



Voluntary Carbon Standard 2007.1

Validation Report

Report Number: 53208109-08/510

Name of Verification company:	Date of the issue:
TÜV NORD CERT GmbH	14 November 2009
Report Title:	Approved by:
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Client:	Project Title:
South Pole Carbon Asset Management Ltd	Chol Charoen Group Wastewater Treatment with Biogas System I(Cholburi)

Summary:

The M/s South Pole Carbon Asset Management Ltd. on behalf of M/s Chol Chareon Co. Ltd., has commissioned the TÜV NORD JI/CDM Certification Program to validate (along with 1st verification) the project: “Chol Charoen Group Wastewater Treatment with Biogas System I Cholburi)”, with regard to the relevant requirements of the VCS 2007.1 Guidelines/ VCSA Rules for project activities, as well as criteria for consistent project operations, monitoring and reporting.

The purpose of this project activity is to recover methane from wastewater treatment and combustion of methane for onsite utilisation and flaring, thereby reducing the baseline methane emissions; and baseline grid emission due to power generation. An additional claim for grid electricity displacement is made.

The review of the VCS PD and additional documents related to baseline and monitoring methodology; the subsequent background investigation, follow-up interviews and review of comments by parties, stakeholders have provided TÜV NORD JI/CDM CP with sufficient evidence to validate the fulfilment of the stated criteria.

A risk-based approach has been followed to perform this validation. In the course of the validation, eight (08) Corrective Action Requests (CARs) and one (1) clarification request (CL) were raised and successfully closed. Three (03) Forward Action Request (FARs) are raised, which will be verified during the next verification.

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

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

- The project fulfils criteria of VCS 2007.1 provided.
- The project additionality is sufficiently justified in the PD.
- The monitoring plan is transparent, adequate and inline with the applied baseline and monitoring methodologies AMS III.H/Version 13: “Methane Recovery in Wastewater Treatment”, AMS I.C/Version 15: “Thermal energy production with or without electricity” and AMS I.D/Version 14: “Grid Connected Renewable Electricity Generation” approved small scale methodologies of

UNFCCC CDM program are correctly co-applied. - The calculation of the project emission reductions is carried out in a transparent and conservative manner, so that the calculated emission reductions of 288,810 t CO₂e (total) is most likely to be achieved within the 10 years renewable crediting period starting from 1 January 2007, which will be renewed once. No restrictions or uncertainties were identified related to the validation.	
Work carried out by:	Number of pages:
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1 Introduction

1.1 Objective

The purpose of this validation (carried out along with verification) is to have an independent third party assessment of the project design, in particular, the project's baseline, the additionality, the monitoring plan (MP) and the project's compliance with

- The requirements of VCS 2007.1 program guidelines;
- Requirements of the CDM Approved methodologies i.e. AMS III.H.Version13, AMS I.D Version14 and AMS I.C. Version15, which is adopted by VCSA;^{/AMS.III.H./AMS.I.D./AMS.I.C/.}
- To assess the project's compliance with other relevant rules, including the Project country (Thailand) legislation; and
- Other relevant rules, of VCS sustainability criteria are validated in order to confirm that the project design as documented is sound and reasonable and meet the stated requirements and identified criteria. Validation is seen as necessary to provide assurance to stakeholders on the quality of the project and its intended generation of Verified emission reductions (VERs/VCUs¹) without any double counting.

1.2 Scope and Criteria

The validation scope is given as an independent and objective review of the project design, the project's baseline study and monitoring plan (based on AMS III.H/Version 13: “Methane Recovery in Wastewater Treatment”; AMS I.C/Version 15: “Thermal energy production with or without electricity and AMS I.D/Version 14: “Grid connected renewable electricity generation”) which are included in the VCS-PD and other relevant supporting documents.

The items covered in the validation are described below:

- VCS 2007.1 and Project Country Criteria
 - To meet the requirements of VCS 2007.1 guidelines requirements, in particular,
 - Project country requirements / criteria

¹ As per VCS, Verified Emission Reductions (VERs) are considered to be VCUs only after successful registration in an approved VCU Registry

- VCS Project Description
 - Project design
 - Project boundaries and Predicted VCS project GHG emissions
- Project Baseline
 - Baseline methodology
 - Baseline GHG emissions
- Monitoring Plan
 - Monitoring methodology
 - Indicators/data to be monitored and reported
 - Responsibilities
- Project Additionality
- Background investigation and follow up interviews
- Draft validation reporting with CARs, CLs & FARs, if any
- Final validation reporting.

The information included in the VCS-PD and the supporting documents were reviewed against the requirements and criteria mentioned above. The TÜV NORD CERT GmbH JI/CDM CP has employed a risk-based approach in the validation, focusing on the identification of significant risks for project implementation and the generation of VERs. The validation is based on the information made available to TÜV NORD JI/CDM CP and on the contract conditions.

The validation is not meant to provide any consulting to the project participant. However, stated requests for clarifications and/or corrective actions may provide input for improvement of the project design.

1.3 VCS project Description

Baseline Emissions:

Chol Chareon Co. Ltd., Tapioca starch factory located at in Banbung district of Cholburi province, Thailand. The starch factory started starch production in January 1980. Wastewater from 240 TPD Tapioca Starch Processing was being treated by 13 cascading open anaerobic deep lagoons (of average depth of 6m) before methane capture and destruction/ utilization project was implemented.

The operating days of the starch production is approximately 315 days.^{/LOG/}

Baseline fuel for hot oil boiler was Fuel oil and the baseline electricity for starch factory is grid.

The lagoon treated wastewater was used for on site land disposal and tapioca washing purposes within local pollution control norms.

The final sludge is used for soil applications by the local farmers.

Bio-Methane Recovery Project Description:

The 2,400 m³/production day wastewater is being treated (since January 2006) by 2 Anaerobic Fixed Film Reactor (AFFR) systems (minimum of 80% COD removal efficiency) in parallel before being discharged into existing lagoon system (10).

3 open lagoons were redesigned and converted to covered lagoons in order to store recovered biogas at the outlet of AFFRs.

3 no. of gas engines of total capacity 1952 kW was commissioned in phased manner. Phase-I (952 kW) was commissioned in December 2006 and the phase-II (500 kW) was commissioned in April 2007 and the phase-III (500 kW) in December 2007.

A fuel oil fire hot boiler is retrofitted, in order to utilise recovered biogas from the proposed project activity on 7th January 2006.

Bio-Methane destruction/utilisation:

The starting date of the project, i.e., 1st emission reduction happened on 7 January 2006. This is the date on which retrofitted hot oil boiler become operational on biogas. The same was supported with evidence^{/SD/}. The destruction/utilisation of the biogas was being carried out through following devices:

Enclosed flare, one hot oil boiler (Fuel oil+Biogas) and three biogas engines with a total capacity of 1952 kWh.

Additional claim for grid electricity displacement is made due to biogas utilization for electricity generation, which currently meets the partial demand of the starch factory and in future the excess electricity will be supplied to the grid.

Furthermore the project also made a claim for fuel oil displacement due to biogas utilisation for thermal energy generation.

There is no additional sludge treatment in the project activity. The final sludge disposal continued to be soil application in the project scenario.^{/SDR/}

1.4 Level of assurance

The validation report is based on VCS PD^{/PD1//PD2/}, supporting documents made available to the validation team and information collected through performing interviews and during the on-site assessment. The validation opinion is assured provided the credibility of all above.

2 Methodology

The validation of the project was carried out from June 2009 to November 2009

Preparations	:	05/06/2009-10/06/2009
On-site validation	:	17/06/2009
(Draft) Reporting	:	2009/07/16
(Final) Reporting	:	2009/11/14

The validation consisted of the following three phases:

- a desk review of the project design and the baseline and monitoring methodology
- follow-up interviews
- the resolution of outstanding issues and the issuance of the final validation report and opinion

2.1 Review of Document

The draft PD^{/PD1/} submitted by the M/s South Pole Carbon Asset Management Ltd in June 2009 and supporting background documents related to the project design and baseline were reviewed on 09/06/2009. Furthermore, the validation team used additional documentation by third parties like project country legislation, technical reports referring to the project design or to the basic conditions and technical data.

The documents that were considered during the validation process are given in Annexure-2 of this report. They are listed as follows:

- Documents provided by the project proponent (Table 5-1)

- Background investigation and assessment documents (Table 5-2)
- Websites used (Table 5-3).

2.2 Follow-up Interviews

On 17/06/2009, the TÜV NORD JI/CDM CP performed validation visit with the project proponent at M/s Chol Chareon Co. Ltd., Thailand

During this visit, as well as earlier and after, interviews with the project proponent, the consultant, project stakeholders and with local authorities were carried out to confirm selected information and to resolve issues identified in the document review.

The key interviewee and main topics of the interviews are summarised in Table 2-1.

Table 2-1 Interviewed persons and interview topics

Interviewed Persons / Entities	Interview topics
1. Mr. Narin Ka-jon-cha-lerm-sak 2. Mr. Kamoltorn Chenchom 3. Mr. Pavinee Soparak 4. Mr. Panya Visetchart 5. Mr. Phonpharadon Nampichai 6. Mr. Pathathai Tonsuwonnont 7. Mr. Sithisakdi Apichatthanapath 8. Mr. Pradit Pongpan	- Chronological description of Project with documents of key steps - Technical details of the project realisation- project feasibility, designing, engineering, operational life time - Compliance with local laws and regulations - Monitoring and measurement equipments - Financial aspects - Crediting period - Project activity starting date - VER allocation /ownership - Sustainable development issues - Analysis of local stake holder consultation - Roles & responsibilities of the staff members w.r.t project management, monitoring and reporting - QA/QC and calibration procedures - Editorial aspects of PD - Methodology selection aspects - Base line study, project emissions, leakage and additionality - Details of emission reduction

Interviewed Persons / Entities	Interview topics
	calculation.

A detailed list including the functions or designations of the interviewed persons is given in Annexure-2 (see. Table 5-4). This table also includes reference codes to be used in the validation protocol.

2.3 Resolution of any material discrepancy

A few discrepancies were found during the validation and the validation report containing a set of CARs and CLs were submitted to the project proponent. The project design document was revised addressing the CARs and CLs issued by TÜV NORD JI/CDM CP.

After reviewing the revised and resubmitted project documentation^{/PDD/}; resolving the CARs & CRs raised and outstanding concerns, TÜV NORD JI/CDM CP issues this final validation report and opinion.

