,413</td></tr> <tr> <td>01/01/2016 to 11/05/2016</td><td>1,826</td></tr> </tbody> </table> The calculation mentioned in the ER sheet /04/ was verified and found inline with the registered VCS PD /26/.	Monitoring Period	Value (MWh)	01/01/2012 to 31/12/2012	4,413	01/01/2013 to 31/12/2013	4,413	01/01/2014 to 31/12/2014	4,413	01/01/2015 to 31/12/2015	4,413	01/01/2016 to 11/05/2016	1,826
Monitoring Period	Value (MWh)												
01/01/2012 to 31/12/2012	4,413												
01/01/2013 to 31/12/2013	4,413												
01/01/2014 to 31/12/2014	4,413												
01/01/2015 to 31/12/2015	4,413												
01/01/2016 to 11/05/2016	1,826												
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?	The data management procedure is transparent; which will ensure correct transfer of data and reporting of emission reductions.												

Monitored Parameter	Assessment/ Observation
Data / Parameter: (as in monitoring plan of the	Sludge removed and its application

VCS PD):	The quantity of organic material / sludge removed from treatment plant and its application (Tonnes and type of application)																
Measuring/Reading/Recording frequency:	Whenever the sludge is removed, the quantity shall be recorded and documented. The practice found to be followed during site visit and consistent with registered monitoring plan.																
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. The measuring and reporting frequency of the parameter is inline with the monitoring plan and also with the monitoring methodology.																
Type of monitoring equipment:	The monitoring equipment details have been checked during the site visit and found consistent. <table border="1"> <tr> <td>Meter name</td><td>Weighbridge</td></tr> <tr> <td>Serial Number</td><td>0001648</td></tr> <tr> <td>Brand</td><td>Commandor</td></tr> <tr> <td>Type</td><td>HP-06</td></tr> <tr> <td>Accuracy</td><td>±20 kg</td></tr> <tr> <td>Calibration Frequency</td><td>Every two years</td></tr> <tr> <td>Calibration Date</td><td>12/01/2012 03/06/2014</td></tr> <tr> <td>Validity</td><td>02/06/2016</td></tr> </table>	Meter name	Weighbridge	Serial Number	0001648	Brand	Commandor	Type	HP-06	Accuracy	±20 kg	Calibration Frequency	Every two years	Calibration Date	12/01/2012 03/06/2014	Validity	02/06/2016
Meter name	Weighbridge																
Serial Number	0001648																
Brand	Commandor																
Type	HP-06																
Accuracy	±20 kg																
Calibration Frequency	Every two years																
Calibration Date	12/01/2012 03/06/2014																
Validity	02/06/2016																
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	It is as per the industry standard.																
Calibration frequency /interval:	Once in 2 year which is found in compliance with the registered PDD /26/.																
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	No, Though there were calibration gap during 01/01/2012 to 11/01/2012 and 12/01/2014 to 02/06/2014, the sludge was not removed during this monitoring period. Thus, no error had been applied to the emission reduction.																
Company performing the calibration:	The calibration was carried out by "Government body of Thailand" /08/ which is accepted.																
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes.																
Is (are) calibration(s) valid for	Yes																

