Verification and certification report form for CDM project activities

(Version 01.0)

VERICATION AND CERTIFICATION REPORT	
Title of the project activity	CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand
Reference number of the project activity	UNFCCC no: 2141 registered on 25th March 2009 GS ID: GS560; GS Project ID: 103000000002356 registered on 24th May 2010
Version number of the verification and certification report	2.1
Completion date of the verification and certification report	15th September 2017
Monitoring period number and duration of this monitoring period	5th GS Monitoring; 21st August 2013 to 14th September 2014 (first and last day included)
Version number of monitoring report to which this report applies	2.1 dated 22nd June 2017
Crediting period of the project activity corresponding to this monitoring period	Fixed; 25th March 2009 to 24th March 2019 (both days inclusive)-CDM Fixed: 25th May 2008 to 24th May 2018 (both days inclusive)-GS
Project participant(s)	CYY Bio Power Co Ltd South Pole Carbon Asset Management Ltd Kommunalkredit Public Consulting GmbH
Host Party	Thailand
Sectoral scope(s), selected methodology(ies), and where applicable, selected standardized baseline(s)	Sectoral Scope 13 : Waste handling and disposal AM0022 ver. 4.0 - Avoided Wastewater and On-site Energy Use Emissions in the Industrial Sector
Estimated GHG emission reductions or net anthropogenic GHG removals for this monitoring period in the registered PDD	110,464 tCO2e
Certified GHG emission reductions or net anthropogenic GHG removals for this monitoring period	72,404 tCO2e
Name of DOE	EPIC Sustainability Services Private Limited (E-0062) Report: ESSPL/CDM/2016/141a Scope: GS verification
Name, position and signature of the approver of the verification and certification report	R. Vijayaraghavan Lead Auditor  K. Sudheendra, Director and Head Operations

	(approver of this report) 

SECTION A. Executive summary

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EPIC Sustainability Services Private Limited (EPIC) has been contracted by South Pole Carbon Asset Management Ltd to undertake the fifth verification of the registered CDM project activity titled "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand" (UNFCCC reference number: 2141; GS ID:560). The objectives of this verification are to verify and certify emission reductions reported for project activity for the monitoring period of 21st August 2013 to 14th September 2014 (first and last day included); and to verify that the data reported are complete and transparent.

This report summarizes the findings of the verification of the project, performed on the basis of UNFCCC criteria for CDM, as well as criteria given to provide for consistent project operations, monitoring and reporting. UNFCCC criteria refer to the Kyoto Protocol, the CDM rules and modalities, GS requirements as agreed in the Bonn Agreement, the Marrakech Accords and the CDM Executive Board's decisions.

The verification team has, based on the recommendations in the Validation and Verification Standard version 9.0/1/, and Gold Standard Energy Requirement/1/ version 2.2, Gold Standard Energy toolkit/1/ version 2.2 and employed a risk-based approach in the verification, focusing on the identification of significant risks and reliability of project monitoring and generations of GS-CERs. The verification is not meant to provide any consulting towards the client. However, stated request for clarifications and/or corrective actions may provide input for improvement of the project design.

The scope of the verification is the independent and objective review and ex-post determination of the monitored reductions in GHG emission by the project activity. The verification is based on the project design document/2/ Version 4.1, dated 31st January 2012 (hereinafter PDD), corresponding validation report/2/, previous monitoring reports/2/, previous verification reports/2/. These documents were reviewed against the requirements of the Kyoto Protocol, the CDM Modalities and Procedures and related rules and guidance.

The project activity involves the installation of an anaerobic wastewater treatment facility, based on Upflow Anaerobic Sludge Blanket (UASB) technology (rated at 6,000 m^3), at a starch manufacturing plant. Prior to project implementation, the wastewater was treated using an open lagoon system. Anaerobic bacteria in the ponds break down organic compounds in the wastewater, resulting in the release of biogas. The resulting biogas is characterized by the chemical oxygen demand of the wastewater. The implementation of system enables the recovery of biogas that would have been released to the atmosphere in the baseline scenario and the utilization of the recovered biogas for thermal use and electricity generation. The biogas recovered, which would be absent in the baseline scenario, directly contributes to the emission reductions. The utilisation of biogas in replace of HFO in the thermic oil heater and generation of electricity in gas engines (2 x 1.36 MW =2.72 MW_{el}) directly contributes to the emission reductions. The verification team has reviewed the technical specifications/3/ and commissioning certificates/4/ of UASB, gas engines, thermic oil heaters, flaring system.

The verification team determines the conformity of the actual project activity and its operation with the project design document. EPIC has, by means of a desk review and an on-site visit, assessed that all physical features of the proposed CDM project activity proposed in the PDD are in place, and that the project participants have operated the CDM project activity as per the PDD. Thus the verification team has concluded that the project activity was implemented and operated as per PDD, and that all physical features of the project are in place.

The verification team, based on the site visit and document review, was able to conclude that the project activity has been commissioned and implemented as per the PDD. The start date of this monitoring period is 21st August 2013 considering the end date of the fourth verification period/5/.

The monitoring report for this monitoring period is in compliance with the monitoring plan of the PDD. The project activity was registered by applying the large scale methodology/6/ AM0022 version 4.0 and the verification was carried out in accordance with the applied methodology. It was confirmed during the site visit that the project activity during the current periodic verification is in accordance with the applicability criteria of the methodology.

It is the responsibility of EPIC to express an independent GHG verification opinion on the GHG emissions reductions and on the calculation of GHG emission reductions from the project for this monitoring period based on the reported emission reduction in the monitoring Report.

EPIC's verification approach was based on the requirements as defined under the Kyoto Protocol, Marrakech accord, as well as those defined by the CDM Executive board. EPIC's approach was risk-based, drawing on an understanding of the risks associated with reported GHG emissions data and the controls in place to mitigate these. The examination includes assessment of evidence relevant to the amounts and disclosures in relation to the project's GHG emission reductions for this monitoring period.

The verification team has planned and performed the work to obtain the information and explanations that is considered necessary to provide sufficient evidence for it to give reasonable assurance that the amount of calculated GHG emission reductions for this monitoring period were fairly stated.

SECTION B. Verification team, technical reviewer and approver

B.1. Verification team member

No.	Role	Type of resource	Last name	First name	Affiliation (e.g. name of central or other office of DOE or outsourced entity)	Involvement in			
						Desk review	On-site inspection	Interview(s)	Verification findings
1.	Team Leader	IR	Radhamadhavan	Vijayaraghavan	Central office, Bangalore	√	√	√	√

B.2. Technical reviewer and approver of the verification and certification report

No.	Role	Type of resource	Last name	First name	Affiliation (e.g. name of central or other office of DOE or outsourced entity)
1.	Technical reviewer	IR	Anbazhagan	Prabu das	Central office, Bangalore
2.	Approver-Head Operations	IR	Krishnachar	Sudheendra	Central office, Bangalore

SECTION C. Application of materiality

C.1. Consideration of materiality in planning the verification

No.	Risk that could lead to material errors, omissions or misstatements	Assessment of the risk		Response to the risk in the verification plan and/or sampling plan
		Risk level	Justification	
1.	No risk	Nil	Not applicable	Complete verification of all the values indicated in the emission reduction spread sheet in documents such as log sheets, lab reports, and calibration certificates.

C.2. Consideration of materiality in conducting the verification

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In line with Guidelines for Application of materiality in verifications[7], a reasonable level of assurance is defined for the verification of the project by complete verification of all the values indicated in the emission reduction spread sheet at the document review stage and onsite. There are no material errors, omissions or misstatements.

SECTION D. Means of verification

D.1. Desk review

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The verification was performed primarily based on the review of the monitoring report and the supporting documentation. This process included review of data and information presented to verify their completeness and review of the monitoring plan and monitoring methodology, paying particular attention to the frequency of measurements, the quality of metering equipment including calibration requirements, and the QA/QC procedures, and an evaluation of data management and the QA/QC system in the context of their influence on the generation and reporting of emission reduction.

The first MR/8/ version 1.0 submitted by the project participant and additional background documents related to the emission reductions are reviewed as an initial step of the verification process. The subsequent step involved the identification of corrective action requests and clarification requests (CAR and CR) which are presented in Appendix 4 of this report. As a result of these findings, the MR is revised to MR version 2.1/8/. A complete list of all documents and records reviewed is as attached in Appendix 3 of this report.

D.2. On-site inspection

Duration of on-site inspection: 20th Feb and 21st Feb 2017				
No.	**Activity performed on-site**	**Site location**	**Date**	**Team member**
1.	The verification team conducted visits to the project site to confirm the information and to resolve issues identified in the document review. An on-site assessment was conducted as a part of verification activity and involved: 1) an assessment of the implementation and operation of the CDM project activity as per the PDD 2) a review of information flows for generating, aggregating and reporting of the monitoring parameters 3) interviews with relevant personnel to confirm that the operational and data collection procedures are implemented in accordance with the Monitoring Plan 4) a cross-check between information provided in the MR and data from other sources 5) a check of the monitoring equipment including calibration performance, and observations of monitoring practices against the requirements of the PDD and the applied methodology 6) a review of calculations and assumptions made in determining the GHG data and ERs, and 7) an identification of QA/QC procedures in place to prevent, or identify and correct, any errors or omissions in the reported monitoring parameters 8) Verification of Stakeholder Consultation by interviewing the stakeholders. 9) Verification of Sustainable Development Monitoring Plan and mitigation measures. 10) Verification of the scores of the Sustainable Development indicators. 11) Verification of Sustainable Development Assessment. 12) Verification of Sustainable Development indicators with respect to the level of risk associated with the Safeguarding Principles of the Do-No Harm Assessment (DNHA).	Project site	20th Feb and 21st Feb 2017	Full team

D.3. Interviews

No	Interviewee			Date	Subject	Team member
	Last name	First name	Affiliation			
1.	Amwan	Yupin	Head of Biogas Production - CYY	20th Feb and 21st Feb 2017	As above	Full team
2.	Santosh Kumar	Singh	Regional Director-Southpole	20th Feb and 21st Feb 2017	As above	Full team
3.	Rukwongtrakool	Suwipa	Project Manager-Southpole	20th Feb and 21st Feb 2017	As above	Full team
4.	Anukul	Saichon	Head Electrician-CYY	20th Feb and 21st Feb 2017	As above	Full team
5.	Srisoongnern	Werayut	Operator-CYY	20th Feb and 21st Feb 2017	As above	Full team
6.	Stichum	Korapat	Safety Officer-CYY	20th Feb and 21st Feb 2017	As above	Full team
7.	Rungnapha	Homsuntia	Quality control officer-CYY	20th Feb and 21st Feb 2017	As above	Full team
8.	Songkhow	Somkid	Personnel Development-CYY	20th Feb and 21st Feb 2017	As above	Full team
9.	Thongkhokkraut	Anchalee	Officer at Weiging room-CYY	20th Feb and 21st Feb 2017	As above	Full team
10.	Cholticha	Boonbanjong	Villager located opposite the starch factory	20th Feb and 21st Feb 2017	As above	Full team
11.	Kaewkiew	Add	Villager located in Moo 5, Pong Deng Subdistrict	20th Feb and 21st Feb 2017	As above	Full team
12.	Soontorn	Praneatpolkrang	Villager located in Simoom Subdistrict	20th Feb and 21st Feb 2017	As above	Full team

D.4. Sampling approach

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No sampling is used as the verification team has visited project site including UASB, flaring system, thermic oil heater, gas engines and lagoon ponds. The verification team has reviewed all the documents like log sheets, lab reports, calibration certificates, technical specifications etc.

D.5. Clarification requests, corrective action requests and forward action requests raised

Areas of verification findings	No. of CL	No. of CAR	No. of FAR
Compliance of the monitoring report with the monitoring report form	0	1 (CAR 3)	0
Compliance of the project implementation with the registered PDD	3 (CL 1, CL 4 and CL 6)	0	0
Post-registration changes	0	0	0
Compliance of the monitoring plan with the monitoring methodology including applicable tool and standardized baseline	0	0	0
Compliance of monitoring activities with the registered monitoring plan	3 (CL 2, CL 3 and CL 5)	2 (CAR 2 and CAR 5)	0
Compliance with the calibration frequency requirements for measuring instruments	0	1 (CAR 1)	0
Assessment of data and calculation of emission reductions	0	1 (CAR 4)	0

or net removals			
Others (please specify)	0	0	0
Total	6	5	0

SECTION E. Verification findings

E.1. Compliance of the monitoring report with the monitoring report form

Means of verification	As per para 381 of VVS[/1/] version 9.0, the verification team has determined whether the monitoring report was completed using the valid version of the applicable monitoring report form. The verification team has checked whether all the sections of the monitoring report follows the guidelines provided in the template itself.
Findings	One CAR (CAR 3) was raised in this section.
Conclusion	PP has used the version 5.1 of the MR template[/8/] which is current and active one. The monitoring report has been prepared as per the instructions provided in the template. EPIC has made the version 1.0 of the monitoring report[/8/] covering the monitoring period from 21st August 2013 to 14th September 2014 publicly available on 10th January 2017 through its dedicated interface on the UNFCCC CDM website[/5/]. The verification team has concluded that the monitoring report was completed using the valid version of the applicable monitoring report form and is followed the guidelines given in the template itself.

E.2. Remaining forward action requests from validation and/or previous verification

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The verification has reviewed the previous validation report and observed that there is no open issue i.e FARs was found from the validation. EPIC has not raised a forward Action Request (FAR) during this verification process.

E.3. Compliance of the project implementation with the registered project design document

Means of verification	As per para 383 and 384 of VVS[/1/] version 9.0, the verification team determined the conformity of the actual project activity and its operation with the project design document. EPIC has, by means of a desk review and an on-site visit, assessed that all physical features of the proposed CDM project activity proposed in the PDD[/2/] are in place, and that the project participants have operated the CDM project activity as per the PDD[/2/].
Findings	Three CLs (CL 1, CL 3 and CL 6) were raised in this section.
Conclusion	The verification team determines the conformity of the actual project activity and its operation with the project design document. EPIC has, by means of a desk review and an on-site visit, assessed that all physical features of the proposed CDM project activity proposed in the PDD[/2/] are in place, and that the project participants have operated the CDM project activity as per the PDD[/2/]. Thus the verification team has concluded that the project activity was implemented and operated as per PDD, and that all physical features of the project are in place and comply with para 383 to 384 of VVS[/1/].

E.4. Post-registration changes

E.4.1. Temporary deviations from the registered monitoring plan, monitoring methodology or standardized baseline

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There is no temporary deviation for this monitoring period from the PDD.

E.4.2. Corrections

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There are no corrections in this monitoring period.

E.4.3. Changes to the start date of the crediting period

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There is no change to the start date of the crediting period in this monitoring period.

E.4.4. Inclusion of a monitoring plan to a registered project activity

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Not applicable

E.4.5. Permanent changes from registered monitoring plan, monitoring methodology or standardized baseline

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There is no permanent deviation from the PDD.

E.4.6. Changes to the project design of a registered project activity

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There is no such change.

E.4.7. Types of changes specific to afforestation and reforestation project activities

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Not applicable as the project does not involve afforestation and reforestation activity.

E.5. Compliance of monitoring plan with the monitoring methodology including applicable tool and standardized baseline

Means of verification	As per the para 386 and 387 of VVS version 9.0, the verification team determined whether the monitoring plan indicated in the PDD is in accordance with the applied methodology[6] (AM0022 v4.0) including applicable tools.
Findings	There is no CAR/CL/FAR raised in this section.
Conclusion	The verification team was is able to confirm that the monitoring plan contained in the PDD is in accordance with the approved methodology[6] applied by the project activity, i.e. AM0022 v4.0 and its applicable tools. The monitoring plan of the project is in accordance with the applied methodology. The monitoring has been carried out in accordance with the monitoring plan contained in the PDD. All parameters stated in the monitoring plan and the applied methodology has been fulfilled in the current monitoring period. All parameters used for emission reductions calculation have been verified and found satisfactory. The discussion regarding each parameter has been elaborated in the further sections of this report. The monitoring plan as mentioned in the PDD is in accordance with the applied methodology. The monitoring approach for each parameter described in the PDD was found consistent in terms of unit, measurement procedures and monitoring frequency.

E.6. Compliance of monitoring activities with the registered monitoring plan

E.6.1. Data and parameters fixed ex ante or at renewal of crediting period

Means of verification	As per the para 389 to 391 of VVS version 9.0, the verification team has determined whether all ex-ante parameters used for emission reduction calculation stated in the monitoring plan are used appropriately as per the PDD.
Findings	There is no CAR/CL raised in this section.
Conclusion	Refer Appendix 5 of this report for details

E.6.2. Data and parameters monitored

Means of verification	As per the para 389 to 391 of VVS version 9.0, the verification team has determined whether the monitoring plan has been properly implemented and followed by the PP that the monitoring has been carried out in accordance with the PDD.
Findings	Three CLs and two CARs (CL 2, CL 3, CL 5, CAR 2 and CAR 5) were raised in this section.
Conclusion	Refer Appendix 5 of this report for details

E.6.3. Implementation of sampling plan

Means of verification	As per para 391 of VVS version 9.0, the verification assessed whether the compliance of the sampling efforts and surveys with the sampling plan in

	accordance with the "Standard for sampling and surveys for CDM project activities and programme of activities" if PP had applied a sampling approach to determine data and parameters monitored.
Findings	There is no CAR/CL raised in this section.
Conclusion	PP did not apply sampling plan to determine data and parameters monitored during this monitoring period. The verification team has checked all the documents such as log sheets, calibration certificates etc. hence sampling plan was not required. The verification team hereby confirms that it checked all the documents.