3 Validation Findings

The findings of validation are summarised in table 3-1:

Table 3-1: Summary of CAR, FAR and CL issued

Validation topic (Cp VCS Validation Report Template)	No. of CAR	No. of FAR	No. of CL
D- Project Design	01	01	–
B- Baseline and additionality	02	–	01
M- Monitoring plan	02	02	–
C-Calculation of GHG emissions	03	–	–
E- Environmental Impact	–	–	–
L- Local Stakeholder Comments	–	–	–
SUM	08	03	01

For an in depth analysis/evaluation of all CARs and CLs can be referred to the below sections from 3.1 to 3.6.

3.1 Project Design

The conclusions are as follows:

The technology used: Two Anaerobic fixed film reactors (AFFR) in parallel with volumetric capacity of 5,000 m³ each are implemented. In addition, 3 open lagoons at the outlet of the AFFRs were redesigned and converted to covered lagoons in order to increase the gas storage capacity and to further enhance anaerobic treatment of the wastewater. The designed COD removal efficiency of the system is at least 80%.. The project design implementation and its components are as per the project description given in the final PD section 1.4, 1.9 and 2.3 and were evidenced during the site visit and interviews conducted by validation team.^{/IM01/}

The validation team has physically verified all components installed within the project boundary e.g. AFFRs, covered lagoons, open lagoons boilers, flare, pumps and found to be as depicted in figure 4 of VCS PD version 3.1. The monitoring equipments such as flow meters for biogas flow measurement and electricity generated are found to be installed and records were verified. However the certain monitoring equipments such wastewater flow meters were found to be in process of installation and will be completed as depicted in figure 5 of the of the VCS PD version 3.1. Deviation taken for the first monitoring period is described in the appendix-1 of this report.

- Project duration: 15 years (=residual operational life time.)^{/TD/}
- Crediting time: 10 years
- Project start date: 07/01/2006^{/SD/}
- Ownership
 - o Proof of title: The proof of title is considered by following evidences: Evidences of proof of title /ownership (Cp section 8.1 of the VCS-PD template) for actual project^{/PT/} owner “M/s Chol Chareon Co. Ltd., Thailand” are as follows.
 - Company affidavit dated 13.05.1974^{/PT/}
 - Contract for construction, installation and commissioning of biogas system dated 20th December

VCS 2007.1 Validation Report of the GHG emission reduction project entitled “Chol Charoen Group Wastewater Treatment with Biogas System I(Cholburi)”

2004 & contract for installation Biogas engine dated 14 July 2006.^{/PT/}

- The project is not participated and intends to participate in another emission trading program. Hence no double counting applies for this project.^{/UND/}
- This project is not rejected under other GHG programme.
- The project is eligible under the VCS 2007.1 standard.

Nevertheless following FAR D1 is raised and would be closed in next verification.

	D1
Classification	☐ CAR ☒ FAR ☐ CL ☐ None
Findings	Marking of flow direction and name of the fluid on all HDPE pipelines (wastewater, biogas gas) within the project boundary are requested in section 2.3 of the PD to facilitate easy traceability during next verifications.
Corrective Action # 1	Action will be taken according to this recommendation prior to next verification site visit.
DOE Assessment # 1	The compliance will be checked during next periodic verification site visit.
Conclusion	☒ To be checked during the first periodic verification ☐ Appropriate action was taken ☐ Project documentation was corrected correspondingly ☐ Appropriate was action not taken ☐ The project complies with the requirements

	D2
Classification	☒ CAR ☐ FAR ☐ CL ☐ None
Findings	Applied version 09 of the approved methodology AMS III.H is expired and can not be used as per VCS guidelines ^{/vcs-m/} . The PP should use latest approved version of the methodology and make necessary changes in the VCS PD. Also pl. review the corrective actions against all findings raised and justify the compliance to the latest version of the methodology.

	D2
Corrective Action # 1	The VCS PD is updated for change in methodology version. The major impact is observed in estimation of emission reduction are listed as below: - Introduction of model correction factors for baseline and project emissions. - The project emissions ($PE_{ww,treatment,y}$) are estimated for system without biogas recovery, i.e. open lagoon system. - Project emissions are excluded for the methane dissolved in waste water - Project emissions for flaring are included as per the tool for estimating flare emissions. - The baseline emissions and estimated on the basis of lagoon efficiency before the implementation of the project. For ex-post estimations, the emission reductions are estimated as per the para 31 of AMS III.H version 13. Estimation from ex-post approach based on methane destruction approach and COD reduction approach are compared and conservative values are chosen. The same is very transparently described in revised PD.
DOE Assessment # 1	The PD has been revised. Version 13 of Approved SSC Methodology AMS III.H has been correctly applied, which is in accordance with the requirements of VCS 2007.1. Following major changes were validated: 1. Model correction factors for baseline (UF_{BL}) and for project activity emissions (UF_{PJ}) have been correctly applied in the calculations and are in line with the AMS III.H Version 13. 2. Following project emissions have been considered in addition to those considered in the older version of the PD: - Methane emissions from wastewater treatment systems affected by the project activity and not equipped with biogas recovery ($PE_{ww,treatment}$) - Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery ($PE_{s,treatment}$). However it is taken as zero as there is no sludge treatment system in the project activity.

	D2
	- Methane emissions due to incomplete flaring ($PE_{flaring}$) - Methane emissions from biomass stored under anaerobic conditions ($PE_{biomass}$) 3. Following project activity emission have been considered in as per the previously applied version of the approved methodology i.e. AMS III.H version 9, but now have been excluded from the revised PD Ver.03, as the same is no more applicable in AMS III.H version 13: - Emissions from dissolved methane in treated wastewater ($PE_{ww,treated}$ as per AMS III.H ver.09/$PE_{ww,discharge}$ as per ver.13) as the treated wastewater is reused within the starch factory premises and not discharged into sea, river or lake. 4. One year historical data before implementation of the project activity has been used to determine baseline parameters i.e. average COD removal efficiency of the baseline lagoon system, historical starch production data in accordance with the Para 17 of AMS III.H version 13. All the related supportive documents were submitted to the DOE during the course of validation. ^{/BLS/} This was checked and found to be ok. Since necessary corrections have been satisfactorily done in the VCS PD to comply with the change in the methodology version, the revised PD ver.03 is accepted and CAR is closed.
Conclusion	☐ To be checked during the first periodic verification ☒ Appropriate action was taken ☒ Project documentation was corrected correspondingly ☐ Appropriate was action not taken ☒ The project complies with the requirements

3.2 Baseline

The conclusions are as follows:

- The applied baseline methodologies are as follows;
 - o AMS III.H/Version 13 i.e. “Methane Recovery in Wastewater Treatment”
 - o AMS I.C/Version 15 i.e. “Thermal energy production with or without electricity” and

- o AMS I.D/ Version 14 i.e. “Grid connected renewable electricity generation”

which are approved CDM methodologies.

- The AMS III.H, I.C and I.D are correctly co-applied. The justifications on applicability conditions presented in the section 2.2 of VCS-PD are found appropriate.
- There are few deviations taken from the applied methodology, which are described in the appendix-1 of this report.
- The project activity involves the capture of methane from wastewater and avoids methane emission through the modification of exiting lagoon system by two AFFRs. The project also utilizes the captured methane to generate hot oil with the help of dual fuel burners in the hot oil boilers and to generate electricity in the captive gas engines. There is provision for onsite flaring for remaining unutilised biogas. However due to high demand of gas for boiler and gas engine there was no flaring happened in the first monitoring period. The baseline for biogas capture is open anaerobic lagoon and the baseline for bio-methane utilization is burning of fuel oil for hot oil boiler and baseline for electricity is national grid of Thailand.
- The project correctly applies the approved CDM small-scale methodology AMS-III.H, version 13 for methane recovery in wastewater treatment. In addition the project co-applies AMS I.D., version 14 for renewable electricity generation and AMS I.C, Version 15, for utilisation of biogas displacing fuel oil in hot oil boiler. The project is within the eligibility requirements of the baseline methodology since the estimated annual emission reductions due to methane capture and utilisation/destruction from the project activity is 288,810tCO₂e (2007-2016), which is less than the stipulated 60 ktCO₂e/yr limit of the methodology (para 12). The baseline for the project activity is selected as per option (vi) of para 1 of AMS III.H/Version 13 which is, “Introduction of a sequential stage of wastewater treatment with biogas recovery and combustion, with or without sludge treatment, to an existing anaerobic wastewater treatment system without biogas recovery”.

The baseline electricity for starch factory is grid.

Baseline determination for wastewater treatment system (in accordance with AMSIII.H.):

Open lagoon systems represent the prevalent mode of wastewater treatment in Thailand and would have been the continued option for Chol Charoen Co. Ltd., Cholburi in the absence of the project activity. Moreover, the project activity is not mandated by any law, and it has been confirmed that the open lagoon system was in compliance with the existing environmental regulations prior to implementation of the activity. Thus, in the baseline scenario, the spent wash treatment would have been lagoon based wastewater treatment, which would have resulted in methane escaping to the atmosphere. By extracting and capturing methane enriched biogas in the anaerobic digester the project reduces CH₄ emission that would have otherwise emitted from the open lagoon system. Hence, for the proposed VCS project activity, baseline emissions are CH₄ emissions from wastewater treatment systems.

The baseline emissions are calculated correctly as per the equation 1 of the applied baseline methodology i.e. AMS III.H Ver. 13, which is clearly and transparently described in section 4.1 & Section 4.2 of the final PD ver. 3.1. The baseline emissions include BE_{ww, treatment} i.e. Baseline emissions of the wastewater treatment systems affected by the project activity (tCO₂e). Other components of baseline emissions have been neglected either due to non applicability or in order to estimate baseline emission conservatively. These are follows;

BE_{power} i.e. Baseline emissions from electricity or fuel consumption (tCO₂e) is neglected for conservativeness.

BE_{s, treatment} i.e. Baseline emissions of the sludge treatment systems affected by the project activity (tCO₂e) is assumed as zero as there are no sludge treatment in baseline scenario as confirmed during site visit assessments.

BE_{ww, discharge} i.e. Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake (tCO₂e) is also assumed to be zero as there are no discharge of treated waste water into surface waster bodies mentioned in the methodology. During site visit interviews it was concluded that the

treated waste water has been reused inside the factory premises for plantation purpose.

BE_{s, final} i.e. Baseline methane emissions from anaerobic decay of the final sludge produced in year y (tCO₂e) is also neglected as the sludge has been used for soil applications. This is confirmed during the site visit interviews with local stakeholders.

Baseline determination for electricity generation (in accordance with AMS.I.D.):

The electricity baseline(BE) under the adopted methodology AMS I.D. ver.14 is calculated by multiplying the grid emission factor (tCO₂/MWh) and the electricity generated by the 1952 kW Gas engine in accordance with equation (1), para 9 and 10 (a) of AMS I.D version 14.