the whole reporting period?													
If applicable, has the reported data been crosschecked with other available data?	This was further crosschecked with the monthly report submitted to the Government (Pollution Control Department) /22/ and found No sludge reported.												
How were the values in the monitoring report verified?	<table border="1"> <thead> <tr> <th>Monitoring Period</th><th>Value (tonnes)</th></tr> </thead> <tbody> <tr> <td>01/01/2012 to 31/12/2012</td><td>0</td></tr> <tr> <td>01/01/2013 to 31/12/2013</td><td>0</td></tr> <tr> <td>01/01/2014 to 31/12/2014</td><td>0</td></tr> <tr> <td>01/01/2015 to 31/12/2015</td><td>0</td></tr> <tr> <td>01/01/2016 to 11/05/2016</td><td>0</td></tr> </tbody> </table> However, sludge was not removed during the monitoring period. This is confirmed based on onsite interviews.	Monitoring Period	Value (tonnes)	01/01/2012 to 31/12/2012	0	01/01/2013 to 31/12/2013	0	01/01/2014 to 31/12/2014	0	01/01/2015 to 31/12/2015	0	01/01/2016 to 11/05/2016	0
Monitoring Period	Value (tonnes)												
01/01/2012 to 31/12/2012	0												
01/01/2013 to 31/12/2013	0												
01/01/2014 to 31/12/2014	0												
01/01/2015 to 31/12/2015	0												
01/01/2016 to 11/05/2016	0												
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?	The data management procedure is transparent; which will ensure correct transfer of data and reporting of emission reductions.												

Monitored Parameter	Assessment/ Observation										
Data / Parameter: (as in monitoring plan of the VCS PD):	$Q_{\text{biogas, flare, h}}$ Biogas sent to flare during a particular hour h (Nm^3/hr)										
Measuring/Reading/Recording frequency:	Continuous monitoring. The parameter is measured on a continuous basis by gas flow meter (GM2). Log record shall be maintained on an hourly basis to ascertain net amount of biogas has gone to flare unit during a particular hour.										
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes, The measuring and reporting frequency is inline with the monitoring plan.										
Type of monitoring equipment:	The monitoring equipment details have been checked during the site visit and found consistent. <table border="1"> <tbody> <tr> <td>Meter name</td><td>GM2</td></tr> <tr> <td>Serial Number</td><td>7568</td></tr> <tr> <td>Brand</td><td>FOX</td></tr> <tr> <td>Type</td><td>FT2-12I</td></tr> <tr> <td>Accuracy</td><td>1%R + 0.2%FS</td></tr> </tbody> </table>	Meter name	GM2	Serial Number	7568	Brand	FOX	Type	FT2-12I	Accuracy	1%R + 0.2%FS
Meter name	GM2										
Serial Number	7568										
Brand	FOX										
Type	FT2-12I										
Accuracy	1%R + 0.2%FS										

	Calibration Frequency	Once in 3 years												
	Calibration Date	29/11/2011 28/04/2016												
	Validity	27/04/2019												
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Verification team has checked the accuracy class of the gas flow meter and found as per industry standard.													
Calibration frequency /interval:	The defined calibration frequency by the PP is at least once every 3 years which is in compliance with the registered VCS PD.													
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	No. Though there were calibration gap during 28/11/2014 – 27/04/2016. There was no biogas flared during this monitoring period. Thus, no error had been applied to the emission reduction.													
Company performing the calibration:	The calibration was carried out by “Miracle International Technology Co Ltd” /08/. (MIT) is accredited calibration laboratory for flow measurement in accordance with ISO/IEC17025 No. 0147 issued by the Thai Industrial Standards Institute (TISI).													
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?	No. Though there were calibration gap during 28/11/2014 – 27/04/2016. There was no biogas flared during this monitoring period. Thus, no error had been applied to the emission reduction.													
If applicable, has the reported data been crosschecked with other available data?	NA													
How were the values in the monitoring report verified?	There was no biogas flared during this monitoring period. The values mentioned in the monitoring report and ER sheet have been verified with the log books/05/ and found consistent. <table><tr><th>Monitoring Period</th><th>Value (Nm³/hr)</th></tr><tr><td>01/01/2012 to 31/12/2012</td><td>0</td></tr><tr><td>01/01/2013 to 31/12/2013</td><td>0</td></tr><tr><td>01/01/2014 to 31/12/2014</td><td>0</td></tr><tr><td>01/01/2015 to 31/12/2015</td><td>0</td></tr><tr><td>01/01/2016 to 11/05/2016</td><td>0</td></tr></table>		Monitoring Period	Value (Nm ³ /hr)	01/01/2012 to 31/12/2012	0	01/01/2013 to 31/12/2013	0	01/01/2014 to 31/12/2014	0	01/01/2015 to 31/12/2015	0	01/01/2016 to 11/05/2016	0
Monitoring Period	Value (Nm ³ /hr)													
01/01/2012 to 31/12/2012	0													
01/01/2013 to 31/12/2013	0													
01/01/2014 to 31/12/2014	0													
01/01/2015 to 31/12/2015	0													
01/01/2016 to 11/05/2016	0													
Does the data management (from monitoring equipment to emission reduction	The data management procedure is transparent; which will ensure correct transfer of data and reporting of emission reductions.													

calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	
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Monitored Parameter	Assessment/ Observation				
Data / Parameter: (as in monitoring plan of the VCS PD):	$\eta_{\text{flare,h}}$ Flare efficiency (%)				
Measuring/Reading/Recording frequency:	Continuous monitoring, record on the daily basis The condition was not met as per the monitoring plan. To be conservative on the project emission calculation, the flare efficiency of 0% default was taken into account. However, there was no record of flame detection since no biogas was flared during the monitoring period.				
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. The measuring and reporting frequency of the parameter is inline with the monitoring plan and also with the monitoring methodology.				
Type of monitoring equipment:	N/A				
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	N/A				
Calibration frequency /interval:	N/A				
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	N/A				
Company performing the calibration:	N/A				
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	N/A				
If applicable, has the reported data been crosschecked with other available data?	N/A				
How were the values in the monitoring report verified?	<table border="1"> <thead> <tr> <th>Monitoring Period</th><th>Value (%)</th></tr> </thead> <tbody> <tr> <td> </td><td> </td></tr> </tbody> </table>	Monitoring Period	Value (%)		
Monitoring Period	Value (%)				

	01/01/2012 to 31/12/2012	0
	01/01/2013 to 31/12/2013	0
	01/01/2014 to 31/12/2014	0
	01/01/2015 to 31/12/2015	0
	01/01/2016 to 11/05/2016	0
	There was no record of flame detection since no biogas was flared during the monitoring period.	
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The data management procedure is transparent; which will ensure correct transfer of data and reporting of emission reductions.	

Remaining Issues from Validation or Previous Verification:

From the review of the validation report and the previous verification report for Monitoring period “03/12/2009 to 31/12/2011”, Verification team has found that there is no remaining FAR to be addressed during this verification.

4.2 Accuracy of GHG Emission Reduction and Removal Calculations

The verification team has reviewed the emission reduction (ER) spread sheet and checked all the formulae and found they are correct and inline with the monitoring plan of the registered VCS PD and the applied monitoring methodology.

All the monitored parameters are described above in section 4.1. All the ex-ante parameters which are used in the calculation of emission reduction are presented in section 3.1 of the MR transparently. It is confirmed that all the ex-ante parameters have been correctly used in the emission reduction calculation.

Baseline emissions:

It is noted that the formula and calculation used for baseline emission calculation in the monitoring report and ER sheet is in compliance with the registered VCS PD. The default values and data used in the monitoring report /02/ is in-line with the registered PD/26/. Hence, accepted.

Project Emissions:

It is noted that the formula and calculation used for project emission calculation in the monitoring report and ER sheet is in compliance with the registered VCS PD. The default values and data used in the monitoring report /02/ is in-line with the registered PD/26/. Hence, accepted.

Leakage:

The used technology is not equipment transferred from another activity, therefore according to the AMS.III.H, there is no leakage to be considered. All the equipment used in the project activity for power and heat generation is either already existing or brought for purpose of project activity and there is no shifting of old equipment takes place. Therefore, there is no leakage as per AMS.I.C and AMS.I.D.

Hence no leakage is considered in the project activity which is in compliance with the registered VCS PD.