E.7. Compliance with the calibration frequency requirements for measuring instruments

Means of verification	As per para 394 to 399 of VVS version 9.0, the verification team determined whether the calibration of the measuring equipment that has an impact on the claimed emission reductions is conducted by the PP at a frequency specified in the PDD.
Findings	One CAR (CAR 1) was raised in this section.
Conclusion	Refer Appendix 5 of this report for details

E.8. Assessment of data and calculation of emission reductions or net removals

E.8.1. Calculation of baseline GHG emissions or baseline net GHG removals by sinks

Means of verification	As per para 401 and 402 of VVS[1] version 9.0, the verification team assessed whether the data and calculations of baseline emission resulting from the PDD is correct. The verification team has checked whether calculations of baseline GHG emissions have been carried out in accordance with the formulae and methods described in the PDD.
Findings	One CAR (CAR 4) was raised in this section.
Conclusion	Refer Appendix 5 of this report for details

E.8.2. Calculation of project GHG emissions or actual net GHG removals by sinks

Means of verification	As per para 401 and 402 of VVS[1] version 9.0, the verification team assessed whether the data and calculations of project emission resulting from the PDD is correct. The verification team has checked whether calculations of project GHG emissions have been carried out in accordance with the formulae and methods described in the PDD.
Findings	There was no CAR/CL/FAR was raised in this section.
Conclusion	Refer Appendix 5 of this report for details

E.8.3. Calculation of leakage GHG emissions

Means of verification	As per para 401 and 402 of VVS[1] version 9.0, the verification team assessed whether the data and calculations of leakage emission resulting from the PDD is correct. The verification team has checked whether calculations of leakage GHG emissions have been carried out in accordance with the formulae and methods described in the PDD.
Findings	There was no CAR/CL/FAR was raised in this section.
Conclusion	Refer Appendix 5 of this report for details

E.8.4. Summary of calculation of GHG emission reductions or net anthropogenic GHG removals by sinks

Means of verification	As per para 401 and 402 of VVS[1] version 9.0, the verification team assessed whether the data and calculations of GHG emission reductions achieved resulting from the registered CDM project activity. The verification team has checked whether calculations of GHG emission reduction have been carried out in accordance with the formulae and methods described in the PDD.
Findings	There was no CAR/CL/FAR was raised in this section.
Conclusion	Refer Appendix 5 of this report for details

E.8.5. Comparison of actual GHG emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Means of verification	The verification team has determined the CER achieved during this monitoring period with the estimated value and reason for increase if any.
Findings	There was no CAR/CL/FAR was raised in this section.
Conclusion	Refer Appendix 5 of this report for details

E.8.6. Remarks on difference from estimated value in registered PDD

Means of verification	The verification team has determined the CER achieved during this monitoring period with the estimated value and reason for increase if any.
Findings	There was no CAR/CL/FAR was raised in this section.
Conclusion	Refer Appendix 5 of this report for details

E.8.7. Actual GHG emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Means of verification	The verification team has determined the CER achieved during second commitment period.
Findings	There was no CAR/CL/FAR was raised in this section.
Conclusion	CER achieved upto 31st Dec 2012 = 0 tCO2e CER achieved from 1st Jan 2013 = 72,404 tCO2e.

SECTION F. Internal quality control

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After the completion of assessment by the verification team all the relevant documentation is submitted to a qualified, Independent Technical reviewer as part of EPIC' internal quality control system. A Technical reviewer team is appointed to review the draft final verification report (Draft FVR). The comments made by the Technical reviewer team are taken into consideration and incorporated in the final FVR. The technical reviewer team assesses whether all the reporting requirements have been fulfilled and whether all the issues raised were closed satisfactorily by the verification team with justification. The technical review process can also raise issues in this regard which is resolved further by the verification team to the satisfaction of the technical reviewer. The technical reviewer team either accepts or rejects the report made by the verification team. The final report (after resolutions of all findings) is then submitted to the Head-operations for review and approval.

SECTION G. Verification opinion

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EPIC Sustainability Services Private Limited (EPIC) has been contracted by South Pole Carbon Asset Management Ltd to undertake the fifth verification of the registered CDM/GS project activity titled "CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand" (UNFCCC reference number: 2141; GS ID:560). The objectives of this verification are to verify and certify emission reductions reported for project activity for the monitoring period of 21st August 2013 to 14th September 2014 (first and last day included); and to verify that the data reported are complete and transparent.

The verification team determines the conformity of the actual project activity and its operation with the project design document. EPIC has, by means of a desk review and an on-site visit, assessed that all physical features of the proposed CDM project activity proposed in the PDD are in place, and that the project participants have operated the CDM project activity as per the PDD[/2/]. Thus the verification team has concluded that the project activity was implemented and operated as per PDD, and that all physical features of the project are in place.

The verification team, based on the site visit and document review, was able to conclude that the project activity has been commissioned and implemented as per the PDD. The start date of this monitoring period is 21st August 2013 considering the end date of the previous monitoring period.

The monitoring report for this monitoring period is in compliance with the monitoring plan of the PDD. The verification team was is able to confirm that the monitoring plan contained in the PDD is in accordance with the approved methodology applied by the project activity, i.e. AM0022 version 4.0 and its applicable tools. It

was confirmed during the site visit that the project activity during the current periodic verification is in accordance with the applicability criteria of the methodology.

The management of project participants is responsible for the preparation and reporting of GHG emissions data, and the reported GHG emission reduction on the basis set out within the project monitoring plan. The development and maintenance of records and reporting procedures in accordance with the monitoring plan, including the calculation and determination of GHG emission reduction from the project is the responsibility of the management of the project. It is the responsibility of EPIC to express an independent GHG verification opinion on the GHG emissions reductions and on the calculation of GHG emission reductions from the project for this monitoring period based on the reported emission reduction in the monitoring Report.

EPIC's verification approach was based on the requirements as defined under the Kyoto Protocol, Marrakech accord, as well as those defined by the CDM Executive board. EPIC's approach was risk-based, drawing on an understanding of the risks associated with reported GHG emissions data and the controls in place to mitigate these. The examination includes assessment of evidence relevant to the amounts and disclosures in relation to the project's GHG emission reductions for this monitoring period.

The verification team has planned and performed the work to obtain the information and explanations that is considered necessary to provide sufficient evidence for it to give reasonable assurance that the amount of calculated GHG emission reductions for this monitoring period were fairly stated.

The verification team has verified that the information included in the revised monitoring report is correct and that the emission reduction achieved has been determined correctly. Based on the information seen and evaluated, the verification team confirms the following:

Project title:	CYY Biopower Wastewater treatment plant including biogas reuse for thermal oil replacement and electricity generation Project, Thailand
UNFCCC ref no: GS ID:	2141 GS 560
CDM Crediting period: GS crediting period:	Fixed; 25th March 2009 to 24th March 2019 (both days inclusive) Fixed; 25th May 2008 to 24th May 2018 (both days inclusive)
CDM PDD GS PDD Monitoring report	Version 4.1, dated 31st January 2012 Version 2.1 dated 13th May 2010 Version 2.1 dated 22nd June 2017; fifth verification
Methodology used for verification:	AM0022 ver. 4.0 - Avoided Wastewater and On-site Energy Use Emissions in the industrial Sector
Applicable monitoring period:	21st August 2013 to 14th September 2014 (first and last day included)
Emissions reductions verified:	72,404 tCO2e

SECTION H. Certification statement

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As above

Appendix 1. Abbreviations

Abbreviations	Full texts
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CEF	Carbon Emission Factor
CER	Certified Emission Reduction(s)
CL	Clarification request
CMS	Central Monitoring Station
CO2	Carbon dioxide
CO2e	Carbon dioxide equivalent
DNA	Designated National Authority
EPA	Energy Purchase Agreement
FAR	Forward Action Request
GHG	Greenhouse gas(es)
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
MP	Monitoring Plan
MR	Monitoring Report
PDD	Project Design Document
UNFCCC	United Nations Framework Convention on Climate Change
VVS	Clean Development Mechanism Validation and Verification Standard

Appendix 2. Competence of team members and technical reviewers

The following validation team has been assigned to carry out the verification of the project.

Name	Mr. R. Vijayaraghavan	Mr. A. Prabu Das
Role	Lead Auditor	Technical Reviewer team
Competence in relevant sectors	Sector 13 including TA 13.1	Sector 13 including TA 13.1
Responsibility	Doc review, onsite, DVR preparation, DVR resolution, FVR preparation	Technical review

Mr. R. Vijayaraghavan holds BE in Mechanical Engineering, M. Tech in Energy Conservation and Management and MBA in Technology Management. He is certified as Energy Auditor by Bureau of Energy Efficiency (BEE), Government of India. He has 12 years of working experience in energy sector including validation / verification of CDM, VCS and GS projects. He has undergone extensive training on CDM validation and verification and has been qualified as Lead Auditor for sector 1 and sector 13. He has also attended quarterly webinar conducted by GSF on 7th August 2014, 23rd July 2015, 27th January 2016, 8th December 2016 and 27th March 2017 for eligibility for fast track procedure. He has also involved in sector 13 projects in Thailand as lead auditor, thus having experience in the host country. He has also involved in verification of some of the GS projects as lead auditor, thus having prior experience in verifying the GS project.

Mr. A Prabu Das, holds a M.Tech Degree in Energy Conservation and Management and B. Tech Degree in Petro-chemical Technology. He is a certified Energy Auditor by Bureau of Energy Efficiency (BEE), Government of India. He has around 8 years of work experience in Design of biomass Power plants, preparing Techno Economic Feasibility Reports (TEFR), carrying out energy audits, of which last six years have been in CDM consultancy and validation services. He has undergone extensive training on CDM validation and verification and is a qualified lead auditor for Sectoral Scope 1 and sector 13 in accordance with procedures of EPIC Sustainability Services Pvt. Ltd. He has also attended quarterly webinar conducted by GSF on 7th August 2014, 23rd July 2015, 27th Jan 2016 and 8th December 2016 for eligibility for fast track procedure. He is also an ISO 26000 lead auditor certified by Professional Evaluation and Certification Board (PECB).

Appendix 3. Documents reviewed or referenced

No	Author	Title	References to the document	Provider
1	UNFCCC	Validation and verification standard version 9.0 https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20150225165215954/accr_stan02.pdf	1	Publicly available
2	UNFCCC	Registered PDD, validation report, previous monitoring reports and corresponding verification reports, GS PDD	2	Publicly available
3	Manufacturer	Technical specifications of UASB, gas engines, thermic oil heaters, flaring system	3	PP
4	Technical provider	Commissioning certificates of UASB, gas engines, thermic oil heaters, flaring system	4	PP
5	UNFCCC	UNFCCC webpage –indicating start date of this monitoring period https://cdm.unfccc.int/Projects/DB/RWTUV1218617500.62/view	5	Publicly available
6	UNFCCC	AM0022 ver. 4.0 - Avoided Wastewater and On-site Energy Use Emissions in the industrial Sector https://cdm.unfccc.int/methodologies/view?ref=AM0022	6	Publicly available
7	UNFCCC	Guidelines for Application of materiality in verifications version 2.0 https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20150225171039008/iss_guid08.pdf	7	Publicly available
8	PP	Webhosted monitoring report version 1.0 dated 4th January 2017 Monitoring report version 2.1 dated 22nd June 2017 (RFI) Monitoring report template version 5.1 https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20150502195155356/iss_form07.doc	8	Publicly available /PP
9	PP	Power Purchase agreement	9	PP
10	PP	Logsheets/lab reports	10	PP
11	Calibration agency	Calibration certificates	11	PP
12	PP	Plan view of the lagoons	12	PP
13	PP	HFO consumption reports and Dry starch production reports	13	PP
14	Technical provider	CH4 reports for determining the combustion efficiency of thermic oil heater and gas engines	14	PP
15	PP	Gas detector procedure	15	PP
16	PP	Attendance register and Salary records	16	PP
17	PP	Training records	17	PP
18	ILO	ILO website- Conventions ratified by Thailand http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:11200:0::NO::P11200_COUNTRY_ID:102843	18	Publicly available
19	PP	Employee contracts	19	PP
20	Thailand Government	Thailand labor regulations http://www.panwagroup.net/business/index2.html Thailand Ministry of Labour Affairs for health and safety conditions http://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---sro-bangkok/documents/policy/wcms_192111.pdf	20	Publicly available

Appendix 4. Clarification requests, corrective action requests and forward action requests

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

FAR ID	xx	Section no.	NA	Date: 21/02/2017
Description of FAR				
No FAR is raised.				

Project participant response	Date: 17/03/2017
NA	
Documentation provided by project participant	
-	
DOE assessment	**Date:** 09/05/2017
NA	

Table 2. CL from this verification

CL ID	1	Section no.	E.3	Date: 21/02/2017
Description of CL				
Please provide documentary evidence for R_{NAWTF} calculation. Please provide explanation how $R_{deposition\ and}$ R_{lagoon}				
Project participant response				**Date:** 17/03/2017
R_{NAWTF}, $R_{deposition}$ and R_{lagoon} are the fixed ex ante parameters as per the PDD. All the documentary evidence was checked by the DOE at validation stage.				
Documentation provided by project participant				
-				
DOE assessment				**Date:** 09/05/2017
R_{NAWTF} : It is a project specific factor used to estimate how much COD will be removed from the system. It is calculated as below. R_{NAWTF} =COD_{in}-COD_{out}/COD_{in} The verification team has accepted the calculation as correct. $R_{deposition}$ and R_{lagoon} are ex-ante parameters and are fixed for the crediting period including this monitoring period. Hence accepted by the verification team as correct.				

CL ID	2	Section no.	E.6.2	Date: 21/02/2017
Description of CL				
Please provide sample log sheets for COD load. What is the sampling plan adopted when COD values are not available.				
Project participant response				**Date:** 17/03/2017
The log sheet for COD data has been provided to the DOE. In case the COD value is not available, it will be excluded from the ER calculation. However, during the monitoring period, the COD values were measured for the entire period.				
Documentation provided by project participant				
-				
DOE assessment				**Date:** 09/05/2017
The verification team has checked the log sheets of COD. The verification team has checked the CER sheet and logsheets and confirmed that COD analysis values are available for all the operational days. Hence sampling plan was not required to be adopted in this case.				

CL ID	3	Section no.	E.6.2	Date: 21/02/2017
Description of CL				
Please provide justification for the flaring efficiency.				
Project participant response				**Date:** 17/03/2017
As per the PDD, the flaring efficiency of the project activity shall be estimated by using the data of flame detection period and period of biogas sent to flare. However, the data was not available during the monitoring period, the flaring efficiency is assumed as zero percent in order to calculate the project emission. This is conservative and the same approach was followed in the previous verifications.				
Documentation provided by project participant				
-				
DOE assessment				**Date:** 09/05/2017
As per the PDD, Amount of minutes per hour where a flame is detected, whenever biogas is sent to the flare. If flame is detected for less than 20 minutes in an hour (whenever biogas is sent to flare), flare efficiency is assumed to be 0%. Otherwise flare efficiency is assumed to be 50%. Flame is detected by the PP, but data is not available with the PP. So PP has assumed to be zero which is accepted by the verification team as it is conservative.				

CL ID	4	Section no.	E.3	Date: 21/02/2017

Description of CL	
Please provide documentary evidence for thermic oil heater and gas engines efficiencies.	
Project participant response	**Date:** 17/03/2017
The evidence for boiler and gas engine efficiency in 2013 and 2014 have been provided to DOE.	
Documentation provided by project participant	
-	
DOE assessment	**Date:** 09/05/2017
The technical specification of thermic oil heater and gas engines are verified and accepted as correct.	

CL ID	5	Section no.	E.6.2	Date: 21/02/2017
Description of CL				
It is not clear how $M_{lagoon\_anaerobic\_PJ}$ is zero for all the years.				
Project participant response				**Date:** 17/03/2017
$M_{lagoon\_anaerobic}$ is calculated from M_{lagoon_total}, $M_{lagoon\_aerobic}$, $M_{lagoon\_chemical\_ox}$ and $M_{lagoon\_deposition}$ as per the methodology. However, in case the $M_{lagoon\_anaerobic}$ is negative which results in more emission reductions, it will be equal to zero for conservativeness. The same approach was followed in the previous verifications.				
Documentation provided by project participant				
-				
DOE assessment				**Date:** 09/05/2017
As per equation 3 of the applied methodology, $M_{lagoon\_anaerobic\_BL}$ is calculated as follows. $M_{lagoon\_anaerobic\_PJ}=M_{lagoon\_total\_PJ}-M_{lagoon\_aerobic\_PJ}-M_{lagoon\_chemical\_ox\_PJ}-M_{lagoon\_deposition\_PJ}$ Where $M_{lagoon\_total\_PJ}$ - Total amount of organic material removed in the lagoon system $M_{lagoon\_aerobic\_PJ}$ - Amount of organic material degraded aerobically in the lagoon system $M_{lagoon\_chemical\_ox\_PJ}$ - Amount of organic material lost through chemical oxidation in the lagoon system $M_{lagoon\_deposition\_PJ}$ - Amount of organic material lost through deposition in the lagoon system For this monitoring period, summation of $M_{lagoon\_aerobic\_PJ}$, $M_{lagoon\_chemical\_ox\_PJ}$ and $M_{lagoon\_deposition\_PJ}$ is more than $M_{lagoon\_total\_PJ}$. For the sake of conservativeness, PP has assumed it to be zero which is accepted by the verification team. Refer Appendix 5 of this report for more details.				

CL ID	6	Section no.	E.3	Date: 21/02/2017
Description of CL				
Please provide monthly starch production data, Technical specifications of UASB, gas engines, thermic oil heaters, flaring system, technical specification of all the meters, colorimeter and methane analyzer. Please provide commissioning certificates of UASB, flaring system, gas engines, and thermic oil heater. Please provide document to support for surface area of all the 22 ponds.				
Project participant response				**Date:** 17/03/2017
The following data and documents have been provided to DOE. - Monthly starch production data from August 2013 to September 2014 - Technical specifications of biogas system (UASB & flaring system), gas engine, water flow meter (FT100), gas flow meter (FT105, FT501A&B, FT501), gas analyzer (AIT101), colorimeter, and portable gas detector - Commissioning certificates of biogas system and gas engine Proof for surface area of 22 ponds				
Documentation provided by project participant				
As above.				
DOE assessment				**Date:** 09/05/2017
The verification team has reviewed the documents and accepted the same. Refer Appendix 5 of this report for details.				