The ex ante estimation of Energy Baseline (EG_{BL}) is based on fraction of biogas used in gas engine for power generation, designed efficiency of gas engine^{/TD/} and NCV² of biogas. The corresponding supporting documents have been verified and the calculation spread sheet is thoroughly cross checked and the baseline estimation is found to be correct and acceptable.

The project participant used grid emission factor, published by, DEDE, Ministry of Energy, Thailand ^{/P-GEF/} and applied as ex-ante fixed value for baseline emission and project emission estimation as well. The grid emission factor chosen is publicly available and published by the Government of Thailand. The source of the document is verified and the same is found to be authentic and hence it is acceptable to the validation team.

Baseline determination for electricity generation (in accordance with AMSI.C.):

The baseline fuel for thermal energy generation from hot oil boiler is fuel oil. The thermal energy baseline (BE_{thermal,CO2}) is calculated by multiplying the fuel oil emission factor (tCO₂/TJ) to the energy content of fuel oil quantity, which is displaced by biogas in the steam boiler in project scenario. Though it is a deviation from the adopted methodology AMS.I.C ver. 15, it is acceptable to the validation team as the deviated approach is conservative as the deviated approach assumes that extra demand of energy (because of efficiency loss due to dual fuel firing) is provided by the fuel oil alone, and thus

² http://www.dede.go.th/dede/fileadmin/usr/wpd/static/thai_ene_2005/41Convers.pdf

not overestimating the estimated emission reductions. Furthermore the deviation satisfies the requirement of para 5.3, page 13 of VCS 2007.1 standard and does not affect the conservativeness of the baseline and the additionality of the project. Moreover the detailed assessment of the deviation is described in the appendix-1 of the methodology.

The average methane baseline emissions (36,171 tCO₂e per year) are calculated in accordance with equation 2 of AMS III.H ver. 13 and calculation found to be ok.

The average baseline emissions due to grid displacement (1,927 tCO₂e per year) are calculated in accordance with equation (1) of AMS I.D ver. 14 and calculation found to be ok.

The average baseline emissions due to fuel oil displacement (3,244 tCO₂e per year) are calculated as per deviated approach to AMS I.C ver. 15 and calculation found to be ok.

Altogether the project activity reduces emissions of 28,8810 tCO₂e over the ten year crediting period (renewable). This was checked and found to be ok.

Nevertheless, CAR B1 was raised and successfully closed.

B1	
Classification	☒ CAR ☐ FAR ☐ CL ☐ None
Findings	Any deviation/ adjustment from/ with the applied methodologies has to be elaborated in the PD, with justification w.r.t. para 5.3 of VCS 2007.1 on following issues; 1. As per the section 3.3, of PD Version 1/^{PD1}/ the flow of waste water $Q_{y,ww}$ is a measured value whereas as per the section 4.1 of the same PD, the ex post value is calculated instead of monitoring in the absence of flow meters. The same is confirmed during site visit, which is deviating from the requirement of Para 35 of AMS III.H, Version 9. 2. In section 3.3 of PD Version 1/^{PD1}/ describes the amount of biogas flared (Biogas _{Flare}) is to be measured, however during site visit it was observed that there is no flow meter for the same, which is deviating from the requirement of Para 36 of AMS III.H, Version 9. 3. In ER calculation spread sheet/^{XLS1}/ the statistical analysis of CH₄% is not carried out, in the absence of online methane analyser, which is deviating from the requirement of Para 36 of AMS III.H, Version 9 and as well as from the described monitoring plan in section 3.3 of the PD /^{PD1}/. 4. In section 4.1 of PD Version 1/^{PD1}/, the compliance of the para 34 of AMS III.H is not properly addressed (refer CAR M1 also) 5. In section 3.3, auxiliary electricity consumption by the plant is calculated based their rated capacity instead of direct measurement, which is deviating from the requirement of Para 13 of AMS III.H, Version 9. 6. In section 4.1, deviation taken for thermal energy estimation as specified by AMS I.C ver.13 must be adequately justified.

	B1
Corrective Action # 1	All deviations from the methodology have been justified on the basis of conservativeness, as evidence^{/PD2/}, as follows: 1) Calculation of $Q_{w, ww}$ has been elaborated and justified section 4.1 in the final PD under deviation 2. This results in a reduction of VERs from the excel sheet presented in the 1st submission. In future monitoring periods, the values shall be monitored using new meters. 2) The biogas has not been sent to flare for more than 2 years (since 4th June 2006). This was also presented to DOE during an interview with project owner and evidenced in log sheets^{/LOG/}. This is because there is insufficient amount of biogas to be utilised in the boiler of ≈ 3.78 MWth capacity and gas engine sets with capacity of ≈ 2 MWe. This is in fact confirmed by ex-post data in which total electricity generated in both 2007 (3,429 MWh) and 2008 (2,684 MWh) is much lower than its potential as per total installed capacity of ≈ 2 MW^{/XLS1/} (i.e. around 15 to 20% PLF). As well, the fact that 3 open lagoons have been converted into covered lagoons has increased the gas storage capacity of the project activity, thus in the case that the biogas utilisation devices are not under operation, the biogas can still be stored for a considerable period. The gas engine is capable of using biogas at low percentage of CH₄. These statements are supported with evidences. 3) For the 1st verification, periodical measurements of %CH₄ has been made and determined at 95% confidence level and the ER sheet is revised accordingly. Later, monitoring of this parameter will be made using the already incorporated online gas analyser by the generation sets. Hence, the project is now being line with AMS III. H. (Version 9). 4) The project proponent has employed guideline as per Para 34 in section 4.1 of revised PD to estimate emission reduction using amount of biogas recovered and destroyed. In addition the baseline emissions are also estimated on COD removal. The lower of the two values as per paragraph 31 AMS III.H. will be used in estimating emission reductions. This approach is thus conservative and is now in line with the applied methodology. 5) Determination of PE_{y, power} is based maximum rated consumption. This is elaborated in section 4.1 of revised PD under deviation 1 and justified therein.

	B1
DOE Assessment # 1	1. As per industry practice and experience generally the discharge of wastewater pumps are close to the rated capacity based on the head of the pump. Based on the site visit observations, head of the pump and referring to performance curve^{/TD/} of type of pump used by the project it can be concluded that, the assumed 65% discharge factor w.r.t. rated capacity is quite conservative and hence acceptable to the validation Team. Moreover flow meters are already procured and the actual flow to be monitored for the subsequent verifications. The invoice of the 3 new flow meters has been submitted by the PP^{/INV/}. A further detail of this deviation is explained in the appendix-1. 2. The demand of biogas by the boiler and the gas engine is much higher than the generation of biogas from the project. Moreover from the provided log sheets ^{/LOG/} of flaring equipment and interview with PP during Site visit it was evidenced that the flare has not been operated since 4th June 2006 till the date of site visit (17th June 2009). Further the PP has already procured gas flow meter and the monitoring will be done for subsequent verifications.^{/PHOTO/} 3. Though online CH₄ analyser is not installed for the 1st verification period, the monitoring for CH₄ is being done by a portable analyser on daily basis and the data obtained is subjected to statistical analysis CH₄% has been considered at 95% confidence level. The calculation is checked by the validation team and found to be in line with \$ 36 of AMS III.H ver.9. 4. Adequate description is provided in section 4.1 of VCS PD ver. 2.0. The description adequately and appropriately satisfies the requirements of para 34 of AMS III.H ver.09. 5. Since the monitored data is not available the PP has taken deviation. The deviation taken is acceptable as it is not over estimating the VERS and Further in subsequent version of the methodology i.e. AMS III.H ver.10 this method of calculation is provided as an alternative approach for estimation of auxiliary consumption. 6. Since the monitoring mechanism is not available for the measurement of baseline

	B1
	input/output thermal energy, a conservative approach under deviation #1, section 4.1, PD version # 3 has been adopted by PP. The same is verified by the validation team and found to be appropriate and acceptable. All the deviations taken, satisfy the requirement of para 5.3, page 13 of VCS 2007.1 standard. Moreover the validation team confirms that the deviations do not affect the conservativeness of the baseline and the additionality of the project.
Corrective Action #2	1. Calculation is not affected by the change in methodology version. Deviation is explained in PD, and is conservative when comparison in ex-post data estimated is made to expected waste water generation based on starch production values. 2. The flare emissions shall be estimated as per the flaring tool and for the flare efficiency a conservative approach shall be applied during monitoring. 3. The revised PD includes the estimation of emission reduction based on conservative approach for methane percentage and the deviation shall be addressed as per actual monitoring availability during verification in a conservative manner. 4. The approach is still applicable, however the reference is revised to para 31. The corresponding section in PD is revised as per the AMS III.H ver. 13. 5. The approach is still applicable and conservative as per the AMS III.H. ver. 13. 6. The estimation is detailed to be more transparent and detailed.
DOE Assessment # 2	The requirements of para 34 of ver.09 has been transformed into para 30 and para 31 of Ver.13. The revised PD i.e. Ver. 03.1 is found to be complying with the requirements of AMS III.H Ver.13.
Conclusion	☐ To be checked during the first periodic verification ☒ Appropriate action was taken ☒ Project documentation was corrected correspondingly ☐ Appropriate was action not taken ☒ The project complies with the requirements

Demonstration and Assessment of additionality:

The additionality was demonstrated in PD acc. to § 5.8, Test 1 (the Project Test) of the VCS 2007.1 specification^{/VCS/} and the attachment A to Appendix B of the Simplified Modalities and procedures for small-scale CDM project activities, as referred by the applied small-scale CDM methodologies.

Regulatory Surplus: Under step 1 of the project test it has been assured that the project is not undertaken to meet any national or local regulatory requirements. It was verified that there are presently no regulatory requirements that enforce implementation of a specific wastewater treatment technology, such as anaerobic digester or aerobic treatment system to tapioca starch processing plants for effluent treatment³. Current Thai law allows utilization of open lagoon systems for wastewater treatment in the tapioca industry. Furthermore, it was verified on-site that the open lagoon system at the project site is in full compliance with the stipulated environmental legislation prior to implementation of the project activity.

Implementation Barrier: Under step 2 (implementation barrier), investment barrier, technological barrier and institutional barrier have been chosen to argue additionality.

Investment Barrier: The project participant has presented detailed investment barrier analysis in the section 2.5 of the PD as per the CDM EB guidance on investment analysis (EB 41, Annex 45). The project IRR has been chosen as the financial indicator for demonstration of investment barrier. Average Minimum Lending Rate (MLR) of local commercial banks in Thailand at the time of decision making is taken as the benchmark for the investment barrier. The DOE has done thorough check of the IRR calculation spread sheets the basis for assumptions provided by the project participant, and the provided arguments. Moreover relevant background information such as public available sources is taken into account.