The following are the ex-ante parameters used in the ER calculation which are in compliance with registered VCS PD/26/:

Parameter	Description	Value	Unit
GWP_{CH_4}	Global warming potential for methane gas	25	tCO ₂ e/tCH ₄
$B_{0,ww}$	Methane producing capacity of the wastewater	0.21	kg CH ₄ /kg COD
UF_{BL}	Model correction factor to account for model uncertainties	0.94	Factor
UF_{PJ}	Model correction factor to account for model uncertainties	1.06	Factor
$MCF_{ww,treatment,BL,Lagoon}$	Methane correction factor for baseline wastewater treatment systems i	0.8	Fraction
$MCF_{ww,treatment,PJ,CL}$	Methane correction factor for project wastewater treatment system covered lagoon equipped with biogas recovery	0.8	Fraction
$MCF_{ww,treatment,PJ,lagoon}$	Methane correction factor for project secondary wastewater treatment system k	0.8	Fraction
COD removal efficiency-baseline	Chemical oxygen demand removal efficiency of baseline treatment system	87.16%	%
CFE_{ww}	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems.	0.9	-
EF_y	CO ₂ emission factor for grid power	0.5057	tCO ₂ /MWh
EF_{CO_2}	Emission factor of fossil fuel replaced – residual fuel oil	77.4	tCO ₂ /TJ
NCV_{FO}	NCV of fuel oil i.e. fossil fuel displaced by biogas	42.76	GJ/tonne
NCV_{biogas}	NCV of biogas	20.93	MJ/Nm ³
$Q_{FO,starch}$	Liters of fossil fuel required per tonne of dry starch historically	39.6	l/tonne
D_{CH_4}	Density of methane at normal conditions	0.716	kg/m ³
D_{FO}	Density of fuel oil	0.93	kg/liter
FE	Flare efficiency	50%	%
DE	Destruction efficiency of the electricity generator	100%	%
P_{el}	Total electrical capacity of the equipment installed in the project activity	458	kW

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 emission reduction is calculated using both COD approach and MD approach as specified by the applied methodology, AMS III.H., version 13. The total emission reduction for the monitoring period calculated by MD approach and by COD approach is stated below.

Emission reductions						
	Parameter	2012	2013	2014	2015	2016
AMS III. H.	ER - COD	60,306	22,697	29,146	6,969	22,631

	ER - MD	75,995	39,483	51,252	80,303	12,201
	ER_{ww,y}	60,306	22,697	29,146	6,969	12,201
AMS I. C.	ER_{heat,y}	7,316	2,390	3,646	5,539	1,700
AMS I. D.	ER_{power,y}					
ER for the project activity		67,622	25,087	32,792	12,508	13,901
Total ERs (tCO₂e)		151,910				

As there was no calibration conducted for the electricity meters, the values for the monitoring parameters “EGy - Net electricity production by the generators during year y (MWh/y)” were not included in baseline emission calculation for conservativeness. Hence the emission reduction from AMS-I.D. is considered as zero which is conservative and hence accepted.

Verification team has checked the justification by PP for the increase in the emission reduction compare to the ex-ante estimation as per the registered VCS PD /26/ and found convincing. The detailed emission reduction calculation is presented in the ER spread sheet/04/. 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.

4.3 Quality of Evidence to Determine GHG Emission Reductions and 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. 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.

It was verified through onsite interviews that the plant's team involved in the monitoring of project activity is well experienced. Hence, the verification team concludes that competent staff is employed by the project proponent to carry out the relevant tasks with sufficient accuracy. Furthermore, it was learnt from the onsite interviews with the operating team that internal training program /25/ are conducted on regular basis.

4.4 Non-Permanence Risk Analysis

Not Applicable to the project activity

5 SAFEGUARDS

5.1 No Net Harm

The project activity has no potential negative environment and social-economic impacts. Assessment team confirms it based on its on-site visit, document review and local & sectoral expertise.