Table 3. CAR from this verification

CAR ID	1	Section no.	E.7	Date: 21/02/2017
Description of CAR				
PP is requested to provide calibration certificates for all the meters covering the monitoring period selected. If valid calibration certificate is not available, maximum permissible error is to be applied.				
Project participant response				**Date:** 17/03/2017
The calibration reports for the following meters/equipment have been provided. As per the above calibration details, there was no calibration delay occurred during the monitoring period.				
Documentation provided by project participant				

As above.
DOE assessment **Date:** 09/05/2017
The verification team has reviewed the documents and accepted the same. Refer Appendix 5 of this report for more details.

CAR ID	2	**Section no.**	E.6.2	**Date:** 21/02/2017
Description of CAR				
How the measurement is undertaken during the monitoring period for loss of biogas due to leakage in the biogas pipes				
Project participant response				**Date:** 17/03/2017
The document for test gas leakage procedure has been provided to DOE. The biogas plant operator conducts the test on a weekly basis by using portable gas analyzer. The test leakage is monitored through biogas pipes and the test results are recorded in the report form.				
Documentation provided by project participant				
-				
DOE assessment				**Date:** 09/05/2017
As per the PDD, it is measured using mobile gas leak detector. It is denoted as percentage of biogas generated by the PP. The verification team has observed that UASB reactor gas collection system consists of a gas tight concrete coated gas dome and the delivery pipe to the boilers is less than 2 km in length. Integrity of biogas pipeline for losses or leakages is checked using mobile gas leak detector and there is no such losses in this monitoring period. Thus QA/QC is assured.				

CAR ID	3	**Section no.**	E.1	**Date:** 21/02/2017
Description of CAR				
Section B.2.7 and D.3 is left blank, Annex 1 is missing in the MR.				
Project participant response				**Date:** 17/03/2017
The explanation has been provided in section B.2.7 and D.3. Annex 1 has been removed as it is the reference to Annex 1 in the PDD.				
Documentation provided by project participant				
-				
DOE assessment				**Date:** 09/05/2017
The verification team has reviewed the revised MR and accepted the changes as correct.				

CAR ID	4	**Section no.**	E.8	**Date:** 21/02/2017
Description of CAR				
It is not clear how Chemical Oxidation Losses Factor is calculated and. Please explain this parameter amount of chemical oxidizing agents entering system boundary.				
Project participant response				**Date:** 17/03/2017
The Chemical Oxidation Losses Factor, which is 0.651 kg/m3, is a default value as per the methodology and used for calculation of $M_{lagoon\_chemical\_ox}$. The parameter amount of oxidizing chemical material entering system boundary is monitored values of concentration of oxidizing agent where they are identified as being likely to be present in waste water when they are part of the process (i.e. sulphuric acid) as per the methodology. Since the chemical used in starch production process, the wastewater at the inlet of the system boundary is monitored and used in the calculation of $M_{lagoon\_chemical\_ox}$.				
Documentation provided by project participant				
-				
DOE assessment				**Date:** 09/05/2017

As per the appendix 2 of the applied methodology, if wastewater contains oxidative chemical species such as sulphate ion (SO_4^{2-}), it would oxidise organic material, and reduce chemical oxygen demand. For example, where the concentration of sulphate is observed to be 1 kg/m^3 of waste water, 0.651kg/m^3 of COD would be through chemical reaction with the sulphate.

$M_{lagoon\_chemical\_ox\_BL} = \sum (WW_{in} \times SO_4^{2-} \text{ concentration}) \times COD_{loss\_chem\_ox}$

Where
WW_{in} - Waste water flows entering the project treatment facility i.e. UASB
SO_4^{2-} concentration - Sulphate (Qox) concentration
$COD_{loss\_chem\_ox-}$ COD removal factor

$M_{lagoon\_chemical\_ox}$ is calculated daily and yearly values are calculated by adding all the daily values.

Waste water flows entering the project treatment facility i.e. UASB
As per the PDD, it is to be measured/ recorded continuously and transferred to the control system. At the site, the verification team has observed that a water flow meter (FT 100) measures untreated wastewater entering the UASB. The total volume of wastewater leaving the project treatment facility is same as that of waste water entering the project facility by assuming 100% hydrological balance. The hydrological balance is assumed at the time of validation is remains for the entire crediting period.

The verification team has checked the measurement methods and found that plant operators first manually archive the monitored data onto the log sheets then transfer to the computer for electronic storage. Yearly value is cumulative of the daily values. Hence the verification team was able to conclude that this parameter is being monitored and recorded as per the PDD. The verification team has accepted the measurement methods, aggregation approach and data used for baseline emission calculations.

Sulphate concentration:
As per the PDD, it has to be measured daily as per the PDD using colorimetric analysis at the lab located at the project site. Daily sampling of the untreated process effluent was carried out and is analyzed for Sulphate concentration on a daily basis.

The verification team has checked the measurement methods and found that Sulphate content will be analyzed using colorimetric method in the onsite lab. The results are then logged by the operators in the plant operation report on a daily basis. The plant operators then transfer to the computer for electronic storage. The colorimetric method is found to be as per national standards. Hence the verification team was able to conclude that this parameter is being monitored and recorded as per the PDD. The verification team has accepted the measurement methods, aggregation approach and data used for baseline emission calculations.

COD removal factor ($COD_{loss\_chem\_ox}$) =0.651 kg/m^3
It is assumed at the time of validation and it remains same during the entire crediting period.

CAR ID	5	**Section no.**	E.6.2	**Date:** 21/02/2017
Description of CAR				
Please provide fossil fuel consumption in the project activity during the monitoring period. How overestimation of the baseline is avoided. Refer p27 of PDD. Power purchase agreement and electricity imported.				
Project participant response				**Date:** 17/03/2017
The fossil fuel consumption and Power Purchase Agreement[9] (PPA) have been provided to the DOE.				
Documentation provided by project participant				
Revised ER, MR submitted.				
DOE assessment				**Date:** 09/05/2017
Refer Appendix 5 of this report for details.				

Table 4. FAR from this verification

FAR ID	xx	**Section No.**	NA	**Date:** 21/02/2017
Description of FAR				
There was no FAR raised from this verification.				
Project participant response				**Date:** 17/03/2017
NA				
Documentation provided by project participant				

-	
DOE assessment	**Date:** 09/05/2017
NA	

Appendix 5:

Parameter	Conclusion by the verification team
Emission Reductions achieved by the project during the monitoring period (ER_y)	As per equation 12 of the applied methodology, emission reductions are calculated as the difference between baseline and project emissions & leakage emissions. $ER = E_{BL,y} - E_{project,y} - E_{leakage,y}$ Where $E_{BL,y}$ –Baseline emissions during the monitoring period y $E_{project,y-}$ Project emissions during the monitoring period y $E_{leakage,y}$- Leakage emissions during the monitoring period y The verification of the same is detailed below.
Baseline emissions during the monitoring period ($E_{BL,y}$)	As per the applied methodology, total estimated baseline emissions are the sum of fugitive methane emissions from the existing lagoon-based water treatment system and, if relevant**,** CO_2 emissions from the generation of heat on site and/or the generation of power on site or off site. Baseline emissions consists of 1) Emissions from the existing lagoon-based waste water treatment system up to, and including, the point at which organic material flows can be quantified or estimated into and out of the wastewater treatment facility ($E_{CH4\_lagoons\_BL}$) 2) CO2 emissions from fossil fuel use for onsite heat and/or power generation ($E_{CO2\_heat+power\_BL}$); 3) CO2 emissions from fossil fuel use for offsite/grid generation of electricity that would otherwise have been produced ($E_{CO2\_grid\_BL}$). As per the applied methodology, Baseline boundaries are almost identical to the project boundaries, but do not include potential methane emissions from the project anaerobic waste water treatment facility, or from biogas (incomplete combustion, leaks). It is agreed as per the applied methodology that emissions such as nitrous oxide from the waste treatment system, nitrous oxide and methane from fossil energy use in heat and/or electricity generation are ignored. The verification team has checked the PDD and accepted the same as correct. Total estimated baseline emissions are the sum of fugitive methane emissions from the existing lagoon-based water treatment system and, if relevant, CO2 emissions from the generation of heat on site and/or the generation of power on site or off site. As per equation 8 of the applied methodology, $E_{BL} = E_{CH4\_lagoons\_BL} + E_{CO2\_heat+Power\_BL} + E_{CO2\_Grid\_BL}$. The verification details of each of the parameter and calculation methods are indicated below.
Emissions from the existing lagoon-based waste water treatment system up to, and including, the point at which organic material flows can be quantified or estimated into and out of the wastewater treatment facility ($E_{CH4\_lagoons\_BL}$)	As per equation 2 of the applied methodology, $E_{CH4\_lagoons\_BL}$ is calculated as follows. $E_{CH4\_lagoons\_BL} = M_{lagoon\_anaerobic\_BL} \times EF_{CH4} \times GWP_{CH4}$ Where $M_{lagoon\_anaerobic}$ - Amount of organic material removed by anaerobic processes in the lagoon system EF_{CH4}- Methane emission factor GWP_{CH4}- Global warming potential of methane The verification details of each of the parameter and calculation methods are indicated below.

Amount of organic material removed by anaerobic processes in the lagoon system ($M_{lagoon\_anaerobic\_BL}$)	As per equation 3 of the applied methodology, $M_{lagoon\_anaerobic\_BL}$ is calculated as follows. $M_{lagoon\_anaerobic\_BL}=M_{lagoon\_total\_BL}-M_{lagoon\_aerobic\_BL}-M_{lagoon\_chemical\_ox\_BL}-M_{lagoon\_deposition\_BL}$ Where $M_{lagoon\_total\_BL}$ - Total amount of organic material removed in the lagoon system $M_{lagoon\_aerobic\_BL}$- Amount of organic material degraded aerobically in the lagoon system $M_{lagoon\_chemical\_ox\_BL}$- Amount of organic material lost through chemical oxidation in the lagoon system $M_{lagoon\_deposition\_BL}$- Amount of organic material lost through deposition in the lagoon system The verification details of each of the parameter and calculation methods are indicated below.
Total amount of organic material removed in the lagoon system ($M_{lagoon\_total\_BL}$)	As per equation 5 of the applied methodology, M_{lagoon_total} is calculated as follows. $M_{lagoon\_total\_BL} = M_{lagoon\_input\_BL} \times R_{lagoon}$ Where M_{lagoon_input} - Input of organic material from the new project anaerobic waste water treatment facility into the lagoon system $R_{lagoon-}$ Total organic material removal ratio of the lagoon The verification details of each of the parameter and calculation methods are indicated below.
Input of organic material from the new project anaerobic waste water treatment facility into the lagoon system ($M_{lagoon\_input\_BL}$)	As per equation 11 of the applied methodology, it is calculated as follows $M_{lagoon\_input\_BL} = M_{input\_total\_BL}$ Where $M_{input\_total\_BL}$ - Input of organic material from the new project anaerobic waste water treatment facility into the lagoon system The verification details of each of the parameter and calculation methods are indicated below.

<table>
<tr><td>$M_{input\_total\_BL}$</td><td>It is calculated based on COD load into UASB. Daily COD load for each of the UASB is calculated as follows
Daily COD load = Waste water flows entering the project treatment facility x COD of wastewater organic material concentration entering the project treatment facility.
Yearly COD load is summation of all the daily values.</td></tr>
<tr><td>Waste water flows entering the project treatment facility i.e. UASB (AM0022 ID1 and AM0022 ID2)

(ex-post parameter)

<table>
<tr><td>Year</td><td>Waste water flows entering the project treatment facility (WW_{in}) (total)</td></tr>
<tr><td>2013</td><td>359,861 m^3</td></tr>
<tr><td>2014</td><td>659,923 m^3</td></tr>
</table>

QA/QC procedure:

<table>
<tr><td>Particulars</td><td>Value</td></tr>
<tr><td>Tag no</td><td>FT100</td></tr>
<tr><td>Serial no of flow meter</td><td>A064 2633</td></tr>
<tr><td>1. Date of installation of this meter

2. Date of replacement of the meter (Measurement dates by this meter)</td><td>1. Available from start date of this monitoring period as per log sheets.
2.Retained atleast upto time of onsite visit by the verification team</td></tr>
<tr><td>Maximum permissible error of the meter</td><td>±0.3%</td></tr>
<tr><td>Calibration Validity</td><td>1 year</td></tr>
<tr><td>Date of first calibration</td><td>19th October 2012</td></tr>
<tr><td>Calibration Agency</td><td>Miracle International Technology Co Ltd</td></tr>
<tr><td>Validity upto</td><td>18th October 2013</td></tr>
<tr><td>Date of second calibration</td><td>27th September 2013</td></tr>
<tr><td>Calibration Agency</td><td>Miracle International Technology Co Ltd</td></tr>
<tr><td>Validity upto</td><td>26th September 2014</td></tr>
<tr><td>Calibration delay period if any</td><td>No</td></tr>
<tr><td>Applied error</td><td>Not applicable</td></tr>
</table>
</td><td>As per the PDD, it is to be measured/ recorded continuously every day and transferred to the control system. At the site, the verification team has observed that a water flow meter (FT 100) measures untreated wastewater entering the UASB. The total volume of wastewater leaving the project treatment facility is same as that of waste water entering the project facility by assuming 100% hydrological balance. The hydrological balance is assumed at the time of validation is remains for the entire crediting period.

The verification team has checked the measurement methods and found that plant operators first manually archive the monitored data onto the log sheets/10/ then transfer to the computer for electronic storage. Yearly value is cumulative of the daily values. Hence the verification team was able to conclude that this parameter is being monitored and recorded as per the PDD. The verification team has accepted the measurement methods, aggregation approach and data used for baseline emission calculations.

QA/QC procedure:
Water flow meter would be calibrated as per manufacturer's specifications/3/ but atleast once in every year. The verification team has checked the calibration certificates/11/ against meter number, serial number, date of calibration, validity and found that meter is having calibration validity covering the monitoring period. Hence QA/QC of the meter is ensured.

AM0022 ID16:

There is no waste water bypassed the UASB system. Hence this parameter is zero during the monitoring period.</td></tr>
</table>

Flow of wastewater directly to the current wastewater treatment system
(AM0022 ID16)

(ex-post parameter)

Year	Flow of wastewater directly to the current wastewater treatment system
2013	0 m^3
2014	0 m^3

COD of wastewater organic material concentration entering the project treatment facility
(AM0022 ID3)
(ex-post parameter)

Year	COD of wastewater organic material concentration entering the project treatment facility (Average)
2013	20,072 mg/litre
2014	17,720 mg/litre

Particulars	Value
Tag no	Colorimeter
Serial no of flow meter	070890 C64902
1. Date of installation of this meter/ 2. Date of replacement of the meter (Measurement dates by this colorimeter)	1. Available from start date of this monitoring period as per log sheets. 2.Retained atleast upto time of onsite visit by the verification team
Maximum permissible error of the meter	±0.24%
Calibration Validity	1 year
Date of first calibration	30th October 2012
Calibration Agency	EnviScience Company Ltd
Validity upto	29th October 2013
Date of second calibration	21st October 2013
Calibration Agency	EnviScience Company Ltd
Validity upto	20th October 2014
Calibration delay period if	No

As per the PDD, it has to be measured daily as per the PDD using colorimetric analysis at the lab located at the project site. Daily sampling of the untreated process effluent was carried out and is analyzed for COD concentration on a daily basis.

The verification team has checked the measurement methods and found that COD content will be analyzed using colorimetric method/ Close Reflux Titrimetric method in the onsite lab. The results are then logged by the operators in the plant operation report on a daily basis in the lab reports/10/. The plant operators then transfer to the computer for electronic storage. The colorimetric method is found to be as per national standards. Hence the verification team was able to conclude that this parameter is being monitored and recorded as per the PDD. The verification team has accepted the measurement methods, aggregation approach and data used for baseline emission calculations.