Moreover PP has carried out sensitivity analysis of major parameters that can affect the project IRR as per the CDM EB guidance on investment analysis (EB 41, Annex 45).

After successful closure of respective CARs/CLs the validation team has arrived at the conclusion that the

³ Notification by the Ministry of Industry, No. 2, B.E. 2539 (1996) issued under the Factory Act B.E. 2535 (1992)

assumptions and computations in the IRR spreadsheet are in line with the supporting documents provided by the PP. Thus, the validity of IRR calculation can be confirmed. The calculation of the financial indicator (project IRR) reflecting the project’s feasibility in financial terms has demonstrated its additionality when comparing the project IRR with the benchmark value - Minimum Lending Rate (MLR).

Moreover, the sensitivity analysis revealed that the variation of key financial parameters substantiate project’s additionality as the benchmark is still not crossed. One of the major parameter, which affects the IRR calculation is fuel oil price which is assumed based on fuel oil price (wholesale market price) available for only for a period of 1.5 years before investment as per actual invoices^{/INV/} (from January 2001 to July 2002). These prices are compared with the publicly available ex-refinery price for the same period and the correlation is used to backpolate the wholesale price for three years and there year average has been considered for the computation. The sensitivity analysis on fuel price shows that the project IRR has not crossed the benchmark. Thus the approach has been accepted by the DOE. Further assessment on investment barrier is described in the table 3-2;

The applied benchmark value - Thai Minimum Lending Rate (MLR) has been further explained and discussed with the PP during site visit. Investigations on its conservativeness revealed that this value is comparatively low considering other rates at the time of taking the investment decision. MLR⁴ represents the most conservative choice of financial benchmarks for a project IRR comparison among the options provided by the said EB guidance e.g. the other option i.e. weighted average costs of capital (WACC) will be always higher than the MLR as the WACC is also takes cost of equity into account. The overall assessment found to be appropriate and acceptable.

Technological barrier: The baseline scenario i.e. open lagoon system represents the common handling of wastewater from tapioca starch production in Thailand. The related technology, skills and labour are readily available in Thailand and there are few risks associated with this technology and hence the baseline technology

⁴ http://www.bot.or.th/English/Statistics/FinancialMarkets/Interstrate/_layouts/application/interest_rate/IN_Rate.aspx

does not face any technical barriers. Presently, only a few tapioca starch processing facilities have adopted anaerobic digester technology for wastewater treatment in Thailand. Based on the literature review^{5 6} cited in the VCS PD/^{PD2/}, it is confirmed that the project employs a relatively rare technology. Therefore the practice requires skilled labor to operate and maintain the new wastewater system properly is not adequately available in the host country and would therefore represent performance and technology risks. Moreover the anaerobic digestion system requires ongoing precise and rigorous monitoring of a variety of parameters in order to avoid disruptions to the anaerobic treatment process. Thus it is concluded that the project faces technological barriers which is not faced by the realistic and plausible alternatives.

Institutional barrier: Institutional barriers such as social barriers and safety issues associated with biogas storage and handling are adequately described in the section 2.5 of the PD. Moreover the poor coordination among government agencies and especially with the private sector has resulted in barriers for implementation of the biogas projects. Different energy agencies with different roles and responsibilities working under several ministries, lacks suchronisation. Government regulations also do not encourage them to cooperate with the private sector.^{7 8}

However the validation team is of the opinion that though provided arguments are acceptable as these barriers are actually exists (based on site observation and interviews) these are not decisive barriers.

Common practice analysis: Under Step 3, common practice analysis has been found to be in line with chapter 7 of guidance on GHG protocol for project accounting which has been supported with data and authentic documents and reference has been duly cited in section 2.5 of the final PD. Ver 3.1.. Based on the assessment of the validation it can be assured that biogas recovery projects without carbon revenues is not a common practice in the starch processing sector in Thailand. The demonstration of common practice has been found to be acceptable.

⁵ The Promotion of Biogas from Wastewater as An Alternative Energy and for Environmental Improvement, published by the Energy Conservation and Renewable Energy Division and Energy Policy and Planning Office (EPPO), 2007

⁶ Biomass and biogas energy in Thailand: Potential, opportunity and barriers by S. Prasertsana, B. Sajjakulnukitb

⁷ The Promotion of Biogas from Wastewater as An Alternative Energy and for Environmental Improvement, published by the Energy Conservation and Renewable Energy Division and Energy Policy and Planning Office (EPPO), 2007

⁸ Biomass and biogas energy in Thailand: Potential, opportunity and barriers by S. Prasertsana, B. Sajjakulnukitb

The individual arguments presented in the PD (section 2.5) to justify the additionality were summarised in table 3-2. This table also includes the assessment of the validation team.

Table 3-2: Additionality assessment

Step # / Barrier	Demonstration	Assessment
(1) Regulatory surplus	Project is not implemented to meet any applicable local and national regulatory requirements. The proposed project activity is in compliance with all local laws and regulations from the local government and the Ministry of Industry, Thailand.	As confirmed during the site visit interviews and verification of local laws it was concluded that the baseline open lagoon treatment system is also in compliance with the local legal requirements and anaerobic digesters (project case) are not mandated by any enforced regulation in Thailand⁹. Moreover the proposed project activity is in full compliance with local laws and regulations and is demonstrated by the valid operational permit.^{/SC/} ☐ Argument not justified ☐ Argument not convincing ☐ Argument justified but not a decisive barrier ☒ Argument justified / significant barrier
(2): Implementation Barrier		
Investment barrier	The project IRR has been chosen as the financial indicator for demonstration of investment barrier. Average Minimum	As described above under financial additionality the chosen financial indicator i.e. project IRR and the benchmark (MLR) ¹⁰ is

⁹ Notification by the Ministry of Industry, No. 2, B.E. 2539 (1996) issued under the Factory Act B.E. 2535 (1992)

¹⁰ http://www.bot.or.th/English/Statistics/FinancialMarkets/Interstrate/layouts/application/interest_rate/IN_Rate.aspx

Step # / Barrier	Demonstration	Assessment
	Lending Rate (MLR) of local commercial banks in Thailand on 12th July 2002 (investment decision date) at 7.2115% is taken as the benchmark for the investment barrier. The pre-tax project IRR wo-VER revenue (4.65%) is not financially attractive. The pre-tax project IRR w-VER revenue 9.64%(10,534,658 THB) enables to alleviate financial viability of the project as evidenced from the IRR analysis. Further the project IRR found to be sensitive to following parameters; the initial investment, the price of electricity, the price of fossil fuel, the operation and maintenance costs and biogas generation. The results of sensitivity analysis confirms that project activity without carbon revenues is lower than the benchmark, under circumstances which could bring about variations in the above parameters used for the IRR computations.	found to be appropriate as per the para 3 of EB guidance. The comparison of financial indicator and benchmark w-VER and wo-VER were assessed found to be appropriate as per the prevalent accounting principles. Moreover the actual cost has been considered for calculating the project IRR, instead of proposed cost due to non-availability of the data at the time of investment decision. However the proposed cost and investment cost was compared with similar projects in the host country and variation is found to be within 2-3%. Moreover it is also observed that the actual cost is higher than the proposed cost. Thus the adopted approach is based on actual cost found to be conservative and hence acceptable to the validation team. The sensitivity analysis is verified from the IRR computation sheet^{/IRR2/} and found to be accurate and free from material misstatements. ☐ Argument not justified ☐ Argument not convincing

Step # / Barrier	Demonstration	Assessment
		☐ Argument justified but not a decisive barrier ☒ Argument justified / significant barrier
(3) Technological Barrier	The project faces technological barriers due to risk of failure associated with an advanced and biochemical technology. Moreover the technology requires rigorous monitoring and skilled manpower. Other alternatives, such as open lagoons do not face such barriers.	On the basis of site visit, literature review^{11 12} cited in the VCS PD/^{PD2/} it is concluded that the project employs a relatively rare technology in tapioca starch industry in Thailand and such technologies face barriers related to shortage of skilled manpower. ☐ Argument not justified ☐ Argument not convincing ☐ Argument justified but not a decisive barrier ☒ Argument justified / significant barrier
Institutional Barriers	With the open lagoon system already able to meet the desirable quality of treated wastewater and meet applicable national standard, owners are generally reluctant to switch to a closed anaerobic treatment system for biogas recovery. Again the safety issues associated with storage and handling	Since associated infrastructure requirement and safety issues associated with biogas storage and handling are visible from site visits and interviews it can be considered as a barrier to adopt biogas recovery and utilisation projects in starch industry. ☐ Argument not justified ☐ Argument not

¹¹ Biomass and biogas energy in Thailand: Potential, opportunity and barriers by S. Prasertsana, B. Sajjakulnukitb

¹² The Promotion of Biogas from Wastewater as An Alternative Energy and for Environmental Improvement, published by the Energy Conservation and Renewable Energy Division and Energy Policy and Planning Office (EPPO), 2007

Step # / Barrier	Demonstration	Assessment
	of biogas requires additional investment.	convincing ☒ Argument justified but not a decisive barrier ☐ Argument justified / significant barrier
(3) Common practice	As per the GHG protocol for project accounting chapter 7 common practice refers to the predominant technologies or practices have penetrated the market. In demonstrating common practice barrier PP has established statistical data in section 2.5 of the PD. Out of 85 starch factories located in Thailand only 27 have opted for biogas recovery projects and all of them have opted for carbon revenue.	The common practice barriers have been supported with data and authentic documents and reference^{13 14 15} has been duly cited in section 2.5 of the final PD Ver 3.1 footnote 37 to 51. Based on the assessment, the validation team concludes that, biogas recovery projects without carbon revenues, are not a common practice in the starch processing sector in Thailand. ☐ Argument not justified ☐ Argument not convincing ☐ Argument justified but not a decisive barrier ☒ Argument justified / significant barrier
Assessment of the validation team		☒ Project is additional ☐ Project is not additional

As the project is regulatory surplus and complies with the requirements of investment barrier under step (2) of test 1 of VCS 2007.1 specification, hence the project meets the additionality requirement of small scale CDM project as part of applied main methodology (AMS III.H ver,13). Moreover the additionality is further supported

¹³ <http://www.thaitapiocastarch.org>

¹⁴ <http://cdm.unfccc.int/Projects>

¹⁵ http://www.tgo.or.th/english/index.php?option=com_content&task=view&id=17&Itemid=29

by common practice analysis under step (3) of project test, which overall concludes that the project is additional.

However following CAR was raised and successfully closed.