5.2 Local Stakeholder Consultation

The local stakeholder consultation meeting for the project activity has been conducted on project site on 10/07/2008 and the process was validated during the registration of project activity under

VCS. VCS validation report verified to confirm the same. The PP had invited identified stakeholders well in advance. The stakeholder meeting process is described in the section 6 of the registered VCS PD in detail. Further the verification team has interviewed the local stakeholders during the on-site visit for this verification and could not find any negative impact out of the project activity.

6 VERIFICATION CONCLUSION

KBS Certification Services Pvt. Ltd. has been contracted by 'South Pole Carbon Asset Management Ltd.' to undertake independent periodic verification and certification for the greenhouse gas (GHG) emission reductions reported from "Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)", for the monitoring period 01/01/2012 to 11/05/2016 (including both the days).

The verification is based on the registered VCS PD and the monitoring report for this project activity. Our verification approach was based on the requirements as defined under the Kyoto Protocol, Marrakech accord, as well as those defined by the CDM Executive Board and the VCS Standard Version 3.7.

The management of 'Kean Charoen Co., Ltd.' and 'South Pole Carbon Asset Management Ltd.' is responsible for the preparation of the GHG emissions data and the reported GHG emissions reductions on the basis set out within the project Final Monitoring Report Version 03 and dated 11/06/2019. The calculation and determination of GHG emission reductions from the project is the responsibility of the management of 'Kean Charoen Co., Ltd.' and 'South Pole Carbon Asset Management Ltd.'. The development and maintenance of records and reporting procedures are in accordance with the Monitoring Report Version 03 and dated 11/06/2019.

It is our responsibility to express an independent GHG verification opinion on the GHG emissions and on the calculation of GHG emission reductions from the project for the period 01/01/2012 to 11/05/2016 based on the reported emission reductions in the Final Monitoring Report Version 03 and dated 11/06/2019 for the same period.

As a result of the verification, the verification team confirms that:

- All operations of the project are implemented and installed as planned and described in the project description.
- The monitoring system is in place and functional.
- The installed equipment essential for generating emission reductions runs reliably.
- The GHG emission reductions are calculated without material misstatements in a conservative and appropriate manner.

Based on an understanding of the risks associated with reporting GHG emissions data and the controls in place to mitigate these, KBS planned and performed our work to obtain the information and explanations that we considered necessary to provide sufficient evidence for us to give reasonable assurance that this reported amount of GHG emission reductions for the period is fairly stated.

Verification period: From [01-01-2012] to [11-05-2016]

Verified GHG emission reductions and removals in the above verification period:

Year	Net GHG emission reductions or removals (tCO ₂ e)
2012	67,622

(01/01/2012 to 31/12/2012)	
2013 (01/01/2013 to 31/12/2013)	25,087
2014 (01/01/2014 to 31/12/2014)	32,792
2015 (01/01/2015 to 31/12/2015)	12,508
2016 (01/01/2016 to 11/05/2016)	13,901
Total	151,910

Location: Faridabad
Date: 12/06/2019



Authorized Signatory: Kaushal Goyal
Designation: Managing Director
KBS Certification Services Pvt. Ltd.

APPENDIX 1: ABBREVIATIONS

Abbreviations	Full texts
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CDM EB	CDM Executive Board
CL	Clarification request
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
COD	Chemical Oxygen Demand
DOE	Designated Operational Entity
EB	Executive Board
ER	Emission Reduction
FAR	Forward Action Request
GHG	Greenhouse Gas(es)
MP	Monitoring Plan
MR	Monitoring Report
PD	Power Density
PP	Project Participant
QA/QC	Quality Assurance / Quality Control
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Verified Carbon Standard
VCSA	VCS Association
VCS PD	VCS Project Design document