QA/QC procedure:
Colorimeter would be calibrated as per manufacturer's specifications/3/ but atleast once in every year. The verification team has checked the calibration certificates/11/ against meter number, serial number, date of calibration, validity and found that meter is having calibration validity covering the monitoring period. Hence QA/QC of the meter is ensured.

any	
Applied error	Not applicable

$M_{input\_total\_BL}$ (calculated)	It is calculated based on COD load into UASB. Daily COD load for each of the UASB is calculated as follows Daily COD load = Waste water flows entering the project treatment facility x COD of wastewater organic material concentration entering the project treatment facility. Yearly COD load is summation of all the daily values.

y	$M_{input\_total\_BL}$
2013	7,218,284 kg COD
2014	11,313,878 kg COD

Input of organic material from the new project anaerobic waste water treatment facility into the lagoon system ($M_{lagoon\_input\_BL}$)	As per equation 11 of the applied methodology, it is calculated as follows $M_{lagoon\_input\_BL} = M_{input\_total\_BL}$

y	$M_{lagoon\_input\_BL}$
2013	7,218,284 kg COD
2014	11,313,878 kg COD

Total organic material removal ratio of the lagoon (R_{lagoon}) = 98.90% (ex-ante parameter)	It is assumed at the time of validation and it remains same during the entire crediting period.
Total amount of organic material removed in the lagoon system ($M_{lagoon\_total\_BL}$)	As per equation 5 of the applied methodology, $M_{lagoon\_total\_BL}$ is calculated as follows. $M_{lagoon\_total\_BL} = M_{lagoon\_input\_BL} \times R_{lagoon}$

y	$M_{lagoon\_total\_BL}$
2013	7,138,883 kg COD
2014	11,189,426 kg COD

Amount of organic material degraded aerobically in the lagoon system ($M_{lagoon\_aerobic\_BL}$)	As per the applied methodology, $M_{lagoon\_aerobic}$ is defined as Surface aerobic losses of organic material in pond based systems equal to 254 kg COD per hectare of pond surface area and per day is assumed to be lost through aerobic processes or it is calculated as follows $M_{lagoon\_aerobic\_BL} = COD_{loss\_aerobic\_BL} \times A_{lagoon\_surface} \times dd_{year}$ Where $COD_{loss\_aerobic\_BL}$ – Surface aerobic losses of organic material $A_{lagoon\_surface}$ - Total surface area of the lagoon based wastewater treatment system dd_{year} - number of days per year The verification details of each of the parameter and calculation methods are indicated below.
Surface aerobic losses of organic material ($COD_{loss\_aerobic\_BL}$) =254 kg COD per hectare (ex-ante parameter)	It is sourced from the applied methodology/PDD, hence accepted.
Total surface area of the lagoon based wastewater treatment system ($A_{lagoon\_surface}$) = 25.18 hectare (ex-ante parameter)	It is based on the plan view[12] of all the 22 ponds. Hence accepted.
Number of days per year (dd_{year}) y: 2013 – dd_{year}: 131 days y: 2014 – dd_{year}: 243 days	It is based on the operational days. Hence accepted.
Amount of organic material degraded aerobically in the lagoon system ($M_{lagoon\_aerobic\_BL}$) y: 2013 – $M_{lagoon\_aerobic\_BL}$: 837,839 kg COD y: 2014 – $M_{lagoon\_aerobic\_BL}$: 1,554,160 kg COD	As per the applied methodology, $M_{lagoon\_aerobic}$ is defined as Surface aerobic losses of organic material in pond based systems equal to 254 kg COD per hectare of pond surface area and per day is assumed to be lost through aerobic processes or it is calculated as follows $M_{lagoon\_aerobic\_BL} = COD_{loss\_aerobic} \times A_{lagoon\_surface} \times dd_{year}$
Amount of organic material lost through chemical oxidation in the lagoon system ($M_{lagoon\_chemical\_ox\_BL}$)	As per the appendix 2 of the applied methodology, if wastewater contains oxidative chemical species such as sulphate ion (SO_4^{2-}), it would oxidise organic material, and reduce chemical oxygen demand. For example, where the concentration of sulphate is observed to be 1 kg/m^3 of waste water, 0.651kg/m^3 of COD would be through chemical reaction with the sulphate. $M_{lagoon\_chemical\_ox\_BL} = \sum(WW_{in} \times SO_4^{2-}\text{ concentration}) \times COD_{loss\_chem\_ox}$ Where WW_{in} - Waste water flows entering the project treatment facility i.e. UASB SO_4^{2-} concentration - Sulphate concentration $COD_{loss\_chem\_ox-}$ COD removal factor The verification details of each of the parameter and calculation methods are indicated below.
Waste water flows entering the project treatment facility i.e. UASB (WW_{in}) (AM0022 ID1) (monitored parameter) Year: Waste water flows entering the project	The parameter is already verified as above.

	treatment facility (WW_{in}) (total)
2013	359,861 m^3
2014	659,923 m^3

Sulphate concentration (Q_{ox}) (AM0022 ID13) (monitored parameter)	As per the PDD, it has to be measured daily as per the PDD using colorimetric analysis at the lab located at the project site. Daily sampling of the untreated process effluent was carried out and is analyzed for Sulphate concentration on a daily basis. The verification team has checked the measurement methods and found that Sulphate content will be analyzed using colorimetric method in the onsite lab. The results are then logged by the operators in the plant operation report on a daily basis in the lab reports/10/. The plant operators then transfer to the computer for electronic storage. The colorimetric method is found to be as per national standards. Hence the verification team was able to conclude that this parameter is being monitored and recorded as per the PDD. The verification team has accepted the measurement methods, aggregation approach and data used for baseline emission calculations. QA/QC procedure for this parameter and COD is the same.

Year	Sulphate concentration (average)
2013	1,257 mg/litre
2014	453 mg/litre

COD removal factor ($COD_{loss\_chem\_ox}$) =0.651 kg/m^3 (ex-ante parameter)	It is assumed at the time of validation and it remains same during the entire crediting period.
Amount of organic material lost through chemical oxidation in the lagoon system ($M_{lagoon\_chemical\_ox\_BL}$)	As per the appendix 2 of the applied methodology, if wastewater contains oxidative chemical species such as sulphate ion (SO_4^{2-}), it would oxidise organic material, and reduce chemical oxygen demand. For example, where the concentration of sulphate is observed to be 1 kg/m^3 of waste water, 0.651kg/m^3 of COD would be through chemical reaction with the sulphate. $M_{lagoon\_chemical\_ox\_BL} = \sum (WW_{in} \times SO_4^{2-} \text{ concentration}) \times COD_{loss\_chem\_ox}$ $M_{lagoon\_chemical\_ox}$ is calculated daily and yearly values is calculated by adding all the daily values.
Amount of organic material lost through deposition in the lagoon system ($M_{lagoon\_deposition\_BL}$)	As per equation 6 of the applied methodology, $M_{lagoon\_deposition}$ is calculated as below. $M_{lagoon\_deposition\_BL} = M_{lagoon\_input\_BL} \times R_{deposition}$ where $M_{lagoon\_input\_BL}$- Input of organic material from the new project anaerobic waste water treatment facility into the lagoon system $R_{deposition}$ – Organic material deposition ratio of the lagoon. The verification details of each of the parameter and calculation methods are indicated below.

Year	$M_{lagoon\_chemical\_ox\_BL}$
2013	301,360 kg COD
2014	202,187 kg COD

Input of organic material from the new project anaerobic waste water treatment facility into the lagoon system ($M_{lagoon\_input\_BL}$) y: 2013 — $M_{lagoon\_input\_BL}$: 7,218,284 kgCOD y: 2014 — $M_{lagoon\_input\_BL}$: 11,313,878 kgCOD	It is already verified as above
Organic material deposition ratio of the lagoon ($R_{deposition}$) =7.05% (ex-ante parameter)	It is assumed at the time of validation and it remains same during the entire crediting period.
Amount of organic material lost through deposition in the lagoon system ($M_{lagoon\_deposition\_BL}$) y: 2013 — $M_{lagoon\_deposition\_BL}$: 508,889 kg COD y: 2014 — $M_{lagoon\_deposition\_BL}$: 797,628 kg COD	As per equation 6 of the applied methodology, $M_{lagoon\_deposition}$ is calculated as below. $M_{lagoon\_deposition\_BL} = M_{lagoon\_input\_BL} \times R_{deposition}$
Amount of organic material removed by anaerobic processes in the lagoon system ($M_{lagoon\_anaerobic\_BL}$) y: 2013 — $M_{lagoon\_anaerobic\_BL}$: 5,490,795 kg COD y: 2014 — $M_{lagoon\_anaerobic\_BL}$: 8,635,450 kg COD	As per equation 3 of the applied methodology, $M_{lagoon\_anaerobic}$ is calculated as follows. $M_{lagoon\_anaerobic\_BL}=M_{lagoon\_total\_BL}-M_{lagoon\_aerobic\_BL}-M_{lagoon\_chemical\_ox\_BL}-M_{lagoon\_deposition\_BL}$
Methane emission factor (EF_{CH4}) =0.21 kg CH_4/kg COD (ex-ante parameter)	It is assumed at the time of validation and it remains same during the entire crediting period.
Global warming potential of methane (GWP_{CH4}) = 25 $tCO2e/tCH_4$	PP has considered GWP of methane as 25 which is accepted for the second commitment period which is in accordance with decision 4/CMP 7 as prescribed by the "Standard for application of the global warming potentials to CDM PA and PoA for the second commitment period of the Kyoto protocol" Version 1.0 (EB 69 Annex 3).
Emissions from the existing lagoon-based waste water treatment system up to, and including, the point at which organic material flows can be quantified or estimated into and out of the wastewater treatment facility ($E_{CH4\_lagoons\_BL}$) y: 2013 — $E_{CH4\_lagoons\_BL}$: 28,827 tCO2e y: 2014 — $E_{CH4\_lagoons\_BL}$: 45,336 tCO2e	As per equation 2 of the applied methodology, $E_{CH4\_lagoons\_BL}$ is calculated as follows. $E_{CH4\_lagoons\_BL} = M_{lagoon\_anaerobic\_BL} \times EF_{CH4} \times GWP_{CH4}$
CO_2 emissions from on-site fossil heat generation in the baseline case that are displaced by generation based on biogas collected in the anaerobic treatment facility ($E_{CO2\_heat\_BL}$)	The use of fossil fuels is considered in calculating CO_2 emissions from on-site heat displaced by biogas collected in the anaerobic treatment. As per the equation 9 of the applied methodology, $E_{CO2\_heat\_BL} = F_{HFO} \times NCV_{HFO} \times EF_{HFO}$ Where F_{HFO} - Amount of fossil fuel (heavy fuel oil) displaced by the use of biogas for the generation of on-site heat NCV_{HFO}- Net calorific value of the fossil fuel considered EF_{HFO}- Carbon emission factor of the fossil fuel considered
Amount of fossil fuel (heavy fuel oil) displaced by the use of biogas for the generation of on-site heat	Amount of HFO displaced is calculated based on the following approach. PP has assumed that heat supplied by biogas in the project activity is equal to heat that would be supplied by fuel oil in

<table>
<tr><td>(F_{HFO})</td><td>the baseline.

Amount of HFO displaced x NCV of HFO =∑(Amount of methane sent to the boiler x NCV of methane)

Or
Amount of HFO displaced x NCV of HFO =∑(Amount of biogas sent to the boiler x methane concentration x NCV of methane)

Amount of HFO displaced is calculated daily and yearly value is arrived at by adding all the daily values.

The verification details of each of the parameter and calculation methods are indicated below.</td></tr>
<tr><td>Amount of biogas sent to the facility heaters (thermic oil heater) (AM0022 ID5)

(monitored parameter)

<table>
<tr><td>y</td><td>Amount of biogas sent to the thermic oil heater (total)</td></tr>
<tr><td>2013</td><td>1,305,472 m^3</td></tr>
<tr><td>2014</td><td>2,855,064 m^3 (adjusted)</td></tr>
</table>

QA/QC procedure:

<table>
<tr><td>Particulars</td><td>Value</td></tr>
<tr><td>Tag no</td><td>FT501</td></tr>
<tr><td>Serial no of flow meters</td><td>1. 91FA19 282639 and
2. C140397</td></tr>
<tr><td>1. Date of installation of this meter/
2. Date of replacement of the meter (Measurement dates by this meter)</td><td>1. Available from start date of this monitoring period as per log sheets. 2.30th July 2014
--
1. 31st July 2014
2. Retained atleast upto time of onsite visit by the verification team</td></tr>
<tr><td>Maximum permissible error of the meter</td><td>±0.04% of span</td></tr>
<tr><td>Calibration Validity</td><td>1 year</td></tr>
<tr><td>Date of first calibration of first meter</td><td>19th October 2012</td></tr>
<tr><td>Calibration Agency</td><td>Miracle International Technology Co Ltd</td></tr>
<tr><td>Validity upto</td><td>18th October 2013</td></tr>
<tr><td>Date of second calibration of first meter</td><td>27th September 2013</td></tr>
<tr><td>Calibration Agency</td><td>Yokagawa (Thailand) Ltd</td></tr>
<tr><td>Validity upto</td><td>26th September</td></tr>
</table>
</td><td>As per the PDD, it is to be measured/ recorded continuously and transferred to the control system. At the site, it is measured by the biogas flow meter (FT501) installed at the entry of the thermic oil heater. The monitored data were recorded on log sheets/10/ as well as on digital storage device. Hence the verification team was able to conclude that this parameter is being monitored and recorded as per the PDD. The verification team has accepted the measurement methods, aggregation approach and data used for baseline emission calculations.

QA/QC procedure:

Gas flowmeter would be calibrated as per manufacturer's specifications/3/ but atleast once in every year. The verification team has checked the calibration certificates/11/ against meter number, serial number, date of calibration, validity and actual error and found that meter is calibrated by the certified agency but is having calibration delay. As the actual error is more than the maximum permissible error, observed from the results of delayed calibration records, actual error is applied to the measured value for the calibration delayed period as follows.

Adjusted value = Measured value x (100%- applied error)

The adjustment is done on a daily basis. The formula is accepted by the verification team as the adjustment leads to conservative baseline emissions. Hence the verification team was able to conclude that error is applied for the delayed calibration period in a conservative approach so as to arrive at a conservative baseline emission value. Thus it is in line with para 395 and 396 of VVS/1/ version 9.0. Yearly data is cumulative of daily adjusted readings. Yearly data is used for the calculation of baseline emissions. Hence QA/QC of the meter is ensured.</td></tr>
</table>

	2014
Date of first calibration of second meter	27th August 2014
Calibration Agency	Binder GmbH
Validity upto	24th September 2015
Calibration delay period if any	31st July 2014 to 26th August 2014
Actual error	0.72%
Applied error	0.72%

NCV of biogas	It is calculated as follows. NCV_{biogas} =$NCV_{methane}$ x methane concentration
NCV of methane =35.94 MJ/NM^3	It is sourced from NIST website and accepted.
Methane concentration (AM0022 ID11) (monitored parameter)	As per the PDD/2/, methane content will be measured continuously. At the site, CH4 content is measured through electronic probe (AIT101) and analysis. The monitored data were recorded on log sheets/10/ as well as on digital storage device. Every day, one sample is taken for analysis at the laboratory located at the site. The verification team was able to confirm that the measurements points of biogas flow and methane content is very close to each other. Hence the verification team was able to conclude that this parameter is being monitored and recorded as per the PDD. The verification team has accepted the measurement methods, aggregation approach and data used for baseline emission calculations. QA/QC procedure: Methane analyser would be calibrated as per manufacturer's specifications/3/ but atleast once in every year. The verification team has checked the calibration certificates/11/ against meter number, serial number, date of calibration, validity and found that meter is having calibration validity covering the monitoring period. Hence QA/QC of the meter is ensured.

y	Methane concentration (average)
2013	68.79%
2014	66.67%

Particulars	Value
Tag no	AIT101
Serial no of analysers	ARCC-0038 and ARBM-0023
1. Date of installation of this anlayser 2. Date of replacement of the anlayser (Measurement dates by this anlayser)	1. Available from start date of this monitoring period as per log sheets. 2.5th October 2013 -- 1.6th October 2013 2. Retained atleast upto time of onsite visit by the verification team
Maximum permissible error of the anlayser	±1%
Calibration Validity	1 year
Date of first calibration of first analyser	22nd December 2012
Calibration Agency	Miracle International Technology Co Ltd
Validity upto	21st December 2013
Date of first calibration of second analyser	22nd December 2012
Calibration Agency	Miracle International Technology Co Ltd
Validity upto	21st December

	2013
Date of second calibration of second analyser	20th October 2013
Calibration Agency	UT precision Co Ltd.
Validity upto	19th October 2014
Calibration delay period if any	No
Applied error	Not applicable

NCV of biogas
(AM0022 ID19)
(monitored parameter)

y	NCV of biogas (average)
2013	24.53 MJ/NM^3
2014	23.96 MJ/NM^3

It is calculated as follows.
NCV_{biogas} =$NCV_{methane}$ x methane concentration

Since it is calculated from parameters like methane content which is QA/QC assured, the calculation of NCV_{biogas} is QA/QC assured.

NCV of HFO =40.4 MJ/kg of HFO

It is sourced from IPCC 2006 guidelines/PDD and hence accepted.

Amount of fossil fuel (heavy fuel oil) displaced by the use of biogas for the generation of on-site heat (F_{HFO})
(AM0022 ID8)

(monitored parameter)

y	F_{HFO} (total)
2013	805.18 tonnes of HFO (measured from biogas sent to the boiler)
2014	1,697.54 tonnes of HFO (measured from biogas sent to the boiler)

y	HFO consumed in the project activity
2013	278,757 litres or 277.36 tonnes
2014	621,238 litres or 618.13 tonnes

y	Dry starch production in the project activity
2013	22,673 tonnes
2014	61,580 tonnes

y	HFO that would be consumed in the absence of the project activity
2013	748.89 tonnes
2014	2033.99 tonnes

y	F_{HFO} (total)
2013	471.53 tonnes of HFO (claimed for baseline emissions)

Amount of HFO displaced is calculated based on the following approach.

Amount of HFO displaced x NCV of HFO =∑(Amount of methane sent to the boiler x NCV of methane)

Or
Amount of HFO displaced x NCV of HFO =∑(Amount of biogas sent to the boiler x methane concentration x NCV of methane)

Amount of HFO displaced is calculated daily and yearly value is arrived at by adding all the daily values.

Since it is calculated from parameters like amount of methane sent to the boiler, methane content and NCV of methane which is QA/QC assured, the calculation of F_{HFO} is QA/QC assured.

As per the PDD (p27), for ex-ante estimation of emission reductions the amount of heavy fuel displaced is based on the historic average annual HFO demand of 1,466 t HFO per year. Based on the historic average annual HFP consumption of 1,466 t HFO/year and on the historic average dry starch production (44,376 t starch/yr), the specific heavy fuel oil consumption is determined as 0.03303 t HFO/t dry starch. The historic average specific heavy fuel oil consumption shall be used as reference value during the monitoring period in order to avoid an overestimation of baseline emissions.

Accordingly, PP limited the HFO saved due to the project activity upto 0.03303 tHFO/tdryStarch only. The verification team has reviewed the monthly HFO consumption reports/13/ and dry starch production reports/13/ in the project activity.

HFO that would be consumed in the absence of the project activity =Dry starch production x specific HFO consumption

HFO thus saved due to the project activity or due to compensation by sending the biogas into the boiler = HFO that would be consumed in the absence of the project activity- HFO consumed in the project activity.

HFO saved due to the project activity is used for calculating the baseline emissions to avoid overestimation.