		B2			
Classification		☒ CAR	☐ FAR	☐ CL	☐ None
Findings	A consolidated CAR has been raised based on description in section 2.5 of PD version 1^{/PD1/} and provided Investment analysis spread sheet^{/NPV/} for investment barrier: 1. Computation of manpower cost based on capital cost (1.5%) is neither correct, nor acceptable. 2. Efficiency of gas engine assumed at 36% is very low and correspondingly PLF works out to less than 24%, which is need to be adequately justified. 3. Both in VCS-PD and Worksheet, NPV is repeatedly used, while the additionality is demonstrated through NPV & NPV. Appropriate changes may be incorporated.				
Corrective Action # 1	1. Initially, a conservative assumption has been made with manpower cost being at 1.5% of total project cost. This has now been corrected to actual manpower cost (10 people being involved in this project activity) as evidence in revised NPV excel sheet. 2. The efficiency assumed is based on the technical specifications of the gas engines. It is derived from having one gas engine (Guascor) with an efficiency of 37.78% (electrical capacity/fuel consumption) and another two Chinese gas engines (500GF-RZ) with lower efficiency in the range of 32.73-37.13%. Based on this, the assumed level of efficiency is adequately justified. Moreover accordingly the assumed PLF 23% is quite conservative as actual electricity generation at the plant resulted in a PLF of in the range of 15-20% in the year 2007 and 2008. 3. The NPV is the preferred method to quantitatively demonstrate the investment barrier of the project. All along, the NPV has only been used for the purpose of cross-checking of the discount rate applied. Appropriate corrections have been made in the revised PD and calculation sheet.				

	B2
DOE Assessment # 1	1. Necessary corrections were carried out in calculation spread sheet and found to be appropriate^{/IRR/}. 2. The justification provided for assumed efficiency and PLF of gas engines is convincing and acceptable. 3. The revised PD and Excel sheet has considered NPV as the only financial indicator, which is appropriate and acceptable.
Corrective Action # 2	1. The assumed values are not affected by change in methodology version. 2. The estimation approach for amount of power generated power doesn't change with change in methodology version. 3. The PD and excel sheet is revised to have an IRR estimation for the project activity.
DOE Assessment # 2	The methodology version change has not impacted the additionality of the project. Financial indicator has been changed to project IRR and the project IRR w/o carbon credit revenue is lower than the benchmark and thus is accepted. CAR remains closed out.
Conclusion	☐ To be checked during the first periodic verification ☒ Appropriate action was taken ☒ Project documentation was corrected correspondingly ☐ Appropriate was action not taken ☐ The project complies with the requirements

	B3
Classification	☐ CAR ☐ FAR ☒ CL ☐ None
Findings	A consolidated CL has been raised as on section 2.5 of PD version 1^{/PD1/} for investment barrier and provided Investment analysis spread sheet^{/NPV/}: 1. Reasons for accounting savings due to fuel replacement at 90% may be explained. 2. The basis for assuming the salvage value at 6.7% (See cell C46 of IRR_NPV worksheet) of initial investment cost and whether it conforms to the guidance given by EB vide annex 45 of EB 41 of the may be explained. 3. Basis for providing O&M cost at 100% and 50% of

	B3
	manpower cost in the first year of operation may be explained. Moreover pl. clarify, whether the equipments are not covered by warranty even for one year. 4. The O&M cost alone works out to >90% of the total revenue in 2006 and approximately 50% thereafter. Such a high ratio of O&M cost to total revenue needs to be clarified.
Corrective Action # 1	1) There will be constant time lags between biogas supply and heat demand in the starch production process. Due to this reason, operation of boilers in dual fuel mode (using HFO and biogas) is inevitable. The efficiency of the boiler when used in dual-fuel mode drops, reducing also the biogas to HFO displacement rate. This can be further explained by a number of reasons as listed below: • Higher hydro/moisture loss makes boiler efficiency lower with biogas. • Higher dry flue gas loss makes boiler efficiency lower with dual fuel firing • Variation in biogas quality and quantity influences the air regulation mechanism, thus lowering the efficiency of the system. The statements above can be confirmed through interviews with technical experts if necessary. Thus, in order to account for these issues, we introduce an assumption that 10% of energy need is still provided by fuel oil and not 100% by biogas. 2) The consideration of a minimal salvage value for estimation of NPV value is based on the fact that approximate lifetime of biogas projects is 15 years as per the published document submitted to the DOE. So assuming a lifetime of 15 years and straight line depreciation (complies with Accounting practices) salvage value is considered. 3) There was a mistake in the O & M cost calculation for first year of operation, which is now corrected in investment analysis. The warranty is usually taken only in case of dysfunctional of the machinery. Regular maintenance and operation cost are not considered in the warranty condition. This is supported by relevant warranty documents. 4) With corrections in O&M cost for the year 2006 the O&M cost has now accounts for 58% and 47% afterwards of total revenue. Though still it appears that O&M to total revenue ratio is high,

	B3
	actually the operation and maintenance cost is assumed conservatively. In actual scenario maintenance costs increase with every passing year with the increasing wear and tear of machineries. In addition to regular maintenance and repair, similar projects (especially that with covered lagoon installations) incur additional cost for replacement of HDPE sheet (and other major equipments) in every 5 years, which is not accounted in O&M cost as a conservative approach. So the assumption of O & M cost comparatively at lower side.
DOE Assessment # 1	1) As per the expert opinion and subsequent telephonic interview with expert^{/IM04//TD/}, the clarification provided for the usage of the factor 0.9 in calculation of the savings due to fuel replacement is adequate and convincing. Also refer to the appendix-1 for detailed explanation. 2) Though 15 years has been considered for the investment analysis, which is same as the residual technical life time of the project, salvage value has been still accounted for as a conservative approach and hence acceptable to the validation team. 3) The validation team has verified the revised calculation of O&M cost and the warranty conditions. The claim by the PP found to be correct.^{/ADD/} 4) The corrections made in the revised NPV sheet version 2.0 were checked and found to be accurate. Moreover the O&M cost assumed found to be conservative.
Corrective Action #2	1) The assumptions and estimation approach is not affected by methodology version. 2) No affect in approach, still conservative. 3) The approach is not affected by methodology revision. 4) The NPV analysis is changed to IRR analysis and IRR and PD is revised.
DOE Assessment # 2	The methodology version change has not impacted the additionality of the project. The financial indicator for investment analysis to demonstrate additionality of the project is found to be changed from NPV to project IRR and the value of project IRR is lower than the benchmark for investment decision. Thus, CL remains closed.

	B3
Conclusion	☐ To be checked during the first periodic verification ☒ Appropriate action was taken ☒ Project documentation was corrected correspondingly ☐ Appropriate was action not taken ☒ The project complies with the requirements

3.3 Monitoring Plan

The conclusions are as follows:

- The project applies the monitoring methodology AMS III.H version 13 which is an approved CDM methodology.
- The AMS III.H ver.13, AMS I.D ver.14 and AMS I.C ver.15 are correctly co-applied. The justifications on applicability conditions presented in the section 3.3 of VCS-PD are found appropriate.
- The baseline and project emission parameters that are monitored are indicated in Section 3.3 of the VCS-PD. Validation Team has verified the list of parameters and confirms that these are in line with the requirements of AMS III.H, AMS.I.D and AMS I.C. The final disposal of the sludge will be monitored during crediting period. In case the final disposal of sludge is not used for soil application, the $PE_{s,final,y}$ (as per equation number (7) of AMS. III.H, Version 13) will be accounted as per the input data provided in PD. In accordance with para 34 of AMS III.H version 9 (and also as per para 30 of AMS III.H version 13), the emission reduction for methane recovered and combusted would be calculated by conservative approach using the actual amount of methane produced during project operation. The formula incorporated in section 4.1 of the PD is deemed OK. However, CAR M1 & M2 were raised and successfully closed.
- The monitoring parameters as mentioned in section 3.3 of the PD are found to be in line with requirements of the monitoring methodology. The monitoring measurement method, frequency, accuracy and calibration procedures are clearly and transparently described and will give opportunity for real measurements of achieved emission reductions.

Kommentar [IK1]: But above no parameters were mentioned in detail. Pl provide the whole process more detailed and project specific. Was has to be monitored and what is the procedure for monitoring this values.
It is not sufficient to write only everything is described correctly in the PD.

VT Response: The description in the PD is improved to discuss all the requirements. Moreover the monitoring details will be described in the verification report.

Explain a little bit more detailed as discussed yesterday.

Done: Leave it for me

The data and parameters are available during the validation and are correctly chosen and applied. The major parameters monitored ex post are as follows;

1. Volume of wastewater treated in the year (Q_{ww})
2. COD of wastewater entering the treatment plant (COD_{ww} , untreated)
3. COD of water exiting the AFFR treatment process ($COD_{removed}$, PJ, k)
4. Amount of biogas combusted for gainful use ($BG_{combusted}$)
5. Amount of biogas flared ($BG_{TOFlare}$)
6. Quantity of fossil fuel used in boiler (Q_{FO})
7. Methane content in biogas (W_{CH4})
8. Quantity of dry starch produced (Q_{starch})
9. Net electricity production by the generators (EG)
10. Electricity consumption by auxiliary equipments (EC)

Details of the data to be collected, the frequency of data recording, format and storage type are described. Algorithms and formulae used are clearly presented and the calculations are without errors. The monitoring parameters, monitoring methodologies, and equipments are deemed appropriate and in accordance with applied methodologies.

- The monitoring plan provided detailed information related to the collection and archiving of all relevant data needed to:
 - Estimate or measure emissions occurring from GHG sources, sinks and reservoirs
 - Determine the baseline emissions
 - Estimate changes in emissions from the site
- The frequency, responsibility, and authority for registration, monitoring, measurement and reporting activities are contend in section 3.4 of the VCS-PD. Following metering and measurement was verified during onsite visit:
 - 3 point COD measurements (in and out of AFFR circuits). Sampling points were verified and the COD measurement lab was found to be in place. The records of COD measurement were recorded on daily basis. The wastewater from final lagoon is

analysed on monthly basis. However the project activity will further enhance the COD sampling points as depicted in the figure 5. .^{/LOG/}

- 3 point running hour meter (into AFFR system) for estimation of waste water flow and corresponding records were evidenced during the onsite assessment. However for future monitoring periods flow meters will be used which were found to be procured during site visit. .^{/LOG/}
- 2 point gas flow meter (into hot oil boiler and gas engine-common meter for 3 gas engines) were verified. The meter displays volume data in m³, and same is found to be recorded in log sheet. .^{/LOG/}
- 3 point electricity generation meters were installed to measure electricity generated by the 3 gas engines. .^{/LOG/}
- CH₄% in biogas (vol, dry basis) ~ is measured from the sample collected from the inlet of the steam boiler through a portable CH₄ analyser. The respective record was verified and collected. ^{/LOG/}
- Final sludge disposal is being monitored by the PP and relevant records are maintained. Through interviews with stakeholders it was evidenced that the final sludge is being used for soil application. ^{/SDR/}
- Ambient Temp data is obtained form the metrological department. ^{/MET/}

The site conditions are found to be as per the monitoring plan described in section 3 of the PD. The calibration records were made available to the validation team^{/CAL/}. Nevertheless following CARs M1 and M2 and also FAR M3 and FAR M4 are raised and closed successfully during the validation.