VCU	Verified Carbon Unit
VVS	Validation And Verification Standard

APPENDIX 2: REFERENCES

S. No.	Name of document	date
/1/	Draft Monitoring Report	Version 01, dated 05/04/2019
/2/	Final Monitoring Report	Version 03, dated 11/06/2019
/3/	Draft ER sheet corresponding to Monitoring report Version 01	Version 01, dated 05/04/2019
/4/	Final ER sheet corresponding to Monitoring report Version 03	Version 03, dated 11/06/2019
/5/	Daily reports for all the monitoring parameters.	-
/6/	COD Measurement from External Laboratory during this monitoring period	-
/7/	Operating License by Industrial Ministry: For starch production, Valid till 01/01/2024	-
/8/	Calibration certificates for the instruments used in the project activity covering this monitoring Period	-
/9/	Competency proof of the calibrating agency.	-
/10/	Extract of manual of all the major equipments and all meters/measuring instruments/devices clearly indicating their specifications/ technical details corresponding to the project activity.	-
/11/	List of auxiliary drives along with their rated capacity	-
/12/	Operation Manual of Biogas Plant	-
/13/	COD sampling method.	-
/14/	Operation start date of the project activity, as per the first record of biogas sent to boiler	-
/15/	VCS Verified Carbon Standard: VCS Monitoring Report Template Version 3.4	19 October 2016
/16/	Single line diagram corresponding to the project activity describing the monitoring points	-

/17/	Snap shots of the following 1. Equipments: Covering the equipment and corresponding nameplates under project boundary (all major equipments). 2. All the meters and measuring & testing equipment (including their specifications/nameplates).	-
/18/	1. Extract of operation and maintenance record 2. Records of outage	-
/19/	Competency certificates of operators.	-
/20/	Flare specification	-
/21/	All the Government approvals e.g. from local section and ministry of industry, Thailand. Operational permit.	-
/22/	Sludge removal and its application - "Monthly performance reporting to Department of Pollution Control" for the monitoring period.	-
/23/	Work Instructions for the Operation of wastewater treatment plant, emergency plan for biogas leakage, COD test and waste water sampling	-
/24/	Organization structure	-
/25/	Training reports corresponding to this monitoring period	-
/26/	VCS registered PD for project: "Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)"	Version 3.1 dated 13/11/2009
/27/	CDM-EB: Clean Development Mechanism Validation and Verification Standard for project activities	Version 02.0
/28/	TÜV NORD CERT GmbH: Validation report for the project "Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)", report number 53208409-09/309 issued on 17/11/2009	Dated 17/11/2009
/29/	Germanischer Lloyd Certification GmbH: Verification report of the project "Chol Charoen Group Wastewater Treatment with Biogas System I (Khonkaen)" for the monitoring period 03/12/2009 to 31/12/2011, Version 04, dated 04/06/2012.	Dated 04/06/2012
/30/	Small-Scale CDM methodologies: AMS-I.C: "Thermal energy production with or without electricity", version 15, AMS-I.D: "Grid connected renewable electricity	-

	generation", version 14, AMS-III.H: "Methane Recovery in Wastewater Treatment", version 13	
/31/	"Tool to determine project emissions from flaring gases containing methane", version 01. Tool to calculate project leakage CO2 emissions from fossil fuel combustion", version 1.2 Tool to calculate baseline, project and/or leakage emissions from electricity consumption" version 1.0. "Tool to calculate the emission factor for an electricity system" version 1.1.	Version 01 Version 1.2 Version 1.0 Version 1.1
/32/	VCS Verified Carbon Standard: VCS Program Guide, v3.7	21 June 2017
/33/	VCS Verified Carbon Standard: VCS Standard, v3.7	21 June 2017
/34/	VCS Verified Carbon Standard: VCS Verification Report Template Version 3.4	19 October 2016
/35/	VCS Verified Carbon Standard: VCS Guidance, Validation and Verification Manual, Version 3.2	19 October 2016
/36/	Starch Production details along with the sales record.	-
/37/	Meter change documents	-
/38/	Thailand grid emission factor: The calculation of emission factor for an electricity system in Thailand 2007 by Thailand Greenhouse Gas Organization (TGO).	-