2014 | 1,079.41 tonnes of HFO (claimed for baseline emissions)	
NCV of HFO =40.4 MJ/kg of HFO (ex-ante parameter)	It is sourced from IPCC 2006 guidelines and hence accepted.
Carbon emission factor of the fossil fuel considered (EF_{HFO}) =77.40 tCO2/TJ (ex-ante parameter)	It is sourced from IPCC 2006 guidelines and hence accepted.
CO_2 emissions from on-site fossil heat generation in the baseline case that are displaced by generation based on biogas collected in the anaerobic treatment facility ($E_{CO2\_heat\_BL}$) y | $E_{CO2\_heat\_BL}$ 2013 | 1,474 tCO2e 2014 | 3,375 tCO2e	The use of fossil fuels is considered in calculating CO_2 emissions from on-site heat displaced by biogas collected in the anaerobic treatment. As per the equation 9 of the applied methodology, $E_{CO2\_heat\_BL} = F_{HFO} \times NCV_{HFO} \times EF_{HFO}$
On site and/or off site Grid Power Generation Emissions displaced by generation based on biogas collected in the anaerobic treatment facility ($E_{CO2\_Power\_BL}$)	As per equation 10 of the applied methodology, $E_{CO2\_Power\_BL}$ is calculated as follows. $E_{CO2\_Power\_BL} = EL \times CEF$ Where EL - Amount of electricity displaced by the electricity generated from the biogas collected from the anaerobic treatment facility CEF- Carbon emission factor for the electricity displaced by the electricity generated from the biogas. The verification of the above parameters is detailed below.
Amount of electricity displaced by the electricity generated from the biogas collected from the anaerobic treatment facility (EL) (AM0022 ID7) (monitored parameter) y | EL 2013 | 1,661.50 MWh 2014 | 1,416.11 MWh Particulars | Value Tag no | Gen A Serial no of flow meters | A010393 1. Date of installation of this meter/ 2. Date of replacement of the meter (Measurement dates by this meter) | 1. Available from start date of this monitoring period as per log sheets. 2. Retained atleast upto time of onsite visit by the verification team Maximum permissible error of the meter | ±1% Calibration Validity | 1 year	As per the PDD, this parameter is to be measured continuously and recorded monthly by a standard electricity meter located at the two generators. At the site, the verification team has able to confirm that the electricity generation is being monitored by using electricity meter daily and the monitored data were recorded on log sheets[/10/] as well as on digital storage device. Hence the verification team was able to conclude that this parameter is being monitored and recorded as per the PDD. In the absence of the project activity, the same amount of electricity would be imported from the grid. Hence accepted by the verification team as correct. The verification team has accepted the measurement methods, aggregation approach and data used for baseline emission calculations. QA/QC procedure: Electricity meters would be calibrated as per manufacturer's specifications[/3/] but atleast once in every year. The verification team has checked the calibration certificates[/11/] against meter number, serial number, date of calibration, validity and found that meter is having calibration validity covering the monitoring period. Hence QA/QC of the meter is ensured.

Date of first calibration of first meter	27th October 2012
Calibration Agency	TIP Industry Services Co Ltd
Validity upto	26th October 2013
Date of second calibration	12th October 2013
Calibration Agency	TIP Industry Services Co Ltd
Validity upto	11th October 2014
Calibration delay period if any	No
Applied error	Not applicable

Particulars	Value
Tag no	Gen B
Serial no of flow meters	A004997
1. Date of installation of this meter/ 2. Date of replacement of the meter (Measurement dates by this meter)	1. Available from start date of this monitoring period as per log sheets. 2. Retained atleast upto time of onsite visit by the verification team
Maximum permissible error of the meter	±1%
Calibration Validity	1 year
Date of first calibration of first meter	27th October 2012
Calibration Agency	TIP Industry Services Co Ltd
Validity upto	26th October 2013
Date of second calibration	12th October 2013
Calibration Agency	TIP Industry Services Co Ltd
Validity upto	11th October 2014
Calibration delay period if any	No
Applied error	Not applicable

Carbon emission factor for the electricity displaced by the electricity generated from the biogas (CEF) =0.52 tCO2/MWh (ex-ante parameter)	It is assumed at the time of validation and it remains same during the entire crediting period.
On site and/or off site Grid Power Generation Emissions displaced by generation based on biogas collected in the anaerobic treatment facility ($E_{CO2\_Power\_BL}$)	As per equation 10 of the applied methodology, $E_{CO2\_Power\_BL}$ is calculated as follows. $E_{CO2\_Power\_BL}$ = EL x CEF

y	$E_{CO2\ Power\ BL}$
2013	863.98 tCO2e
2014	736.38 tCO2e

CO2 emissions from fossil fuel use for offsite/grid generation of electricity that would otherwise have been produced ($E_{CO2\_grid\_BL}$) = 0 tCO2e	Since there is no DG set available in the baseline in generating electricity, hence this emission is considered to be zero.
Baseline emissions during the monitoring period (E_{BL}) y: 2013 — E_{BL}: 31,165.09 tCO2e y: 2014 — E_{BL}: 49,447.76 tCO2e	As per equation 8 of the applied methodology, $E_{BL} = E_{CH4\_lagoons\_BL} + E_{CO2\_heat+Power\_BL} + E_{CO2\_Grid\_BL}$
Project emissions ($E_{Project}$)	As per the applied methodology, total estimated project emissions are the sum of fugitive methane emissions from the existing lagoon-based water treatment system, from possible methane emissions from the new anaerobic waste water treatment facility, from incomplete biogas combustion, biogas leaks. As per equation 1 of the applied methodology, $E_{Project}$ is calculated as follows. $E_{project} = E_{CH4\_lagoons\_PJ} + E_{CH4\_NAWTF\_PJ} + E_{CH4\_IC+leaks\_PJ}$ Where $E_{CH4\_lagoons}$ - fugitive methane emissions from lagoons E_{CH4_NAWTF} - fugitive methane emissions from the new anaerobic waste water treatment facility $E_{CH4\_IC+leakss}$ - methane emissions from inefficient combustion and leaks The verification of the above parameters is detailed below.
Methane emissions from the lagoons ($E_{CH4\_lagoons\_PJ}$)	As per equation 2 of the applied methodology, $E_{CH4\_lagoons\_BL}$ is calculated as follows. $E_{CH4\_lagoons\_PJ} = M_{lagoon\_anaerobic\_PJ} \times EF_{CH4} \times GWP_{CH4}$ Where $M_{lagoon\_anaerobic\_PJ}$ - Amount of organic material removed by anaerobic processes in the lagoon system EF_{CH4}- Methane emission factor GWP_{CH4}- Global warming potential of methane The verification details of each of the parameter and calculation methods are indicated below.
Amount of organic material removed by anaerobic processes in the lagoon system ($M_{lagoon\_anaerobic\_PJ}$)	As per equation 3 of the applied methodology, $M_{lagoon\_anaerobic\_BL}$ is calculated as follows. $M_{lagoon\_anaerobic\_PJ} = M_{lagoon\_total\_PJ} - M_{lagoon\_aerobic\_PJ} - M_{lagoon\_chemical\_ox\_PJ} - M_{lagoon\_deposition\_PJ}$ Where $M_{lagoon\_total\_PJ}$ - Total amount of organic material removed in the lagoon system $M_{lagoon\_aerobic\_PJ}$ - Amount of organic material degraded aerobically in the lagoon system $M_{lagoon\_chemical\_ox\_PJ}$ - Amount of organic material lost through chemical oxidation in the lagoon system $M_{lagoon\_deposition\_PJ}$- Amount of organic material lost through deposition in the lagoon system The verification details of each of the parameter and calculation methods are indicated below.
Total amount of organic material removed in the lagoon system ($M_{lagoon\_total\_PJ}$)	As per equation 5 of the applied methodology, $M_{lagoon\_total\_PJ}$ is calculated as follows. $M_{lagoon\_total\_PJ} = M_{lagoon\_input\_PJ} \times R_{lagoon}$

	Where $M_{lagoon\_input\_PJ}$ - Input of organic material from the new project anaerobic waste water treatment facility into the lagoon system $R_{lagoon-}$ Total organic material removal ratio of the lagoon The verification details of each of the parameter and calculation methods are indicated below.
Input of organic material from the new project anaerobic waste water treatment facility into the lagoon system ($M_{lagoon\_input\_PJ}$)	As per equation 4 of the applied methodology, it is calculated as follows $M_{lagoon\_input\_PJ} = M_{input\_total\_PJ} \times (1-R_{NAWTF})$ Where $M_{input\_total\_PJ}$ - Input of organic material from the new project anaerobic waste water treatment facility into the lagoon system R_{NAWTF}- Total organic material removal efficiency of the new project water treatment facility The verification details of each of the parameter and calculation methods are indicated below.

<table>
<tr>
<td>$M_{input\_total\_PJ}$</td>
<td>It is calculated based on COD load into UASB. Daily COD load for each of the UASB is calculated as follows
Daily COD load = Waste water flows entering the project treatment facility x COD of wastewater organic material concentration entering the project treatment facility.
Yearly COD load is summation of all the daily values.</td>
</tr>
<tr>
<td>Waste water flows entering the project treatment facility i.e. UASB (AM0022 ID1)
(monitored parameter)

<table>
<tr><th>Year</th><th>Waste water flows entering the project treatment facility (WW_{in}) (total)</th></tr>
<tr><td>2013</td><td>359,861 m^3</td></tr>
<tr><td>2014</td><td>659,923 m^3</td></tr>
</table>

(monitored parameter)

Organic material removed from wastewater facility (AM0022 ID18)
(monitored parameter)

<table>
<tr><th>Year</th><th>Organic material removed from wastewater facility</th></tr>
<tr><td>2013</td><td>0 tonnes</td></tr>
<tr><td>2014</td><td>0 tonnes</td></tr>
</table>

<table>
<tr><th>Particulars</th><th>Value</th></tr>
<tr><td>Tag no</td><td>Weigh bridge</td></tr>
<tr><td>Serial no of flow meters</td><td>0000237</td></tr>
<tr><td>1. Date of installation of this meter/ 2. Date of replacement of the meter (Measurement dates by this meter)</td><td>1. Available from start date of this monitoring period as per log sheets. 2. Retained atleast upto time of onsite visit by the verification team</td></tr>
<tr><td>Maximum permissible error of the meter</td><td>±20 kg</td></tr>
<tr><td>Calibration Validity</td><td>2 years</td></tr>
<tr><td>Date of first calibration of first meter</td><td>18th January 2013</td></tr>
<tr><td>Calibration Agency</td><td>Central Bureau of Weights and Measures</td></tr>
<tr><td>Validity upto</td><td>17th January 2015</td></tr>
<tr><td>Calibration delay period if any</td><td>No</td></tr>
<tr><td>Applied error</td><td>Not applicable</td></tr>
</table>
</td>
<td>It is already verified as above.

Organic material removed from wastewater facility:

There is no organic material removed from the system during the monitoring period.</td>
</tr>
<tr>
<td>COD of wastewater organic material concentration entering the project treatment facility (AM00222 ID3)

(monitored parameter)</td>
<td>It is already verified as above.</td>
</tr>
</table>

<table><tr><td>Year</td><td>COD of wastewater organic material concentration entering the project treatment facility (COD_{in}) (Average)</td></tr><tr><td>2013</td><td>20,072 mg/litre</td></tr><tr><td>2014</td><td>17,720 mg/litre</td></tr></table>	
$M_{input\_total\_PJ}$ <table><tr><td>y</td><td>$M_{input\_total\_PJ}$</td></tr><tr><td>2013</td><td>7,218,284 kgCOD</td></tr><tr><td>2014</td><td>11,313,878 kgCOD</td></tr></table> (calculated)	It is calculated based on COD load into UASB. Daily COD load for each of the UASB is calculated as follows Daily COD load = Waste water flows entering the project treatment facility x COD of wastewater organic material concentration entering the project treatment facility. Yearly COD load is summation of all the daily values.
Total organic material removal efficiency of the new project water treatment facility (R_{NAWTF})	It is a project specific factor used to estimate how much COD will be removed from the system. It is calculated as below. $R_{NAWTF} = COD_{in}-COD_{out}/COD_{in}$
COD of wastewater organic material concentration entering the project treatment facility (AM0022 ID3) (monitored parameter) <table><tr><td>Year</td><td>COD of wastewater organic material concentration entering the project treatment facility (COD_{in}) (Average)</td></tr><tr><td>2013</td><td>20,072 mg/litre</td></tr><tr><td>2014</td><td>17,720 mg/litre</td></tr></table>	It is already verified as above.
COD of wastewater organic material concentration leaving the project treatment facility (AM0022 ID4) (monitored parameter) <table><tr><td>Year</td><td>COD of wastewater organic material concentration leaving the project treatment facility (COD_{out} (Average)</td></tr><tr><td>2013</td><td>1,827 mg/litre</td></tr><tr><td>2014</td><td>1,642 mg/litre</td></tr></table>	The verification opinion of COD_{out} and COD_{in} including QA/QC are the same.
Total organic material removal efficiency of the new project water treatment facility (R_{NAWTF}) <table><tr><td>Year</td><td>R_{NAWTF}</td></tr><tr><td>2013</td><td>90%</td></tr><tr><td>2014</td><td>90%</td></tr></table>	It is a project specific factor used to estimate how much COD will be removed from the system. It is calculated as below. $R_{NAWTF} = COD_{in}-COD_{out}/COD_{in}$ PP has calculated this value by considering the minimum value of ex-ante assumed value of 90% and daily measured values. The verification team has accepted this approach as it results in conservative project emissions.
Input of organic material from the new project anaerobic waste water treatment facility into the lagoon system ($M_{lagoon\_input\_PJ}$) <table><tr><td>Year</td><td>$M_{lagoon\_input\_PJ}$</td></tr><tr><td>2013</td><td>721,828 kg COD</td></tr></table>	As per equation 4 of the applied methodology, it is calculated as follows $M_{lagoon\_input\_PJ} = M_{input\_total\_PJ} \times (1-R_{NAWTF})$ Where $M_{input\_total\_PJ}$ - Input of organic material from the new project anaerobic waste water treatment facility into the lagoon system

2014 | 1,131,388 kg COD	R_{NAWTF}- Total organic material removal efficiency of the new project water treatment facility
Total organic material removal ratio of the lagoon (R_{lagoon}) = 98.90% (ex-ante parameter)	It is assumed at the time of validation and it remains same during the entire crediting period.
Total amount of organic material removed in the lagoon system ($M_{lagoon\_total\_PJ}$) y | $M_{lagoon\_total\_PJ}$ 2013 | 713,888 kg COD 2014 | 1,118,943 kg COD	As per equation 5 of the applied methodology, $M_{lagoon\_total\_PJ}$ is calculated as follows. $M_{lagoon\_total\_PJ} = M_{lagoon\_input\_PJ} \times R_{lagoon}$

Amount of organic material degraded aerobically in the lagoon system ($M_{lagoon\_aerobic\_PJ}$)	As per the applied methodology, $M_{lagoon\_aerobic\_PJ}$ is defined as Surface aerobic losses of organic material in pond based systems equal to 254 kg COD per hectare of pond surface area and per day is assumed to be lost through aerobic processes or it is calculated as follows $M_{lagoon\_aerobic\_PJ} = COD_{loss\_aerobic\_PJ} \times A_{lagoon\_surface} \times dd_{year}$ Where $COD_{loss\_aerobic\_PJ}$ – Surface aerobic losses of organic material $A_{lagoon\_surface}$ - Total surface area of the lagoon based wastewater treatment system dd_{year} - number of days per year The verification details of each of the parameter and calculation methods are indicated below.
Surface aerobic losses of organic material ($COD_{loss\_aerobic\_PJ}$) =254 kg COD per hectare (ex-ante parameter)	It is sourced from the applied methodology, hence accepted.
Total surface area of the lagoon based wastewater treatment system ($A_{lagoon\_surface}$) = 25.18 hectare (ex-ante parameter)	It is based on the plan view[12] of all the 22 ponds. Hence accepted.
Number of days per year (dd_{year}) y: 2013 – dd_{year}: 131 days y: 2014 – dd_{year}: 243 days	It is based on the operational days. Hence accepted.
Amount of organic material degraded aerobically in the lagoon system ($M_{lagoon\_aerobic\_PJ}$) y: 2013 – $M_{lagoon\_aerobic\_PJ}$: 837,839 kgCOD y: 2014 – $M_{lagoon\_aerobic\_PJ}$: 1,554,160 kgCOD	As per the applied methodology, $M_{lagoon\_aerobic}$ is defined as Surface aerobic losses of organic material in pond based systems equal to 254 kg COD per hectare of pond surface area and per day is assumed to be lost through aerobic processes or it is calculated as follows $M_{lagoon\_aerobic\_PJ} = COD_{loss\_aerobic} \times A_{lagoon\_surface} \times dd_{year}$
Amount of organic material lost through chemical oxidation in the lagoon system ($M_{lagoon\_chemical\_ox\_PJ}$)	As per the appendix 2 of the applied methodology, if wastewater contains oxidative chemical species such as sulphate ion (SO_4^{2-}), it would oxidise organic material, and reduce chemical oxygen demand. For example, where the concentration of sulphate is observed to be 1 kg/m^3 of waste water, 0.651kg/m^3 of COD would be through chemical reaction with the sulphate. $M_{lagoon\_chemical\_ox\_PJ} = \sum(WW_{in} \times SO_4^{2-} \text{ concentration}) \times COD_{loss\_chem\_ox}$ Where WW_{in} - Waste water flows entering the project treatment facility i.e. UASB SO_4^{2-} concentration - Sulphate (Qox) concentration $COD_{loss\_chem\_ox}$- COD removal factor The verification details of each of the parameter and calculation methods are indicated below.
Waste water flows entering the project treatment facility i.e. UASB (WW_{in}) (AM0022 ID1) Year: Waste water flows entering the project	The parameter is already verified as above.