	M1			
Classification	☒ CAR	☐ FAR	☐ CL	☐ None
Findings	Following consolidated CAR is raised as per PD Version 1 against the requirement monitoring methodology described in AMS III.H ver.9 : 1. The flow of waste water $Q_{y,ww}$ is calculated instead of monitoring. (Cp Para 35 of AMS III.H ver.9) 2. Since $Q_{y,ww}$ is calculated based on running hours and rated capacity of pump, running hours shall be described as a separate monitoring parameter in section 3.3 of the PD. Moreover the back up calculation shall be clearly and transparently presented in excel worksheets. 3. The compliance of the para 34 of AMS III.H ver.9 is not properly addressed in PD version1/PD1/.			
Corrective Action # 1	1. Calculation of $Q_{y,ww}$ has been elaborated and justified section 4.1 in the final PD under deviation 2. This results in a reduction of VERs from the excel sheet presented in the 1st submission. 2. Section 3.3 of the revised PD has been modified to include parameters relevant to the calculation of $Q_{y,ww}$ and back up calculation is now shown transparently in revised ER calculation sheet. 3. The project proponent has employed guideline as per Para 34 in section 4.1 of revised PD to estimate emission reduction using amount of biogas recovered and destroyed. In addition the baseline emissions are also estimated on COD removal. The lower of the two values will be used in estimating emission reductions. This approach is thus conservative and is now in line with the applied methodology.			

M1	
DOE Assessment # 1	1. As per industry practice and experience generally the discharge of wastewater pumps are close to the rated capacity based on the head of the pump. Based on the site visit observations, head of the pump and referring to performance curve^{/TD/} of type of pump used by the project it can be concluded that, the assumed 65% discharge factor w.r.t. rated capacity is quite conservative and hence acceptable to the validation Team. Moreover flow meters are already procured and the actual flow to be monitored for the subsequent verifications. The invoice of the 3 new flow meters has been submitted by the PP^{/INV/}. 2. The revised PD^{/PD2/} and revised ER sheets^{/XLS2/} were verified and corrections made were found to be correct and appropriate. 3. Adequate description is provided in section 4.1 of VCS PD ver. 2.0. The description adequately and appropriately satisfies the requirements of para 34 of AMS III.H ver.09.
Corrective Action # 2	1. The deviated approach is not affected by the change in methodology version. 2. The approach is not affected by change in methodology version. 3. The conservative approach is still followed, however reference for revised PD is changed to para 31 of AMS III.H version 13 and applicable notations are followed.
DOE Assessment # 2	The requirements of para 34 of ver.09 has been transformed into para 30 and para 31 of Ver.13. With respect to this CAR, the revised PD i.e. Ver. 03 is found to be complying with the requirements of AMS III.H Ver.13. Thus the CAR remains closed out.
Conclusion	☐ To be checked during the first periodic verification ☒ Appropriate action was taken ☒ Project documentation was corrected correspondingly ☐ Appropriate was action not taken ☒ The project complies with the requirements

M2				
Classification	☒ CAR	☐ FAR	☐ CL	☐ None

	M2
Findings	Monitoring approach for ex-post measurement/calculation for the 1st monitoring period and ex ante estimations for 2009 onwards needs to be clearly and transparently described in the section 3.3 of the PD.
Corrective Action # 1	Monitoring approaches used in both ex-ante and ex-post calculation have been transparently described in section 3.3 in the revised PD.
DOE Assessment # 1	The necessary corrections have been carried out in the PD version 2.
Corrective Action # 2	The Excel sheets and PD is revised to include only ex-ante data, and no monitored data is included in PD. The emission reduction estimation reflects ex-ante estimations and the monitoring section has been revised to reflect proposal values or expected values for the monitored parameters. Based on CAR D2 the necessary corrections were made as per the latest applied methodology .i.e. AMS III.H Ver.13.
DOE Assessment # 2	Corrections are also duly applied in the version 3 of the PD ^{/PD2/} . Thus CAR remained closed.
Conclusion	☐ To be checked during the first periodic verification ☒ Appropriate action was taken ☒ Project documentation was corrected correspondingly ☐ Appropriate was action not taken ☐ The project complies with the requirements

	M3
Classification	☐ CAR ☒ FAR ☐ CL ☐ None
Findings	The operational condition of the retrofitted dual fuel boiler, need to be verified during the subsequent verifications. In case it is found that the existing boiler is replaced with a new one during any verification no emission reductions shall be granted for heat displacement.
Corrective Action # 1	During verification, the assessment of the presence of the baseline boiler equipment shall be verified and the same shall be included in the monitoring report.
DOE Assessment # 1	The proposed corrective action by the PP deemed appropriate.

	M3
Conclusion	☒ To be checked during the next periodic verification ☐ Appropriate action was taken ☐ Project documentation was corrected correspondingly ☐ Appropriate was action not taken ☐ The project complies with the requirements

	M4
Classification	☐ CAR ☒ FAR ☐ CL ☐ None
Findings	Flame detection system and temperature monitoring device need to be in place as per the requirement of the flare tool for the closed flare for the subsequent verifications and record of the same need to be maintained.
Corrective Action # 1	The PP assures to install necessary flame detection and temperature monitoring device and necessary records will be maintained.
DOE Assessment # 1	The proposed corrective action by the PP deemed appropriate and will be checked during next verification..
Conclusion	☒ To be checked during the next periodic verification ☐ Appropriate action was taken ☐ Project documentation was corrected correspondingly ☐ Appropriate was action not taken ☐ The project complies with the requirements

3.4 Calculation of GHG Emissions

The conclusions are as follows:

- As per the final PD^{/PD2/} the project is expected to reduce emissions of 288,810 tCO₂e over a 10 year crediting period.
- The source, sink and reservoir for the project activity are appropriately mentioned (Cp section 2.3 of VCS-PD)
- The formulae and factors used in the calculations of emission reductions are in accordance to the approved baseline methodology AMS III.H, version 13, AMS IC, Version 15 and AMS ID Version 14. Moreover formulae and factors used in the deviations taken from the applied methodologies are explained in the appendix-1 of this report. All aspects related to the direct

Kommentar [IK2]: Pl. provide more detailed/project specific and explain how emissions reduction will be calculated.

VT Response: The description in PD is improved and verified by the validation team. Formulae and factors used in the deviations taken from the applied methodology is explained in the appendix-1 of this report.

There is no doubt that you have verified the information in the PD. But you have to explain here how you have checked the information and what is your assessment regarding this.

and indirect GHG emissions relevant to the project activity have been addressed and calculations are presented in a transparent manner and in line with the applied methodologies and tools. The emission reduction calculation spread sheet were thoroughly checked by the validation team and all supporting documents, algorithm were cross checked and found to be appropriate and free from any misstatements.

- No leakage is involved in the project activity.
- The set of ex ante calculations for the estimated emission reductions are transparently documented (in the PD and the spread sheet of VER calculation with the reference sources of data) and correct and appropriate assumptions; default values; correction factors in accordance with AMS III.H version 13 (including grid emission factor for project emission in accordance with AMS I.D Ver 14) have been applied. The fuel oil displacement is appropriately and conservatively calculated as per the deviated approach from AMS I.C version 15. The sources of project specific data were cross-checked and found to be correct based on the evidence provided by the project developer (Table 5.1 of Annexure-2).
- The validation team has checked the underlying input values as well as the computation in the spreadsheet^{/XLS1//XLS2/}. The estimation of the baseline emission, project emission was realized in a transparent and conservative manner. The VER sheet contains the estimated emission reductions for the crediting period of ten years starting from 1 January 2007.
- However few uncertainties were found and appropriately resolved, which is summarised as follows;

	C1			
Classification	☒ CAR	☐ FAR	☐ CL	☐ None
Findings	The COD value for $PE_{y,ww,treated}$ calculation should corresponds to final lagoon not the outlet from AFFR system (Cp para 14 eqn. (2) of AMS III.H Ver. 9)			

	C1
Corrective Action # 1	For the 1st verification, it is assumed that $COD_{y, ww, treated} = COD_{y, out, AFFR}$ in the absence of COD measurement at the outlet of last open lagoon during this period. This assumption is conservative as $COD_{y, ww, treated}$ is always less than $COD_{y, out, AFFR}$ with open lagoons being a secondary treatment process after the AFFR system. For future verification, $PE_{y, ww, treated}$ will be calculated using the COD content at the outlet of last lagoon. For ex-ante estimation, default reduction efficiency of the complete waste treatment system (AFFR+lagoon) is assumed to estimate project emissions.
DOE Assessment # 1	The deviation (#3) taken is assessed by the validation team and found to be in accordance with para 5.3, page 13 of VCS 2007.1 standard. The COD value of treated waste water from AFFR has been taken which is higher than the COD value of waste water from the final lagoon. Therefore the adopted approach is conservative in the view of VER realisation. Moreover deviation does not affect the conservativeness of the baseline and the additionality of the project. Revised ER calculation found to be appropriate and accurate.
Corrective Action # 2	In light of CAR D2 the applied $PE_{y, ww, treated}$ of version 09 is termed as $PE_{ww, discharge, y}$ in version 13. Since there are no discharge of treated waste water in sea/river/lake $PE_{ww, discharge, y}$ has been neglected as per the applied methodology and hence the deviation is removed from the revised PD.
DOE Assessment # 2	This CAR and deviation thereon is not relevant in light of AMS III.H version 13. As per the site visit observations the above corrective action is valid and the removal of the deviation is justified Thus the CAR remains closed.
Conclusion	☐ To be checked during the first periodic verification ☒ Appropriate action was taken ☒ Project documentation was corrected correspondingly ☐ Appropriate was action not taken ☐ The project complies with the requirements

	C2			
Classification	☒ CAR	☐ FAR	☐ CL	☐ None
Findings	During the site visit it was observed that the gas flow meters installed, to measure volume of biogas supplied to boiler and gas engine display data in m ³ , which needs to be adjusted to Nm ³ in ER calculations.			
Corrective Action # 1	As per the gas equation: $P_1 \times V_1 / T_1 = P_2 \times V_2 / T_2$; where 1 represents parameters at measured conditions and 2 refers to parameters at normal conditions. Now for each of these parameters, an explanation of range is as shown below. P1 would always be higher than 1 atm pressure so that there is a positive gauge pressure and gas can flow from gas storage to boiler and gas engines. Let's assume the same to be (1+x) atm where x is a positive number. P2 = 1 atm as per normal conditions of temperature and pressure. Since the gas is generated, stored and sent to boiler and gas engines at ambient conditions T1 (average temperature of 29⁰ C as per meteorological data) and normal conditions as 0⁰C. So if V1 represents volume in m³ and V2 represents volume in Nm³, we have the following situation. $V_2 (Nm^3) = (1+x) \times V_1 (m^3) \times \frac{273}{273+29}$ If we assume x = 0, we get a conservative factor of 0.904 to be multiplied by gas volume in m³ to get biogas volume in Nm³ on a conservative basis. The ex-post emission reduction estimate is corrected.			
DOE Assessment # 1	Though the adopted approach is conservative, pressure is not being monitored. Deviation need to be taken and justified in the PD.			
Corrective Action # 2	Deviation is taken and described in section 3.3 of PD.			