APPENDIX 3: COMPETENCE OF TEAM MEMBERS AND TECHNICAL REVIEWERS

Personnel Name:		Chetan Swaroop Sharma	
Qualified to work as:			
Team Leader	☒	Technical Expert	☒
Validator/Verifier	☒	Financial Expert	☒
Technical Reviewer	☒	Local Expert (India)	☒
Area(s) of Technical Expertise			
Sectoral Scope		Technical Area	

Energy industries (renewable/non-renewable sources)	TA 1.2: Energy generation from renewable energy sources
	TA 1.1: Thermal energy generation from fossil fuels and biomass including thermal electricity from solar
Approved by (Manager C & T)	Gagandeep Kakkar
Approval date:	09/10/2015

Personnel Name:		Rohit Badaya	
Qualified to work as:			
Team Leader	☒	Technical Expert	☒
Validator/Verifier	☒	Financial Expert	☒
Technical Reviewer	☒	Local Expert (India)	☒
Area(s) of Technical Expertise			
Sectoral Scope		Technical Area	
Energy industries (renewable/non-renewable sources)	TA 1.2: Energy generation from renewable energy sources		
	TA 1.1: Thermal energy generation from fossil fuels and biomass including thermal electricity from solar		
Energy demand	TA 3.1. Energy Demand		
Waste Handling and Disposal	TA 13.1 Solid waste and wastewater		
	TA 13.2 Manure		
Approved By	Manager Competency & Training		
Approval date:	16/10/2017		

APPENDIX 4: CLARIFICATION REQUESTS, CORRECTIVE ACTION REQUESTS AND FORWARD ACTION REQUESTS

Table 1. Remaining FAR from validation and/or previous verifications

No pending FAR from previous verification

FAR ID	xx	Section no.	Date: DD/MM/YYYY
Description of FAR			
Project participant response			Date: DD/MM/YYYY

Documentation provided by project participant	
DOE assessment	Date: DD/MM/YYYY

Table 2. CL from this verification

CL ID	01	Section no.	-	Date: 29/04/2019
Description of CL				
From the submitted Monitoring report, the monitoring points for the monitoring parameters are not clear. PP need to mention the monitoring points for each of the monitoring parameter.				
Project participant response				Date: 31/05/2019
The monitoring points for each of the monitoring parameters have been provided and explained in section 3.2 of the revised monitoring report.				
Documentation provided by project participant				
The revised MR version 2 date 31/05/2019				
DOE assessment				Date: 10/06/2019
Corrections have been done in the revised MR /02/ and found OK. Hence this CL is closed.				

Table 3. CAR from this verification

CAR ID	01	Section no.	-	Date: 29/04/2019
Description of CAR				
1. From the section 3.2 of the submitted monitoring report, Verification team has found that Calibration of the monitoring equipment is not covering this monitoring period. PP need to submit the Calibration reports covering the monitoring period and accordingly revise Monitoring report. 2. From the section 3.2 of the submitted monitoring report and the on-site interview, Verification team has found that monitoring equipment has been changed during this monitoring period. PP need to mention the Period of Usage in the Monitoring report. Also submit the supportive document to substantiate the same.				
Project participant response				Date: 31/05/2019

- The calibration details of the monitoring equipment have been updated in section 3.2 of the revised monitoring report. The calibration reports of all the monitoring equipment have been provided to the DOE. - The following equipment was changed during the monitoring period. The Period of Usage has been provided in section 3.2 of the revised monitoring report. The supportive document has been submitted to the DOE. - Replacement of new FM1 at pump sump during 10 – 11/03/2013 and the same was moved to installed at the covered lagoon 1 during 23 – 24/09/2013 - Installation of a new water flow meter (FM2) at the covered lagoon 2 during 23 – 24/09/2013 - Start of using the portable gas analyzer from 01/01/2012 onwards	
Documentation provided by project participant	
- The revised MR version 2 date 31/05/2019 - The revised ER spreadsheet version 2 date 30/05/2019 - The calibration reports	
DOE assessment	Date: 11/06/2019
- Calibration details have been updated in the revised MR /02/ and found OK. The same is also checked from the submitted calibration reports /08/. Hence this part of CAR is closed. - Period of usage for the instruments has been mentioned in the revised MR /02/ and found OK. The same is also checked from the supportive /37/ and found OK. Hence this part of CAR is closed.	