	treatment facility (WW_{in}) (total)
2013	359,861 m^3
2014	659,923 m^3

Sulphate (Qox) concentration (AM0022 ID13)	The parameter is already verified as above.
COD removal factor ($COD_{loss\_chem\_ox}$) =0.651 kg/m^3 (ex-ante parameter)	It is assumed at the time of validation and it remains same during the entire crediting period.
Amount of organic material lost through chemical oxidation in the lagoon system ($M_{lagoon\_chemical\_ox\_PJ}$)	As per the appendix 2 of the applied methodology, if wastewater contains oxidative chemical species such as sulphate ion (SO_4^{2-}), it would oxidise organic material, and reduce chemical oxygen demand. For example, where the concentration of sulphate is observed to be 1 kg/m^3 of waste water, 0.651kg/m^3 of COD would be through chemical reaction with the sulphate. $M_{lagoon\_chemical\_ox\_PJ} = \sum(WW_{in} \times SO_4^{2-}$ concentration) x $COD_{loss\_chem\_ox}$ $M_{lagoon\_chemical\_ox}$ is calculated daily and yearly values is calculated by adding all the daily values.
Amount of organic material lost through deposition in the lagoon system ($M_{lagoon\_deposition\_PJ}$)	As per equation 6 of the applied methodology, $M_{lagoon\_deposition\_PJ}$ is calculated as below. $M_{lagoon\_deposition\_PJ} = M_{lagoon\_input\_PJ} \times R_{deposition}$ where $M_{lagoon\_input\_PJ}$- Input of organic material from the new project anaerobic waste water treatment facility into the lagoon system $R_{deposition}$ – Organic material deposition ratio of the lagoon. The verification details of each of the parameter and calculation methods are indicated below.
Input of organic material from the new project anaerobic waste water treatment facility into the lagoon system ($M_{lagoon\_input\_PJ}$)	It is already verified as above
Organic material deposition ratio of the lagoon ($R_{deposition}$) =7.05% (ex-ante parameter)	It is assumed at the time of validation and it remains same during the entire crediting period.
Amount of organic material lost through deposition in the lagoon system ($M_{lagoon\_deposition\_PJ}$)	As per equation 6 of the applied methodology, $M_{lagoon\_deposition}$ is calculated as below. $M_{lagoon\_deposition\_PJ} = M_{lagoon\_input\_BL} \times R_{deposition}$
Amount of organic material removed by anaerobic processes in the lagoon system ($M_{lagoon\_anaerobic\_PJ}$)	As per equation 3 of the applied methodology, $M_{lagoon\_anaerobic}$ is calculated as follows. $M_{lagoon\_anaerobic\_PJ}=M_{lagoon\_total\_PJ}-M_{lagoon\_aerobic\_PJ}-M_{lagoon\_chemical\_ox\_PJ}-M_{lagoon\_deposition\_PJ}$

Year	Sulphate (Qox) concentration (average)
2013	1,257 mg/litre
2014	453 mg/litre

Year	$M_{lagoon\_chemical\_ox\_PJ}$
2013	301,360 kg COD
2014	202,187 kg COD

y	$M_{lagoon\_input\_BL}$
2013	721,828 kg COD
2014	1,131,388 kg COD

y	$M_{lagoon\_deposition\_PJ}$
2013	50,889 kg COD
2014	79,763 kg COD

y: $M_{lagoon\_anaerobic\_PJ}$ 2013: 0 kg COD 2014: 0 kg COD	
Methane emission factor (EF_{CH4}) =0.21 kg CH_4/kg COD (ex-ante parameter)	It is assumed at the time of validation and it remains same during the entire crediting period.
Global warming potential of methane (GWP_{CH4}) = 25 tCO2e/tCH_4	PP has considered GWP of methane as 25 which is accepted for the second commitment period which is in accordance with decision 4/CMP 7 as prescribed by the "Standard for application of the global warming potentials to CDM PA and PoA for the second commitment period of the Kyoto protocol" Version 1.0 (EB 69 Annex 3).
Fugitive methane emissions from lagoons ($E_{CH4\_lagoons\_PJ}$) y: $E_{CH4\_lagoons\_PJ}$ 2013: 0 tCO2e 2014: 0 tCO2e	As per equation 2 of the applied methodology, $E_{CH4\_lagoons\_PJ}$ is calculated as follows. $E_{CH4\_lagoons\_PJ} = M_{lagoon\_anaerobic\_PJ} \times EF_{CH4} \times GWP_{CH4}$
Methane emissions from new anaerobic waste water treatment facility (E_{CH4_NAWTF})	As per the PDD, methane emissions from the new anaerobic wastewater treatment facility are calculated as follows. $E_{CH4\_NAWTF} = (E_{CH4\_lagoon\_BL} – E_{CH4\_lagoon\_PJ}) \times F_{leakage\_NAWTF}$ Where $E_{CH4\_lagoon\_BL}$- fugitive methane emissions from baseline lagoons $E_{CH4\_lagoon\_PJ}$- fugitive methane emissions from project lagoons $F_{leakage\_NAWTF}$ - leakage factor for the new wastewater treatment system The verification of the parameters is detailed as below.
Fugitive methane emissions from baseline lagoons ($E_{CH4\_lagoon\_BL}$) y: $E_{CH4\_lagoons\_BL}$ 2013: 28,827 tCO2e 2014: 45,336 tCO2e	It is already verified as above
Fugitive methane emissions from lagoons ($E_{CH4\_lagoons\_PJ}$) y: $E_{CH4\_lagoons\_PJ}$ 2013: 0 tCO2e 2014: 0 tCO2e	It is already verified as above
Leakage factor for the new wastewater treatment system ($F_{leakage\_NAWTF}$) =1% (ex-ante parameter)	It is sourced from the PDD. Hence accepted.
Methane emissions from new anaerobic waste water treatment facility (E_{CH4_NAWTF}) y: E_{CH4_NAWTF} 2013: 288.27 tCO2e 2014: 453.36 tCO2e	As per the PDD, methane emissions from the new anaerobic wastewater treatment facility are calculated as follows. $E_{CH4\_NAWTF} = (E_{CH4\_lagoon\_BL} – E_{CH4\_lagoon\_PJ}) \times F_{leakage\_NAWTF}$
Methane emissions from Inefficient Combustion Emissions ($E_{CH4\_IC+leaks} + PE_{flare}$)	As per the applied methodology, the combustion of biogas methane may give rise to significant methane emissions as a result of incomplete or inefficient combustion. The three predominant potential routes for the destruction of methane are 1) Biogas flaring (PE_{flare}) 2a) Biogas use in heating systems ($E_{CH4\_IC\_heat}$) 2b) Biogas use for on-site electricity generation. ($E_{CH4\_IC\_elec}$) 3) Emissions due to leakage in the biogas system.(E_{CH4_Leak})
Methane emissions as a result of	As per the equation 7 of the applied methodology, $E_{CH4\_IC\_heat}$ is

<table>
<tr>
<td>incomplete or inefficient combustion through the route for the destruction of methane in heating systems ($E_{CH4\_IC\_r=heat}$)</td>
<td>calculated as follows.

$E_{CH4\_IC\_heat} = V_{r=heat} \times C_{CH4} \times (1-f_r) \times \rho_{CH4} \times GWP_{CH4}$

Where
$V_{r=heat}$- Biogas combustion process volume in route r
r-Heat generation
$C_{CH4,r}$- methane content
f_r- proportion of biogas destroyed by combustion
ρ_{CH4}- Density of methane
GWP_{CH4}- Global warming potential of methane</td>
</tr>
<tr>
<td>Biogas combustion process volume in route r ($V_{r=heat}$)
(AM0022 ID5)

(monitored parameter)

<table>
<tr><td>y</td><td>Amount of biogas sent to the boiler (total)</td></tr>
<tr><td>2013</td><td>1,305,472 Nm^3</td></tr>
<tr><td>2014</td><td>2,858,560 Nm^3 (adjusted)</td></tr>
</table>

QA/QC procedure:
It is already detailed as above.</td>
<td>It is already verified as above.

QA/QC procedure:

Gas flowmeter would be calibrated as per manufacturer’s specifications[3] but atleast once in every year. The verification team has checked the calibration certificates[11] against meter number, serial number, date of calibration, validity and actual error and found that meter is calibrated by the certified agency but is having calibration delay. As the actual error is more than the maximum permissible error, observed from the results of delayed calibration records, actual error is applied to the measured value for the calibration delayed period as follows.

Adjusted value = Measured value x (100%+ applied error)

The adjustment is done on a daily basis. The formula is accepted by the verification team as the adjustment leads to conservative project emissions. Hence the verification team was able to conclude that error is applied for the delayed calibration period in a conservative approach so as to arrive at a conservative baseline emission value. Thus it is in line with para 395 and 396 of VVS[1] version 9.0. Yearly data is cumulative of daily adjusted readings. Yearly data is used for the calculation of baseline emissions. Hence QA/QC of the meter is ensured.</td>
</tr>
<tr>
<td>Methane concentration (C_{CH4})
(AM0022 ID11)

(monitored parameter)

<table>
<tr><td>y</td><td>Methane concentration (average)</td></tr>
<tr><td>2013</td><td>68.79%</td></tr>
<tr><td>2014</td><td>66.67%</td></tr>
</table>
</td>
<td>It is already verified as above.</td>
</tr>
</table>

<table>
<tr>
<td>Proportion of biogas destroyed by combustion (f_r) = 98.5%
(AM0022 ID15)

(monitored parameter)

<table><tr><td>y</td><td>f_r</td></tr><tr><td>2013</td><td>99.9974% (measured value)</td></tr><tr><td>2014</td><td>99.9997%(measured value)</td></tr></table></td>
<td>As per the PDD, it is to be measured annually. At the site it is measured by third party total hydrocarbon analyser method. The verification team has reviewed the CH4 reports[14] used for determining the combustion efficiency. PP then determined the combustion efficiency as follows.

Combustion efficiency = 100%-noncombustible methane. The conservative of values measured in this method and ex-ante value of 98.5% is finally used for the emission reduction calculation. Ex-ante value is sourced from the technical specification of the thermic oil heater and PDD.

Since the measurements are based on standard industry practice, QA/QC is ensured.</td>
</tr>
<tr>
<td>Density of methane (ρCH4) =0.716 kg/Nm^3
(ex-ante parameter)</td>
<td>It is assumed at the time of validation and it remains same during the entire crediting period.</td>
</tr>
<tr>
<td>Global warming potential of methane (GWP_{CH4})

<table><tr><td>y</td><td>GWP_{CH4}</td></tr><tr><td>2013</td><td>25 tCO_2/tCH_4</td></tr><tr><td>2014</td><td>25 tCO_2/tCH_4</td></tr></table></td>
<td>PP has considered GWP of methane as 25 which is accepted for the second commitment period which is in accordance with decision 4/CMP 7 as prescribed by the “Standard for application of the global warming potentials to CDM PA and PoA for the second commitment period of the Kyoto protocol” Version 1.0 (EB 69 Annex 3).</td>
</tr>
<tr>
<td>Methane emissions as a result of incomplete or inefficient combustion through the route for the destruction of methane in heating systems ($E_{CH4\_IC\_r=heat}$)

<table><tr><td>y</td><td>$E_{CH4\_IC\_r=heat}$</td></tr><tr><td>2013</td><td>241.11 tCO2e</td></tr><tr><td>2014</td><td>511.72 tCO2e</td></tr></table></td>
<td>As per the equation 7 of the applied methodology, $E_{CH4\_IC\_heat}$ is calculated as follows.

$E_{CH4\_IC\_heat} = V_r \times C_{CH4} \times (1-f_r) \times \rho_{CH4} \times GWP_{CH4}$</td>
</tr>
<tr>
<td>Methane emissions as a result of incomplete or inefficient combustion through the route for the destruction of methane in heating systems ($E_{CH4\_IC\_r=electricity}$)</td>
<td>As per the equation 7 of the applied methodology, $E_{CH4\_IC\_electricity}$ is calculated as follows.

$E_{CH4\_IC\_electricity} = V_{r=electricity} \times C_{CH4} \times (1-f_r) \times \rho_{CH4} \times GWP_{CH4}$

Where
V_r- Biogas combustion process volume in route r
r-Electricity generation
$C_{CH4,r}$- methane content
f_r- proportion of biogas destroyed by combustion
ρ_{CH4}- Density of methane
GWP_{CH4}- Global warming potential of methane</td>
</tr>
</table>

Biogas combustion process volume in route *r* ($V_{r=electricity}$)
(AM0022 ID 10)

(monitored parameter)

y	Amount of biogas sent to the generators (total)
2013	738,089 Nm^3
2014	636,571 Nm^3

QA/QC procedure:

Particulars	Value
Tag no	FT501A
Serial no of flow meters	265DS66 0032493
1. Date of installation of this meter/ 2. Date of replacement of the meter (Measurement dates by this meter)	1. Available from start date of this monitoring period as per log sheets. 2. Retained atleast upto time of onsite visit by the verification team
Maximum permissible error of the meter	±0.04% of span
Calibration Validity	1 year
Date of first calibration of meter	19th October 2012
Calibration Agency	Miracle International Technology Co Ltd
Validity upto	18th October 2013
Date of second calibration	27th September 2013
Calibration Agency	Yokagawa (Thailand) Ltd
Validity upto	26th September 2014
Calibration delay period if any	No
Applied error	Not applicable

Particulars	Value
Tag no	FT501B
Serial no of flow meters	265DS66 0028459
1. Date of installation of this meter/ 2. Date of replacement of the meter (Measurement dates by this meter)	1. Available from start date of this monitoring period as per log sheets. 2. Retained atleast upto time of onsite visit by the verification team
Maximum permissible error of the	±0.04% of span

As per the PDD, it is to be measured/ recorded continuously and transferred to the control system. At the site, it is measured by the biogas flow meters (FT501A and FT501B) installed before sending it to the generator A and generator B respectively. The monitored data were recorded on log sheets/10/ as well as on digital storage device. Hence the verification team was able to conclude that this parameter is being monitored and recorded as per the PDD. The verification team has accepted the measurement methods, aggregation approach and data used for project emission calculations.

QA/QC procedure:

Gas flowmeters would be calibrated as per manufacturer's specifications/3/ but atleast once in every year. The verification team has checked the calibration certificates/11/ against meter number, serial number, date of calibration, validity and found that meter is having calibration validity covering the monitoring period. Hence QA/QC of the meter is ensured.

meter	
Calibration Validity	1 year
Date of first calibration of meter	19th October 2012
Calibration Agency	Miracle International Technology Co Ltd
Validity upto	18th October 2013
Date of second calibration	27th September 2013
Calibration Agency	Yokagawa (Thailand) Ltd
Validity upto	26th September 2014
Calibration delay period if any	No
Applied error	Not applicable

Methane concentration (C_{CH4}) (AM0022 ID11)

y	Methane concentration (average)
2013	68.79%
2014	66.67%

It is already verified as above.

Proportion of biogas destroyed by combustion (f_r) =99.0% for both generators
(AM0022 ID14)

(monitored parameter)

y	f_r
2013	99.9961% for Gen A and 99.9931% for Gen B (measured value)
2014	99.9857% for Gen A and 99.9746% for Gen B (measured value)

As per the PDD, it is to be measured annually. At the site it is measured by third party total hydrocarbon analyser method. The verification team has reviewed the CH4 reports[14] used for determining the combustion efficiency. PP then determined the combustion efficiency as follows.

Combustion efficiency = 100%-noncombustible methane. The conservative of values measured in this method and ex-ante value of 99% is finally used for the emission reduction calculation. Ex-ante value is sourced from the technical specification of the generators and PDD.

Since the measurements are based on standard industry practice, QA/QC is ensured.

Density of methane (ρCH4) =0.716 kg/Nm^3

(ex-ante parameter)

It is assumed at the time of validation and it remains same during the entire crediting period.

Global warming potential of methane (GWP_{CH4})

y	GWP_{CH4}
2013	25 tCO_2/tCH_4
2014	25 tCO_2/tCH_4

PP has considered GWP of methane as 25 which is accepted for the second commitment period which is in accordance with decision 4/CMP 7 as prescribed by the "Standard for application of the global warming potentials to CDM PA and PoA for the second commitment period of the Kyoto protocol" Version 1.0 (EB 69 Annex 3).

Methane emissions as a result of incomplete or inefficient combustion through the route for the destruction of methane in heating systems ($E_{CH4\_IC\_r=electricity}$)

y	$E_{CH4\_IC\_r=electricity}$
2013	90.88 tCO2e
2014	75.97 tCO2e

As per the equation 7 of the applied methodology, $E_{CH4\_IC\_electricity}$ is calculated as follows.

$E_{CH4\_IC\_electricty} = V_r \times C_{CH4} \times (1-f_r) \times \rho_{CH4} \times GWP_{CH4}$

<table>
<tr>
<td>Emissions from flaring of the residual gas stream (PE_{flare}) (AM0022 ID12)

(monitored parameter)</td>
<td>Biogas is flared when biogas production exceeds the capacity of boilers or during maintenance shutdown of the starch plant when no biogas is required. As per the PDD, emissions from flaring of the residual gas stream are calculated as per the tool to determine project emissions from flaring gases containing methane.