	C2
DOE Assessment # 2	The deviation taken (deviation#4) is described transparently in the PD version 3, which is acceptable as it satisfies the requirement of para 5.3, page 13 of VCS 2007.1 standard. Moreover the validation team confirms that the deviations do not affect the conservativeness of the baseline and the additionality of the project. The deviation is further justified in the appendix-1 of this report.
Corrective Action # 3	Based on CAR D2 no corrections were required as per the latest applied methodology i.e. AMS III.H Ver.13.
DOE Assessment # 3	The deviation is also applied in the version 3.1 of PD. DOE assessment # 2 is still valid and CAR remains closed.
Conclusion	☐ To be checked during the first periodic verification ☒ Appropriate action was taken ☒ Project documentation was corrected correspondingly ☐ Appropriate was action not taken ☒ The project complies with the requirements

	C3
Classification	☒ CAR ☐ FAR ☐ CL ☐ None
Findings	During site visit it was found that 7,512 Ton of Sludge has been removed from the open lagoon system (01 January 2007 till 25/02/2009), which was sold to the farmers, for soil applications. Though it can be neglected as per the para 41 of the methodology, it needs to be clearly and transparently accounted in the excel worksheet.
Corrective Action # 1	The value of 7,512 tonnes was obtained from the receipts of sludge sold to farmers as fertiliser ^{/SDR/} . The practice thus complies with paragraph 41 in AMS III.H., and this component is correctly neglected from the calculation of emission reductions. This has been noted in the revised excel sheet (in sheet ‘Tables_MR report’).
DOE Assessment # 1	Necessary amendments were made in the revised excel sheet. ^{/XLS2/}
Corrective Action # 2	Based on CAR D2 no corrections were required as per the latest applied methodology i.e. AMS III.H Ver.13.

	C3
DOE Assessment # 2	DOE Assessment # 1 is valid after applying changed methodology version as well. CAR remains closed.
Conclusion	☐ To be checked during the first periodic verification ☒ Appropriate action was taken ☒ Project documentation was corrected correspondingly ☐ Appropriate was action not taken ☒ The project complies with the requirements

3.5 Environmental Impact

Social and environmental impacts of the project have been sufficiently addressed. No adverse environmental impacts compared to baseline situations as well as trans-boundary impacts have been envisaged from this project activity. Compliance as per ISO 14064-2: 5.2.k has been checked and found satisfactory. As per the national law no requirement of carrying out EIA is prescribed for such kind of project.

3.6 Comments by stakeholders

Stakeholders have been directly asked to comment on the project through an open meeting among local stakeholders, project proponent; local authorities on 24th July 2008^{LSHC/}.

A summary of the comments received and a note (through meeting and feed back questionnaire) on how due account was taken of the concerns raised in the above public consultation are included in VCS-PD. All comments are positive in nature. No adverse comments were received and this is addressed in the PD.

4 Validation conclusion

The M/s South Pole Carbon Asset Management Ltd. on behalf of M/s Chol Chareon Co. Ltd., has commissioned the TÜV NORD JI/CDM Certification Program to validate (along with 1st verification) the project: “Chol Charoen Group Wastewater Treatment with Biogas System I Cholburi)”, with regard to the relevant requirements of the VCS 2007.1 Guidelines/ VCSA Rules for project activities, as well as criteria for consistent project operations, monitoring and reporting.

The purpose of this project activity is to recover methane from wastewater treatment and combustion of methane for onsite utilisation and flaring, thereby reducing the baseline methane emissions; and baseline grid emission due to power generation. An additional claim for grid electricity displacement is made.

AMS III.H/Version 13: “Methane Recovery in Wastewater Treatment”, AMS I.C/Version 15: “Thermal energy production with or without electricity” and AMS I.D/Version 14: “Grid Connected Renewable Electricity Generation”, approved small scale methodologies of UNFCCC CDM program are correctly co-applied.

A risk-based approach has been followed to perform this validation. In the course of the validation, Eight (08) Corrective Action Requests (CARs) one (1) clarification request (CL) were raised and successfully closed. Three (03) Forward Action Requests (FARs) is raised, which will be verified during the next verification.

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

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

- The project fulfils criteria of VCS 2007.1 provided.
- The project additionality is sufficiently justified in the PD.
- The monitoring plan is transparent, adequate and inline with the applied baseline and monitoring methodologies
- The calculation of the project emission reductions is carried out in a transparent and conservative manner, so that the calculated emission reductions of 288,810 t CO₂e (total) is most likely to be achieved within the

10 years renewable crediting period starting from 1 January 2007, which can be renewed once.

There are no restrictions or uncertainties faced related to the validation of the project.

Baroda, 2009-11-14



Pankaj Patel
TUV India Pvt. Ltd.

Essen, 2009-11-14



Eric Krupp
TÜV NORD JI/CDM
Certification Program

Appendix-1

Table 4-2: Summary of Deviations taken from methodology

Data/Parameters/Variables/	Reference of methodology	Description of Deviations	Assessment by Validation Team
The baseline emissions from the heat displaced by the project activity $BE_{thermal,CO_2}$ is estimated through an alternative equation against the prescribed equation by the applied methodology.	AMS I.C., version 15 Para 15, Equation 2 & Para 30 (b)	Since there is no metering mechanism for measurement of net quantity of heat supplied by the project activity ($EG_{Thermal}$), an alternative approach is used. This approach, is based on amount of heat required for starch drying, which is estimated on heat requirements per tonne of starch when only fuel oil was used. The deviated equation¹⁶ compensates the fuel oil usage from total fuel oil requirement (in baseline) and conservatively estimates the fuel oil replaced by biogas, irrespective of quantity of biogas combusted. The deviated approach ensures that efficiency lost in system due to dual fired system is conservatively adjusted in the baseline emissions.	The deviated approach described in the section 4.1, of the final PD ver. 3.1 is verified by the validation team and found to be conservative as efficiency loss due to dual fired system is accounted in biogas usage, thereby estimating lower fuel oil replacement for baseline emission estimation. The efficiency drop due to dual fuel firing is confirmed from the expert opinion.^{/IM04/TD/} Thus the deviated approach is deemed appropriate and hence acceptable to the validation team. Thus the validation team confirms that the deviations do not affect the conservativeness of the baseline Moreover since this parameter is not used for demonstration of financial additionality, the deviation has no impact on the additionality of the project. Therefore the deviation taken, satisfies the requirement of para 5.3, page 13 of VCS 2007.1 standard.

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$$BE_{thermal,CO_2,y} = ER_{heat,y} = (Q_{starch,y} * Q_{FO,starch} - q_{FO,y}) * D_{FO} * NCV_{FO} * EF_{co_2} / 10^6$$

Where,

$Q_{starch,y}$ Quantity of dry starch produced in year “y” (tonnes), $Q_{FO,starch}$ Quantity of fossil fuel per unit of dry starch (liter/tonne), $q_{FO,y}$ Quantity of fossil fuel consumed at the project site in year “y” (litres), D_{FO} Density of fossil fuel (kg/litre), & NCV_{FO} Net Calorific value of the fuel oil (TJ/ton)

Data/Parameters/Variables/	Reference of methodology	Description of Deviations	Assessment by Validation Team
Wastewater flow (Q_{ww}) is calculated rather measured for the initial monitoring periods.	AMS III.H., version 13 (paragraph 34)	In the absence of wastewater flow meter, the running hours of the water pumps sending the wastewater into the AFFRs are monitored and used to calculate the wastewater flow. A factor of 0.65 is applied to the rated capacity of the pump in order account the inefficiency of the pumps.	As per industry practice and experience generally the discharge of wastewater pumps are close to the rated capacity based on the head of the pump. Based on the site visit observations, head of the pump and referring to performance curve^{TD/} of type of pump used by the project. Thus, the assumed 65% discharge factor w.r.t. rated capacity is quite conservative and hence acceptable to the validation Team. Moreover flow meters are already procured and the actual flow to be monitored for the subsequent verifications. The invoice of the 3 new flow meters has been submitted by the PP^{INV/}. Further the waste water flow data (543,157 m³/yr) used for baseline & additionality is estimated from average historic starch production for the year 2002-05 (54,317 t/yr) multiplied with specific wastewater generation i.e. 10 m³/ ton of starch production. The waste water flow calculated as per the deviated approach (216,417 m³ for the year 2007 & 147,962 m³ for the year 2008) is found to be much lower than assumed value for baseline and additionality. Thus it can be concluded that neither the baseline nor the additionality has been affected from this deviation.
Flare efficiency is assumed	Paragraph 32 and equation	In the case that biogas is combusted	This approach has been confirmed by the SSC WG

Kommentar [IK3]: Without presenting values for this statement is not traceable. So pl. provide evidence.
VT: Values inserted

Data/Parameters/Variables/	Reference of methodology	Description of Deviations	Assessment by Validation Team
100% in case of combustion MDy (i.e. gainful utilisation of biogas in boiler and gas engine. Whereas it need to be measured as per the applied methodology.	16 of of AMS III.H. Ver.13	for a gainful use of the released energy, flare efficiency (combustion efficiency in boiler and gas engines.) can be assumed to be 100% in case calculation of MD _y .	on 29 th July 2009, who agreed to include such approach in a future revision of AMS III.H. (http://cdm.unfccc.int/UserManagement/FileStorage/VNWAGY8MS92ZXDKUHEF5LB07QICT1P) Based on this reference, it can be concluded that the adopted approach is appropriate and acceptable.
Since employed biogas flow meters do not display normalised flow of biogas Pressure and temperature of the biogas needs to be monitored as required by the applied methodology. However the pressure and tempertuare of biogas is not being monitored in this project activity.	Paragraph 36 of AMS III.H., version 13,.	Since the flow meter to measure volume of gas combusted in boiler and gas engines displays in m ³ instead of Nm ³ the pressure and temperature needs to be monitored in order to calculate density of methane correctly. Since pressure & temperature values are not available these values are assumed to estimate volume of biogas conservatively w.r.t. normalised volume. Standard gas equation $P_1 V_1 / T_1 = P_2 V_2 / T_2$ is used to compare volumes and the value of temperature and pressure are assumed accordingly.	The validation team has thoroughly assessed the deviated approach and concluded that the volume of biogas is conservative. Since the pressure inside the biogas pipeline will be always higher than the atmospheric pressure, however it assumed to be same in order to conservatively calculate the volume of biogas. Moreover the assumed value for temperature is appropriate as there will not be much difference between the measured ambient temperature and the biogas temperature inside the biogas pipeline. Moreover the volume of biogas calculated as per the deviated approach is not used for ex ante estimation of baseline emissions and demonstration of additionality. Thus the approach is acceptable to the validation team, as it meets the deviation requirements as per paragraph 5.3, page 13 of VCS 2007.1.