CAR ID	02	Section no.	-	Date: 29/04/2019
Description of CAR				
As per the requirement of VCS Monitoring Report Template:				
- Under section 3.3 of the submitted Monitoring report, PP needs to mention the line diagram to display the GHG data collection. - PP needs to fill the section 1.9 of the submitted Monitoring Report.				
Project participant response				Date: 31/05/2019
- The monitoring diagram for data collection has been provided in section 3.3 of the revised monitoring report. - The details have been inserted in section 1.9 of the revised monitoring report.				
Documentation provided by project participant				
The revised MR version 2 date 31/05/2019				
DOE assessment				Date: 10/06/2019
- Correction has been done in the revised MR /02/ and found OK. Hence this part of CAR is closed. - Correction has been done in the revised MR /02/ and found OK. Hence this part of CAR is closed.				

CAR ID	03	Section no.	-	Date: 29/04/2019
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Description of CAR	
From the review of the registered VCS PD, verification team has found that the monitoring parameter "COD _{out,lagoon} " is not reported under section 3.2 of the submitted Monitoring report.	
Project participant response	Date: 31/05/2019
COD _{out, lagoon, PJ, y} has been provided under Section 3.2 of the revised monitoring report.	
Documentation provided by project participant	
The revised MR version 2 date 31/05/2019	
DOE assessment	Date: 10/06/2019
Correction has been done in the revised MR /02/ and found ok. Hence this CAR is closed.	

CAR ID	04	Section no.	-	Date: 29/04/2019
Description of CAR				
During the on-site visit, verification team has found that two meters have been installed (one flow meter for each Covered Lagoon) to monitor the monitoring parameter Q _{y,ww} . PP need to update the same in the monitoring report and also submit the supportive document.				
Project participant response				Date: 31/05/2019
During the monitoring period, the monitoring equipment for parameter Q _{y,ww} was changed from one flow meter (FM1) at pump sump measuring the amount of wastewater sent to two covered lagoons to two flow meters (FM1 and FM2) at each covered lagoon. The following period of usage and monitoring diagram have been updated under section 3.2 and section 3.3, respectively, of the revised monitoring report.				
- Replacement of new FM1 at pump sump during 10 – 11/03/2013 and the same was moved to installed at the covered lagoon 1 during 23 – 24/09/2013 - Installation of a new water flow meter (FM2) at the covered lagoon 2 during 23 – 24/09/2013				
Documentation provided by project participant				
The revised MR version 2 date 31/05/2019				
DOE assessment				Date: 10/06/2019
Correction has been done in the revised MR /02/ and found OK. Verification team has checked the supportive document for the meter change /37/ and found the PP justification convincing. Hence this CAR is closed.				

CAR ID	05	Section no.	-	Date: 29/04/2019
Description of CAR				
During the site visit, verification team has found that the serial number for the biogas meter GM1 mentioned in the submitted MR is not correct.				
Project participant response				Date: 31/05/2019
The serial number of GM1 has been corrected from N1-TD02-9544958 to N1-TD02-9544598 in section 3.2 of the revised MR.				
Documentation provided by project participant				
- The revised MR version 2 date 31/05/2019 - Nameplate of GM1				
DOE assessment				Date: 10/06/2019
Correction has been done in the revised MR /02/ and found OK. Hence this CAR is closed.				

Table 4. FAR from this verification

No FAR from this verification

FAR ID	xx	Section No.		Date: DD/MM/YYYY
Description of FAR				
Project participant response				Date: DD/MM/YYYY
Documentation provided by project participant				
DOE assessment				Date: DD/MM/YYYY