As per the PDD, it is calculated as follows.
$PE_{flare} = FV_{RG,h} \times fv_{CH4,RG,h} \times (1-\eta_{flare}) \times \rho_{CH4} \times GWP_{CH4}$

Where $FV_{RG,h}$ - Biogas flared in the project
$fv_{CH4,RG,h}$ - Methane content
η_{flare} - Flare efficiency.
ρ_{CH4}- Density of methane
GWP_{CH4}- Global warming potential</td>
</tr>
<tr>
<td>Biogas flared in the project ($FV_{RG,h}$)

<table>
<tr><td>y</td><td>$FV_{RG,h}$</td></tr>
<tr><td>2013</td><td>147 Nm^3</td></tr>
<tr><td>2014</td><td>676 Nm^3</td></tr>
</table>

<table>
<tr><td>Particulars</td><td>Value</td></tr>
<tr><td>Tag no</td><td>FT105</td></tr>
<tr><td>Serial no of flow meters</td><td>265DS66 0065941</td></tr>
<tr><td>1. Date of installation of this meter/ 2. Date of replacement of the meter (Measurement dates by this meter)</td><td>1. Available from start date of this monitoring period as per log sheets. 2. Retained atleast upto time of onsite visit by the verification team</td></tr>
<tr><td>Maximum permissible error of the meter</td><td>±0.04%</td></tr>
<tr><td>Calibration Validity</td><td>1 year</td></tr>
<tr><td>Date of first calibration of meter</td><td>19th October 2012</td></tr>
<tr><td>Calibration Agency</td><td>Miracle International Technology Co Ltd</td></tr>
<tr><td>Validity upto</td><td>18th October 2013</td></tr>
<tr><td>Date of second calibration</td><td>27th September 2013</td></tr>
<tr><td>Calibration Agency</td><td>Yokagawa (Thailand) Ltd</td></tr>
<tr><td>Validity upto</td><td>26th September 2014</td></tr>
<tr><td>Calibration delay period if any</td><td>No</td></tr>
<tr><td>Applied error</td><td>Not applicable</td></tr>
</table>
</td>
<td>As per the PDD, it is to be measured/ recorded continuously and transferred to the control system. At the site, it is measured by the biogas flow meter (FT105) installed before sending it to the flaring system. The monitored data were recorded on log sheets[/10/] as well as on digital storage device. Hence the verification team was able to conclude that this parameter is being monitored and recorded as per the PDD. The verification team has accepted the measurement methods, aggregation approach and data used for project emission calculations.

QA/QC procedure:

Gas flowmeter would be calibrated as per manufacturer's specifications[/3/] but atleast once in every year. The verification team has checked the calibration certificates[/11/] against meter number, serial number, date of calibration, validity and found that meter is having calibration validity covering the monitoring period. Hence QA/QC of the meter is ensured.</td>
</tr>
<tr>
<td>Methane concentration ($fv_{CH4,RG,h}$) (AM0022 ID11)

<table>
<tr><td>y</td><td>$fv_{CH4,RG,h}$</td></tr>
<tr><td>2013</td><td>68.79%</td></tr>
<tr><td>2014</td><td>66.67%</td></tr>
</table>
</td>
<td>It is already verified as above.</td>
</tr>
<tr>
<td>Flare efficiency (η_{flare}) =0%</td>
<td>As per the PDD, amount of minutes per hour where a flame is detected, whenever biogas is sent to the flare. If flame is detected</td>
</tr>
</table>

<table>
<tr>
<td>Flame detection period = data not available
(AM0022 ID 20)
(monitored parameter)

Period of biogas being sent to the flare = data not available
(AM0022 ID 21)

(monitored parameter)</td>
<td>for less than 20 minutes in an hour (whenever biogas is sent to flare), flare efficiency is assumed to be 0%. Otherwise flare efficiency is assumed to be 50%.

Flame is detected by the PP, but data is not available with the PP. the period of biogas being sent to the flare is also not available with the PP. So PP has assumed flare efficiency to be zero which is accepted by the verification team as it is conservative.</td>
</tr>
<tr>
<td>Density of methane (ρCH4) =0.716 kg/Nm^3

(ex-ante parameter)</td>
<td>It is assumed at the time of validation and it remains same during the entire crediting period.</td>
</tr>
<tr>
<td>Global warming potential of methane (GWP_{CH4})

<table>
<tr><td>y</td><td>GWP_{CH4}</td></tr>
<tr><td>2013</td><td>25 tCO_2/tCH_4</td></tr>
<tr><td>2014</td><td>25 tCO_2/tCH_4</td></tr>
</table>
</td>
<td>PP has considered GWP of methane as 25 which is accepted for the second commitment period which is in accordance with decision 4/CMP 7 as prescribed by the “Standard for application of the global warming potentials to CDM PA and PoA for the second commitment period of the Kyoto protocol” Version 1.0 (EB 69 Annex 3).</td>
</tr>
<tr>
<td>Emissions from flaring of the residual gas stream (PEf_{lare})
(AM0022 ID12)

(monitored parameter)

<table>
<tr><td>y</td><td>PEf_{lare}</td></tr>
<tr><td>2013</td><td>1.82 tCO2e</td></tr>
<tr><td>2014</td><td>7.73 tCO2e</td></tr>
</table>
</td>
<td>Biogas is flared when biogas production exceeds the capacity of boilers or during maintenance shutdown of the starch plant when no biogas is required. As per the PDD, emissions from flaring of the residual gas stream are calculated as per the tool to determine project emissions from flaring gases containing methane.

As per the PDD, it is calculated as follows.
$PE_{flare} = FV_{RG,h} \times fv_{CH4,RG,h} \times (1-\eta_{flare}) \times \rho_{CH4} \times GWP_{CH4}$

Where $FV_{RG,h}$ - Biogas flared in the project
$fv_{CH4,RG,h}$ - Methane content
η_{flare} - Flare efficiency.
ρ_{CH4}- Density of methane
GWP_{CH4}- Global warming potential
Since it is calculated from parameters like Biogas flared and methane content which are QA/QC assured, the calculation of PE flare is QA/QA assured.</td>
</tr>
<tr>
<td>Methane Emissions From Leaks in Biogas System (E_{CH4_leaks})</td>
<td>As pert the applied methodology, emissions due to biogas Leaks in the biogas system include leaks from any anaerobic digester and leaks from the biogas pipeline delivery system.</td>
</tr>
<tr>
<td>Loss of biogas from pipeline
(AM0022 ID 17)

(monitored parameter)

<table>
<tr><td>y</td><td>Loss of biogas from pipeline</td></tr>
<tr><td>2013</td><td>0%</td></tr>
<tr><td>2014</td><td>0%</td></tr>
</table>

<table>
<tr><th>Particulars</th><th>Value</th></tr>
<tr><td>Tag no</td><td>Gas detector</td></tr>
<tr><td>Serial no of flow meters</td><td>10110R4-006</td></tr>
<tr><td>1. Date of installation of this meter/
2. Date of replacement of the meter (Measurement dates by this meter)</td><td>1. Available from start date of this monitoring period as per log sheets.
2. Retained atleast upto time of onsite visit by the verification team</td></tr>
<tr><td>Maximum</td><td>±0.5%</td></tr>
</table>
</td>
<td>As per the PDD, it is measured using mobile gas leak detector. It is denoted as percentage of biogas generated by the PP. The verification team has reviewed the gas detector procedure[/15/]. The verification team has observed that UASB reactor gas collection system consists of a gas tight concrete coated gas dome and the delivery pipe to the boilers is less than 2 km in length. Integrity of biogas pipeline for losses or leakages is checked using mobile gas leak detector and there is no such losses in this monitoring period. Thus QA/QC is assured.</td>
</tr>
</table>

permissible error of the meter	
Calibration Validity	1 year
Date of first calibration of meter	29th November 2012
Calibration Agency	Entech Industrial services
Validity upto	28th November 2013
Date of second calibration	21st November 2013
Calibration Agency	Entech Industrial services
Validity upto	20th November 2014
Calibration delay period if any	No
Applied error	Not applicable

Methane Emissions From Leaks in Biogas System (E_{CH4_leaks}) y: E_{CH4_leaks} 2013: 0 tCO2e 2014: 0 tCO2e	As pert the applied methodology, emissions due to biogas Leaks in the biogas system include leaks from any anaerobic digester and leaks from the biogas pipeline delivery system.
Methane emissions from Inefficient Combustion Emissions ($E_{CH4\_IC+leaks} + PE_{flare}$) y: $E_{CH4\_IC+leaks} + PE_{flare}$ 2013: 333.81 tCO2e 2014: 595.42 tCO2e	As per the applied methodology, the combustion of biogas methane may give rise to significant methane emissions as a result of incomplete or inefficient combustion. The three predominant potential routes for the destruction of methane are 1) Biogas flaring (PE_{flare}) 2a) Biogas use in heating systems ($E_{CH4\_IC\_heat}$) 2b) Biogas use for on-site electricity generation. ($E_{CH4\_IC\_elec}$) 3) Emissions due to leakage in the biogas system.(E_{CH4_Leak})
Project emissions ($E_{Project,y}$) y: $E_{Project}$ 2013: 622.07 tCO2e 2014: 1048.78 tCO2e	As per the applied methodology, total estimated project emissions are the sum of fugitive methane emissions from the existing lagoon-based water treatment system, from possible methane emissions from the new anaerobic waste water treatment facility, from incomplete biogas combustion, biogas leaks. As per equation 1 of the applied methodology, $E_{Project,y}$ is calculated as follows. $E_{project} = E_{CH4\_lagoons\_PJ} + E_{CH4\_NAWTF\_PJ} + E_{CH4\_IC+leaks\_PJ}$
Leakage emissions = 0 tCO2e	As per the applied methodology, leakage emissions are zero.

<table>
<tr><td>Emission Reductions achieved by the project during the monitoring period (ER_y) or initial emission reduction

<table><tr><td>y</td><td>ER_y</td></tr><tr><td>2013</td><td>30,543.02 tCO2e</td></tr><tr><td>2014</td><td>48,398.98 tCO2e</td></tr></table></td><td>As per equation 12 of the applied methodology, Emission reductions are calculated as the difference between baseline and project emissions.

$ER = E_{BL,y} - E_{project,y} - E_{leakage,y}$

Where
$E_{BL,y}$ –Baseline emissions during the monitoring period y
$E_{project,y-}$ Project emissions during the monitoring period y
$E_{leakage,y}$- Leakage emissions during the monitoring period y</td></tr>
<tr><td>Conservative estimate factor</td><td>As per the applied methodology, in order to ensure that the emissions of CH_4 from the lagoons in the baseline situation are not higher than the total emissions of biogas from the digester and the lagoons in the project situation, a conservative estimate factor is deducted from the initial emission reduction, if the factor is positive.

Conservative estimate factor = $E_{CH4\_lagoon\_BL} - (E_{CH4\_lagoon\_PJ} + E_{CH4\_NAWTF\_PJ} + E_{CH4\_coll})$

Where
$E_{CH4\_lagoon\_BL}$- Methane emissions from the lagoons in the baseline
$E_{CH4\_lagoon\_PJ-}$ Methane emissions from the lagoons in the project activity
$E_{CH4\_NAWTF\_PJ}$- Fugitive methane emissions from the new anaerobic waste water treatment facility
E_{CH4_coll} - Amount of methane contained in the biogas collected from the anaerobic treatment facility

The verification of the parameters is detailed below.</td></tr>
<tr><td>Methane emissions from the lagoons in the baseline ($E_{CH4\_lagoon\_BL}$)

<table><tr><td>y</td><td>$E_{CH4\_lagoon\_BL}$</td></tr><tr><td>2013</td><td>28,826.67 tCO2e</td></tr><tr><td>2014</td><td>45,336.11 tCO2e</td></tr></table></td><td>It is already verified as above.</td></tr>
<tr><td>Methane emissions from the lagoons in the project activity ($E_{CH4\_lagoon\_PJ}$)
<table><tr><td>y</td><td>$E_{CH4\_lagoon\_PJ}$</td></tr><tr><td>2013</td><td>0 tCO2e</td></tr><tr><td>2014</td><td>0 tCO2e</td></tr></table></td><td>It is already verified as above.</td></tr>
</table>

Fugitive methane emissions from the new anaerobic waste water treatment facility ($E_{CH4\_NAWTF\_PJ}$) y: 2013 — $E_{CH4\_NAWTF\_PJ}$: 288.27 tCO2e y: 2014 — $E_{CH4\_NAWTF\_PJ}$: 453.36 tCO2e	It is already verified as above.
Amount of methane contained in the biogas collected from the anaerobic treatment facility (E_{CH4_coll})	As per the applied methodology, it is calculated as follows. E_{CH4_coll} =(Biogas sent to flare +Biogas sent to generators +Biogas sent to thermic oil heater) x methane content x Density of methane x GWP_{CH4}
Biogas sent to flare (AM0022 ID9) (monitored parameter) y: 2013 — Biogas sent to flare: 147 Nm^3 y: 2014 — Biogas sent to flare: 676 Nm^3	It is already verified as above.
Biogas sent to generators (AM0022 ID10) (monitored parameter) y: 2013 — Biogas sent to generators: 738,089 Nm^3 y: 2014 — Biogas sent to generators: 636,571 Nm^3	It is already verified as above.
Biogas sent to thermic oil heater (AM0022 ID5) (monitored parameter) y: 2013 — Biogas sent to thermic oil heater: 1,305,472 Nm^3 y: 2014 — Biogas sent to thermic oil heater: 2,858,560 Nm^3	It is already verified as above.
Methane content (AM0022 ID11) (monitored parameter) y: 2013 — Methane content: 68.79% y: 2014 — Methane content: 66.67%	It is already verified as above.
Density of methane =0.716 kg/Nm^3 (ex-ante parameter)	It is sourced from PDD and hence accepted.
GWP_{CH4} =25 tCO2e/tCH4	PP has considered GWP of methane as 25 which is accepted for the second commitment period which is in accordance with decision 4/CMP 7 as prescribed by the "Standard for application of the global warming potentials to CDM PA and PoA for the second commitment period of the Kyoto protocol" Version 1.0 (EB 69 Annex 3).
Amount of methane contained in the biogas collected from the anaerobic treatment facility (E_{CH4_coll}) y: 2013 — E_{CH4_coll}: 25,163.77 tCO2e y: 2014 — E_{CH4_coll}: 41,719.46 tCO2e	As per the applied methodology, it is calculated as follows. E_{CH4_coll} =(Biogas sent to flare +Biogas sent to generators +Biogas sent to thermic oil heater) x methane content x Density of methane x GWP_{CH4}
Conservative estimate factor y: 2013 — Conservative estimate factor: 3,374.64 tCO2e y: 2014 — Conservative estimate factor: 3,163.29 tCO2e	As per the applied methodology, in order to ensure that the emissions of CH_4 from the lagoons in the baseline situation are not higher than the total emissions of biogas from the digester and the lagoons in the project situation, a conservative estimate factor is deducted from the initial emission reduction, if the factor is positive.

	Conservative estimate factor = $E_{CH4\_lagoon\_BL}$ – ($E_{CH4\_lagoon\_PJ}$ + $E_{CH4\_NAWTF\_PJ}$ + E_{CH4_coll})
Emission Reductions achieved by the project during the monitoring period (ER_y) or final emission reduction y: 2013 — ER_y: 27,168.38 tCO2e y: 2014 — ER_y: 45,235.70 tCO2e y: Total — ER_y: 72,404 tCO2e (rounded down)	As per equation 12 of the applied methodology, Emission reductions are calculated as the difference between baseline and project emissions. ER =$E_{BL,y}$-$E_{project,y}$- $E_{leakage,y}$- Conservative estimate factor

Appendix 6:

Sustainable development matrix assessment	The verification team has assessed the scores of the Sustainable Development indicators depending on the baseline which can lead to a revision of the sustainable development monitoring plan. The verification team has also assessed the changes in the scores of the twelve sustainable development indicators as per the sustainable development assessment guidance. The verification opinion of the same is detailed below.
1.Air Quality/ Odour from the wastewater treatment plant (emissions other than GHG) Chosen parameter: Volume of biogas production and combustion Score=+	The parameter was monitored by measuring the total biogas production, biogas utilised in onsite boiler and gas engines and biogas destructed in an open flare using gas flow meters. The parameters are continuously measured and recorded daily. The verification of the parameter is already detailed above. The project treatment system involves capturing of biogas (or methane) through UASB which is a closed system and utilising the biogas as a fuel in boiler and gas engines. Any excess biogas is flared out through an open flare system. Therefore, the odour is reduced and the air quality is improved. A desulphurization system (gas scrubber) was also installed to remove H_2S from the gas stream that goes to gas engines. The scrubber further helps in improving the air quality by removing H_2S from the gas. From the onsite verification, it is confirmed that appropriate monitoring system is in place to measure and record the required parameters. The values reported in the monitoring report were verified with the original hand written daily log sheets[/10/]. The reported values were found to be correct. It is to be noted that there was a flow meter installed for measuring the biogas production. The verification team physically observed during the onsite verification that the meter was located right on top of UASB. Since the biogas utilised in gas engines and boiler and biogas combusted through open flare was separately monitored, the total biogas production was calculated based on mass balance as mentioned in the monitoring plan The project activity resulted in destruction of methane which would have otherwise been released into the atmosphere in the absence of the project activity. The verification team, therefore, confirms that the project activity has resulted in improving the air quality.