Annexure 1: Abbreviations

AFFR	Anaerobic Fixed Film Reactor
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CH₄	Methane
CL	Clarification Request
CO₂	Carbon dioxide
CO₂e	Carbon dioxide equivalent
COD	Chemical oxygen demand
CP	Certification Program
GHG	Greenhouse gas(es)
IPCC	Intergovernmental Panel on Climate Change
ISO	International Standards Organization
kW	Kilowatt
kWh	Kilowatt hour
MP	Monitoring Plan
Nm³	Normal Cubic Meter (Normal = 273 ⁰ K and 1 atm)
PD	Project Document
QC/QA	Quality control/Quality assurance
SSC	Small-Scale
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Voluntary Carbon Standard
VCSA	VCS Association
VER	Voluntary Emission Reductions
VCU	Voluntary Carbon Units
VVM	Validation Verification Manual

Annexure 2: References

Documents referred during the course of validation:

Table 5.1: Documents provided by the project proponent:

Reference	Document
/ADD/	Proof related to all input techno-commercial data and assumptions used for additionality-Investment analysis. 1. Loan approval document for Investment decision dated 12-Jul-2002 2. Minutes of meeting, Board meeting dated 15-Jul-2002. 3. Proof of average technical life time i.e. Pilot study project report dated 30th November 2005. 4. Proof of Fuel oil price (Sample Invoices of fuel oil from the supplier) 5. Proof of electricity tariff, EGAT report for average energy (PEA) sales price for fiscal year 2002. 6. Proof of investment cost of the project (see: Investment itinerary in biogas project and Investment itinerary in genset) 7. Exchange rate (Baht to Euro) 8. Proof of Warranty conditions by the supplier dated July 2004. 9. Proof of the technological & institutional barrier a. “Promotion of biogas from wastewater as an Alternative Energy and for Environmental Improvement, published by the Energy Conservation and Renewable Energy Division and Energy Policy and Planning Office (EPPO), 2007 b. Biomass and biogas energy in Thailand: Potential, opportunity and barriers by S. Prasertsana, B. Sajjakulnukitb
/BLS/	Methodology and project specific baseline study related evidences: • Document supporting the average depth of 6 m of the existing anaerobic lagoon system. • Monthly test reports for COD inlet and outlet of the baseline lagoon system before implementation of the project activity for the period May 2004 to April 2005. • Historical starch production data for the years 2002-2005
/CAL/	Calibration records for the key instruments and measuring devices: • Biogas Flow meter GM1 to measure the biogas sent to the boiler, GM2 to measure biogas to gas engines. • COD Spectrophotometer for COD measurement • Portable CH₄ analyser
/CR/	Commissioning report of equipments used in project activity (AFFR, Flaring equipment, Gas fired boiler, gas engines).
/CON/	The signed contract between TUV-NORD and South pole to carry out the validation and verification dated 18 Nov'2008.

Kommentar [IK4]: This is to general

Kommentar [IK5]: Pl. specify for which years.
Done :

Reference	Document
/FS/	Flare specification on the type and efficiency of flare system provided by the flare manufacturer.
/INV/	Investment itinerary related to purchase biogas project dated 03.06.2009, Coating of HDPE 4.04.06, Contract for Gas engine (Guascor) dated 14 July 2006.
/IRR/	Financial excel calculation spread sheet for IRR w and w-o VER
/LSHC/	Proof of Local stake holder consultation process dated 24 July 2008.
/LOG/	Extract of log of monitored data of the project activity: • Log of gas flow meters with highlighted initial and end readings for each calendar year during monitoring period. • Log sheet indicating first date of gas engine electricity generation. • Log records of wastewater treated • Log of grid electricity consumption. • Log of flare operation • Extract of the COD measurements at inlet and outlet of AFFR system and final lagoon discharge. • Operational log of all gas destruction/ utilisation devices (Biogas boiler, Biogas engine) • Proof for no. of operating days of the starch plant.
/MET/	Local met data on annual average ambient temperature.
/MLR/	Proof of Minimum Lending Rate at the time of investment decision dated (12-Jul-2002)
/NPV/	Financial excel calculation spread sheet for NPV w and w-o VER
/O&M/	O&M record of waste water treatment plant, gas destruction/utilisation equipments (Flaring equipment, dual fuel boiler, Biogas Engine)
/ORG/	Organisation chart describing the project activity
/PHOTO/	Photograph of the project activity site, major equipment installed and baseline activity.
/PD1/	Draft PD version 1 which forms the basis for validation.
/PD2/	Final PD version 3 which forms the basis for validation opinion.
/PT/	Proof of title /actual ownership (Cp section 8.1 of the VCS-PD template) 1. Company affidavit dated 13.05.1974 2. Contract for construction, installation and commissioning of biogas system dated 20 December 2004 and contract for installation of biogas engines dated 14 July 2006.

Reference	Document
/P-EF/	Proof of Grid emission Factor by Department of Alternative Energy Development and Efficiency (DEDE).
/QA-QC/	The QA-QC procedure on data acquisition and storage
/SC/	Statutory clearance for disposal of waste water and sludge. - Valid Operation permit from the Local Government and Ministry of Industry, Thailand dated 21 December 2006 valid upto 31-Dec-2008.^{/PT/} - Extract of historic BOD measurements of treated at the final lagoon by Mahidol University year 2005 result. - Notification by the Ministry of Industry, No. 2, B.E. 2539 (1996) issued under the Factory Act B.E. 2535 (1992)
/SD/	Proof of starting date i.e. Operation log of first destruction/utilisation (dual fuel hot oil boiler) dated 7 January 2006.
/SLD/	Single line diagram for metering system and electricity flow for the project activity
/SDR/	Sludge Disposal Record
/TD/	Technical data/document related to the project plant: • Technical details of key equipment used in the wastewater treatment plant (AFFR) provided by the technology supplier 1. Volumetric capacity of the AFFR reactor 2. Total capacity of the auxiliary drives 3. Technical Life time of the AFFR reactors published by the National Centre for Genetic Engineering and Bio Technology (BIOTEC), dated 30th November 2005 4. Technical life time of the gas engine as confirmed by the supplier 5. Technical details of waste water pumps as provided by the supplier. • List of electrical drives with name plate capacity of the wastewater treatment plant. • Methane content in biogas, Methane – biogas – production guide version 1.0 http://www.small-farm-permaculture-and-sustainable-living.com/support-files/methane-1.pdf • Technical specifications (provided the original equipment manufacturers) of all biogas destruction/utilisation unit i.e. Biogas burner for hot oil boiler, gas engine and enclose flare. • Pilot plant study report by KMUTT University, describing starch plant production capacity, waste water generation and characteristics, COD removal efficiency, dated 9th March 2006. • Expert opinion on efficiency loss efficiency drop in boilers operated in dual fuel mode
/TRG/	Training procedure and record of the plant personal to operate.
/UND/	Undertaking for non rejection and non participation in any other GHG programme

Reference	Document
/XLS1/	Supporting Excel sheets for calculation of emission reduction related to PD1
/XLS2/	Supporting Excel sheets for calculation of emission reduction related to PD2

Table 5.2 : Background investigation and assessment documents:

Reference	Document
/AMS.III.H./	SSC-CDM methodology “Methane Recovery in Wastewater Treatment” Ver. 13.
/AMS .I.D./	SSC-CDM methodology “Renewable energy projects” Ver.14.
/AMS.I.C/	SSC-CDM methodology “Thermal energy production with or without electricity” Ver.15
/LT/	Tool to determine the remaining lifetime of equipment, EB 50, Annex 51
/CPM/	TÜV NORD JI / CDM CP Manual (incl. CP procedures and forms)
/VCS/	Voluntary Carbon Standard 2007.1; Program Guidelines; VCSA Rules ;and VCS Guidance Document
/VVM/	CDM Validation and Verification Manual
/ISO/	ISO 14064-2; ISO 14064-3, ISO 14065
/GHG-P/	GHG Protocol for project accounting Chap 7.

Table 5.3: Websites used:

Reference	Link	Organisation
/egat/	http://www.egat.co.th/en/	EGAT, Thailand
/unfccc/	http://cdm.unfccc.int	UNFCCC
/vcs/	http://www.v-c-s.org/	VCS
/vcs-m/	http://www.v-c-s.org/methodologies.html	VCS website, methodologies page
/pcb/	www.diw.go.th	Department of Industrial Works, Thailand

Table 5.4: List of interviewed persons:

Reference	Mol1		Name	Organisation / Function
/IM01/	V	☒ Mr. ☐ Ms.	Narin Ka-jon-cha-lerm-sak	Managing Director, Chol Chareon Co. Ltd.,
/IM01/	V	☐ Mr. ☒ Ms.	Pavinee Soparak	Deputy Managing Director, Chol Chareon Co. Ltd.,
/IM01/	V	☐ Mr. ☒ Ms.	Kamolporn Chenchom	QC Supervisor, Chol Chareon Co. Ltd.
/IM01/	V	☒ Mr. ☐ Ms.	Panya Visetchart	Biogas Operator, Chol Chareon Co. Ltd.
/IM01/	V	☒ Mr. ☐ Ms.	Phonpharadon Nampichai	Genset Controller, Chol Chareon Co. Ltd.
/IM02/	V	☐ Mr. ☒ Ms.	Pathathai Tonsuwonnont	CDM Country Manager, South Pole Carbon Asset Management Limited
/IM02/	V	☒ Mr. ☐ Ms.	Sithisakdi Apichatthanapath	CDM Project Manager, South Pole Carbon Asset Management Limited
/IM03/	V	☒ Mr. ☐ Ms.	Pradit Pongpan	Member of Nong Chak Sub-district.
/IM04/	T	☒ Mr. ☐ Ms.	M. K. Balaji	Director, F E Clean Energy Pte. Co. Ltd.

1) Means of Interview: (Telephone, E-Mail, Visit)