2.Water quality and quantity Chosen parameter: COD concentration in wastewater at the outlet of the UASB reactor Score =+	As per the PDD, it has to be measured daily as per the PDD using colorimetric analysis at the lab located at the project site. Daily sampling of the untreated process effluent was carried out and is analyzed for COD concentration on a daily basis. The verification team has checked the measurement methods and found that COD content will be analyzed using colorimetric method/ Close Reflux Titrimetric method in the onsite lab. The results are then logged by the operators in the plant operation report on a daily basis in the lab reports/10/. The plant operators then transfer to the computer for electronic storage. The colorimetric method is found to be as per national standards. Hence the verification team was able to conclude that this parameter is being monitored and recorded as per the PDD. The verification team has accepted the measurement methods, aggregation approach and data used for baseline emission calculations. Colorimeter would be calibrated as per manufacturer's specifications/3/ but atleast once in every year. The verification team has checked the calibration certificates/11/ against meter number, serial number, date of calibration, validity and found that meter is having calibration validity covering the monitoring period. Hence QA/QC of the meter is ensured. The verification team can confirm that the project resulted in improving the wastewater treatment facilities and avoiding any harm or threat to the environment or people. The monitoring plan states, "Wastewater quality format the outlet of the reactor is already subject to continuous monitoring under CDM and periodic controls by environmental authorities. Given the fact that the treated wastewater cannot be discharged and is constantly re-circulated and re-used in the starch plant, which was already done prior to the project, the project activity does not have a significant impact on water quantity, From this, it is evident that the impact on the water quality is crucial for an overall positive impact on sustainable development and its monitoring would thus be required in the verification period." The verification team, therefore, confirms that the project activity has resulted in improving the water quality including surface water and ground water. Hence accepted by the verification team.
3.Soil condition (quality and quantity) Chosen parameter: Sludge application =0 tonne Score =0	Whenever sludge is removed from the treatment system, it shall be recorded in plant records/10/ about the application of the sludge. As per the monitoring plan, the sludge shall only be used for soil application as fertiliser. However, no sludge was removed from the treatment system during the monitoring period. This is confirmed from the onsite interviews with the operating team. No traces of sludge could also be observed at project site by the verification team during the onsite verification. There is no impact on soil condition during construction and operation as the project is not emitting any pollutants to the soil. There is no soil erosion as well. The verification team has observed that there was no impact on soil condition as the project activity has been designed to limit their impact on soil condition. Hence there is no impact on soil condition.
4.Other pollutants ((including, where relevant, toxicity, radioactivity, POPs, stratospheric ozone layer depleting gases) Score =0	The project land is usually barren where there was no vegetation available prior to the project activity construction. The verification team has confirmed during the onsite visit to the project site where vegetation and landscaping was done. Also, there were no tree was cut therefore there will be no impact on the climate conditions during the construction and operation phases of the project activity. Access road was also already available for transportation of equipments and hence no harm to the environment as such during construction /transportation of equipments. As evident from the onsite visit and observed from the interviewed people, project site was barren land at the implementation of the project activity, there is no any impact of project activity on vegetation. The project activity would have a positive impact on vegetation as PP is planning for greenbelt over the project activity. Hence there is no negative impact.

5. Biodiversity (species and habitat conservation) Score =0	The project does not pose any biodiversity issues as there is no vegetation available at the project site. There is no forest near to the project activity. Hence there is no negative impact.
6.Quality of employment/ Employment (including job quality, fulfilment of labour standards) Score =+ Chosen parameter: Number of employed staffs =18 Level of income generation= 300 Thai baht per day per employee (1 THB =0.03 USD)	The number of employees and the level of income was monitored through salary payment records/16/ on monthly basis. The list of employees along with their salary for each month has been provided to the verification team. The verification team can confirm that the total number of staff employed for the project activity during the monitoring are 18 at the end of the monitoring period. The parameter was verified from the employment records and salary payment records/16/. The verification team also interviewed the employees working for the project to confirm the information provided. The information provided in the MR is confirmed to be correct. The verification team is of the opinion that the project activity resulted in employment and income generation to the local community during the monitoring period. Thailand is a party to International Labour Organisation and forming employee associations is commonly practiced in the host country. The verification team has reviewed the ILO website/18/ and observed that Thailand has ratified the following ILO fundamental conventions. The details are 1. Forced Labour Convention, 1930 (No. 29) (on 26th Feb 1969) 2. Abolition of Forced Labour Convention, 1957 (No. 105) (2nd December 1969) 3. Minimum Age Convention, 1973 (No. 138) (on 11th May 2004) 4. Worst Forms of Child Labour Convention, 1999 (No. 182) (on 16th Feb 2001) 5. Equal Remuneration Convention, 1951 (No. 100) (on 8th Feb 1999) 6. Discrimination (Employment and Occupation) Convention, 1958 (No. 111) (on 13th June 2017) The verification team has understood that by ratifying the conventions, the host country is committed themselves to applying the convention in national law and practice. By these convections, forced or compulsory labour is abolished in Thailand. The verification team has reviewed the employee contracts/19/. All the staffs are contracted which does not involve forced or compulsory labour. The interview with the staff confirms this. As such there is no risk involved and therefore the project does not violate this safeguarding principle. The verification team has interviewed the staff employed by the PP and following are confirmed. The staffs employed are employed by a contract by which they are free to form an association and there is no restriction on their part for collective bargaining. The contract has provision for the identity of the parties, the place of work, the title, grade, nature or category of the work for which the employee is employed or a brief description thereof, the date of commencement of the contract, the amount of paid leave to which the employee is entitled or, failing that, the procedures for allocating and determining such leave, the length of periods of notice, information regarding the salary and the frequency of its payment and working hours: daily or weekly and the collective agreements governing the conditions of employment. They are provided with sufficient holidays (5 weeks per year) with 40 working hours per week, good work place. The staffs are happy about annual increments in salary/ annual bonuses etc. One staff member conveyed to the verification team that he was proud to be associated with project.

	The verification team reviewed the employee register[/16/] that includes all employees and contractors that work with the operation and equipment maintenance/repair at the project site. All employees and contractors are employed under full conformance with Thailand labor regulations[/20/] (including contracting/registration, health and safety aspects). Furthermore, the company has implemented quality assurance/quality control (QA/QC) and environmental management systems that includes controls for addressing health, safety and environmental aspects. The verification team also confirmed that, as part of such documented procedures, the use and conditions of personal protective equipment is enforced and controlled. Furthermore, as also confirmed by the verification team, the operational conditions and functioning of such protective equipment is regularly monitored. As part of the performed on-site visit, the verification team visualized all the workers using appropriate protective equipment. Based on the interview with PP, the verification team was also made aware that, as established by applicable Thailand labour regulations[/20/], the company is subject to regular inspections from a third-party health and safety technician. PP is also subject to surveillance from the Thailand Ministry of Labour Affairs for health and safety conditions[/20/]. Furthermore, as required by labour regulations, control and reporting of occurred accident events is also continuously performed by PP. The verification team also assessed the technical design[/3/] of the UASB, gas engines, thermic oils heaters, starch factory, flares. Through assessment of a specification sheet of the all the major equipments and a process flow diagram of the starch factory and UASB, the verification team was able to confirm that appropriate safety and emergency aspects were taken into account for the design and operation of the project activity including proper ventilation of confined spaces used by workers, use of flame arrestors under the flaring equipment and proper flare placement (in order to prevent occurrence of fires and gas leak during start-up)). Finally, it was also confirmed through interviews with employees that outpatient/health care service is available for all the employees as covered under Universal Coverage Scheme, Social Security Scheme. Promotional Framework for Occupational Safety and Health Convention[/18/], 2006 (No. 187) came into force on 23rd March 2016 by which providing safe and healthy work environment is mandatory. It recognized the global magnitude of occupational injuries, diseases and deaths, and the need for further action to reduce them, and the protection of workers against sickness, disease and injury arising out of employment, and recognized that occupational injuries, diseases and deaths have a negative effect on productivity and on economic and social development. The verification team has also reviewed the safety checklist used by the employees, details of fire extinguishers, sprinkling system, water hydrants/hoses and its quality check, training records etc. Each staff member is provided with all the necessary personal protective equipments (PPE) among other items. PPE is designed to help minimize exposure to inherent system hazards and to identify potential hazards to the process of selecting the appropriate PPE for the task at hand. Each staff member is provided with all the necessary personal protective equipment (PPE) such as gloves, helmets, boots, safety glasses, waist coats, first aid boxes etc. Thailand is a party to International Labour Organisation and child labour is illegal in the host country. The minimum legal age for

<table>
<tr><td></td><td>employment is 15 in Thailand. All the staff is grown up people and there is no child labour involved. As such there is no risk involved and therefore the project does not violate this safeguarding principle.</td></tr>
<tr><td>7. Livelihood of the poor (including poverty alleviation, distributional equity, and access to essential services)
Score =0</td><td>The verification team accepted the view of PP that the project activity provided jobs for local poor people. Hence it has a positive impact on the livelihood of the poor. But PP preferred to score zero for this parameter which is accepted by the verification team.</td></tr>
<tr><td>8.Access to affordable and clean energy services
Score =+

Fuel oil:
Amount of fossil fuel (heavy fuel oil) displaced by the use of biogas for the generation of on-site heat (F_{HFO})

<table>
<tr><td>y</td><td>F_{HFO} (total) based on energy balance method</td></tr>
<tr><td>2013</td><td>805.18 tonnes of HFO (measured from biogas sent to the boiler)</td></tr>
<tr><td>2014</td><td>1,697.54 tonnes of HFO (measured from biogas sent to the boiler)</td></tr>
</table>

<table>
<tr><td>y</td><td>HFO consumed in the project activity</td></tr>
<tr><td>2013</td><td>278,757 litres or 277.36 tonnes</td></tr>
<tr><td>2014</td><td>621,238 litres or 618.13 tonnes</td></tr>
</table>

<table>
<tr><td>y</td><td>Dry starch production in the project activity</td></tr>
<tr><td>2013</td><td>22,673 tonnes</td></tr>
<tr><td>2014</td><td>61,580 tonnes</td></tr>
</table>

<table>
<tr><td>y</td><td>HFO that would be consumed in the absence of the project activity</td></tr>
<tr><td>2013</td><td>748.89 tonnes</td></tr>
<tr><td>2014</td><td>2033.99 tonnes</td></tr>
</table>

<table>
<tr><td>y</td><td>F_{HFO} (total) based on conservative approach</td></tr>
<tr><td>2013</td><td>471.53 tonnes of HFO (claimed for baseline emissions)</td></tr>
<tr><td>2014</td><td>1,079.41 tonnes of HFO (claimed for baseline emissions)</td></tr>
</table>
</td><td>Fuel oil:
Amount of HFO displaced is calculated based on the following approach.

Amount of HFO displaced x NCV of HFO =∑(Amount of methane sent to the boiler x NCV of methane)

Or
Amount of HFO displaced x NCV of HFO =∑(Amount of biogas sent to the boiler x methane concentration x NCV of methane)

Amount of HFO displaced is calculated daily and yearly value is arrived at by adding all the daily values.

Since it is calculated from parameters like amount of methane sent to the boiler, methane content and NCV of methane which is QA/QC assured, the calculation of F_{HFO} is QA/QC assured.

As per the PDD (p27), for ex-ante estimation of emission reductions the amount of heavy fuel displaced is based on the historic average annual HFO demand of 1,466 t HFO per year. Based on the historic average annual HFP consumption of 1,466 t HFO/year and on the historic average dry starch production (44,376 t starch/yr), the specific heavy fuel oil consumption is determined as 0.03303 t HFO/t dry starch. The historic average specific heavy fuel oil consumption shall be used as reference value during the monitoring period in order to avoid an overestimation of baseline emissions.

Accordingly, PP limited the HFO saved due to the project activity upto 0.03303 tHFO/tdryStarch only. The verification team has reviewed the HFO consumption reports[/13/] and dry starch production reports[/13/] in the project activity.

HFO that would be consumed in the absence of the project activity =Dry starch production x specific HFO consumption

HFO thus saved due to the project activity or due to compensation by sending the biogas into the boiler = HFO that would be consumed in the absence of the project activity- HFO consumed in the project activity.

HFO saved due to the project activity is used for calculating the baseline emissions to avoid overestimation.</td></tr>
</table>

Electricity:

Amount of electricity displaced by the electricity generated from the biogas collected from the anaerobic treatment facility (EL)
(AM0022 ID7)

(monitored parameter)

y	EL
2013	1,661.50 MWh
2014	1,416.11 MWh

Particulars	Value
Tag no	Gen A
Serial no of flow meters	A010393
1. Date of installation of this meter/ 2. Date of replacement of the meter (Measurement dates by this meter)	1. Available from start date of this monitoring period as per log sheets. 2. Retained atleast upto time of onsite visit by the verification team
Maximum permissible error of the meter	±1%
Calibration Validity	1 year
Date of first calibration of first meter	27th October 2012
Calibration Agency	TIP Industry Services Co Ltd
Validity upto	26th October 2013
Date of second calibration	12th October 2013
Calibration Agency	TIP Industry Services Co Ltd
Validity upto	11th October 2014
Calibration delay period if any	No
Applied error	Not applicable

Particulars	Value
Tag no	Gen B
Serial no of flow meters	A004997
1. Date of installation of this meter/ 2. Date of replacement of the meter (Measurement dates by this meter)	1. Available from start date of this monitoring period as per log sheets. 2. Retained atleast upto time of onsite visit by the verification team
Maximum permissible error of the meter	±1%
Calibration Validity	1 year

Electricity:

As per the PDD, this parameter is to be measured continuously and recorded monthly by a standard electricity meter located at the two generators. At the site, the verification team has able to confirm that the electricity generation is being monitored by using electricity meter daily and the monitored data were recorded on log sheets[/10/] as well as on digital storage device. Hence the verification team was able to conclude that this parameter is being monitored and recorded as per the PDD. In the absence of the project activity, the same amount of electricity would be imported from the grid. Hence accepted by the verification team as correct. The verification team has accepted the measurement methods, aggregation approach and data used for baseline emission calculations.

QA/QC procedure:

Electricity meters would be calibrated as per manufacturer's specifications[/3/] but atleast once in every year. The verification team has checked the calibration certificates[/11/] against meter number, serial number, date of calibration, validity and found that meter is having calibration validity covering the monitoring period. Hence QA/QC of the meter is ensured.

The verification team accepted the view of PP that the project activity has a positive impact on the environment. It helps to overcome the ever increasing demand for energy (fuel oil and electricity) in the host country in a sustainable manner which is accepted by the verification team. It also helped in reducing dependency of fuel imports that may lead to more sustainable and affordable energy services locally. It also reduces energy import bill regionally.

Date of first calibration of first meter	27th October 2012
Calibration Agency	TIP Industry Services Co Ltd
Validity upto	26th October 2013
Date of second calibration	12th October 2013
Calibration Agency	TIP Industry Services Co Ltd
Validity upto	11th October 2014
Calibration delay period if any	No
Applied error	Not applicable

9.Human and institutional capacity (including empowerment, education, involvement, gender) Score =0	The project activity has positive impact on human capacities but does not have tangible positive impact on institutional capacity. Hence the score is kept as zero.
10.Quantitative employment and income generation Employment (numbers) Score =+	Refer point no 6 above for details. The verification team has observed that project owner has employed staffs for operation and maintenance of the project which increase their living standard of the staffs. As per the GS passport, it is to be monitored monthly. The score is kept as positive. The verification team has interviewed the staffs and reviewed the staff attendance register/16/ and there are 18 people employed there at the site. Hence accepted that quantitative employment and income generation is positive due to the project activity.
11. Access to investment/ Balance of payments (sustainability) Score =+ Fuel oil: Amount of fossil fuel (heavy fuel oil) displaced by the use of biogas for the generation of on-site heat (F_{HFO})	Fuel oil: In Thailand, fuel oil is always imported from outside the country. So by saving fuel oil, foreign exchange due to import is saved. From a macro-economic perspective, the project is having a positive impact on net foreign currency savings related to fossil fuel import since most of the fossil fuel used in the baseline was sourced from outside country. Electricity: Electricity is not imported from outside country in the baseline as well as in project activity. Hence there is no foreign exchange involved here.

y	F_{HFO} (total) based on conservative approach
2013	471.53 tonnes of HFO (claimed for baseline emissions)
2014	1,079.41 tonnes of HFO (claimed for baseline emissions)

Price of crude oil

y	Price of crude oil
2013	USD 95.99 per barrel (1 barrel = 159 litres)
2014	USD 87.39 per barrel

Source:

<table>
<tr>
<td>https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=f000000__3&f=a

Density of fuel oil = 0.995 kg/litre
Source: PDD

Foreign exchange saved
<table>
<tr><td>y</td><td>Foreign exchange saved</td></tr>
<tr><td>2013</td><td>USD 0.286 Million</td></tr>
<tr><td>2014</td><td>USD 0.596 Million</td></tr>
</table>
</td>
<td></td>
</tr>
<tr>
<td>12.Technology transfer and technological self-reliance

Chosen parameter: Training records</td>
<td>The parameter was monitored through training records[17]. Trainings on the below subjects were provided to the operating team during the monitoring period:
- Operation and maintenance of biogas system
- Safety in biogas operation
- Knowledge of biogas
- Wastewater analysis
Besides, the operating team also informed during the onsite interviews that the technology supplier, GWE, provided onsite training to the operating team while implementing the project activity. The verification team has reviewed the training records[17]. The verification team also interviewed the employees working for the project to confirm the information provided. The information provided in the GS MR is confirmed to be correct. The verification team is of the opinion that the project activity created positive impact regarding technological self-reliance by enhancing the skills of the operating team.</td>
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Local stakeholder consultation process	The verification team has checked how the stakeholder feedback round process for the project is conducted by interviewing the stakeholders. The verification team has verified how the consultation prior to the submission of the request for registration was conducted by the PP. The verification opinion of the same is detailed below. A detailed comprehensive stakeholder consultation was carried out through various meeting conducted on 26th July 2007. The stake holders identified include local people who are affected people due to the project activity. The comments raised were adequately answered to the stakeholders hence accepted by the verification team. As far as GS is concerned, since the project activity falls under retroactive registration, local stakeholder consultation is not required to be conducted again which is in line with para VIII.b.4 of "Gold Standard requirements"/1/ version 2.2. Hence accepted by the verification team. PP has also completed the local stakeholder consultation process after the start date of the project activity (4th August 2006) but before the date of submission of the PDD to the DOE for validation (18th October 2007)-Start date of the validation). The verification team has concluded that PPs completed a local stakeholder consultation process in line with paragraph 161 to 165 of VVS/1/ version 9.0. However, this new rule was not in place at the time of start date of during local stakeholder consultation or start date of the CDM validation, the verification team has accepted. During the interview with people during the onsite visit, the verification team confirmed that local stakeholders are satisfied about the project and have do not have any negative comments. They informed the team that they welcome such projects. They are of the positive opinion on the roads constructed due to the project. They do not have any grievances from the project as such and are aware of the grievance mechanism and how to contact the PP in case of grievances. The verification team has observed that there is no grievance received by the project indicating that people has no grievances from the project.
REC Check	The verification team has checked the VCS website and found that the project is applied only under CDM and GS only.

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