

VERIFICATION REPORT

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

FINAL

**RINA**

Document Prepared By RINA Services S.p.A. (RINA)

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Summary:

RINA Services S.p.A. (RINA), commissioned by South Pole Carbon Asset Management has verified the greenhouse gas emission reductions reported for the project activity “Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co., Ltd, in Thailand, VCS project ID 82, for the period 01/01/2014 to 30/09/2015. The verification includes confirming the implementation of the monitoring plan of the renewed VCS PD (Project ID 82) and the application of the monitoring methodology as per ACM0014, version 0.6 dated 21/02/2014. A site visit was conducted to verify the data submitted in the monitoring report.

The project activity involves installation of an anaerobic wastewater treatment facility, based on Upflow Anaerobic Sludge Blanket (UASB) technology, at a starch manufacturing plant that has been in operation since 1995. The first phase of the project (UASB 1) was implemented at General Starch Co., Ltd. in 2003 with startup of operations in January 2004, and the second phase of the project (UASB 2) began in 2005 with startup of operations in January of 2006. The biogas produced from anaerobic digestion is captured and then used as fuel for heat generation.

In conclusion, it is RINA's opinion that the project activity “Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co., Ltd, in Thailand”, as described in the Monitoring Report version 03 of 13/12/2016, meets all relevant requirements for VCS and correctly applies the baseline and monitoring methodology “ACM0014”, “treatment of wastewater”, version 02.0 of 27/11/2015. Hence RINA is able to certify that the emission reductions from the project during the monitoring period 01/01/2014 to 30/09/2015 amount to 22,042 tCO_{2e}

Table of Contents

1	Introduction.....	5
1.1	Objective	5
1.2	Scope and Criteria	5
1.3	Level of Assurance.....	5
1.4	Summary Description of the Project	6
2	Verification Process	7
2.1	Method and Criteria.....	7
2.2	Document Review	7
2.3	Interviews	10
2.4	Site Inspections	12
2.5	Resolution of Findings.....	12
2.5.1	Forward Action Requests	12
2.6	Eligibility for Validation Activities	12
3	Validation Findings.....	12
3.1	Participation under Other GHG Programs	12
3.2	Methodology Deviations	12
3.3	Project Description Deviations	12
3.4	Grouped Project	12
4	Verification Findings.....	12
4.1	Project Implementation Status	13
4.2	Accuracy of GHG Emission Reduction and Removal Calculations	14
4.3	Quality of Evidence to Determine GHG Emission Reductions and Removals	36
4.4	Non-Permanence Risk Analysis.....	36

5	Verification conclusion	36
	APPENDIX A: Resolution table	38

1 INTRODUCTION

1.1 Objective

RINA has been commissioned by “South Pole Carbon Asset Management” to perform an independent verification of its VCS project, “Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co., Ltd”, already registered and renewed for crediting period under VCS with Project ID. 300044_GSL_02/01 , for the reported GHG emission reductions for the given monitoring period 01/01/2014 up to 30/09/2015. The VCS projects must undergo independent third party verification and certification of emission reductions as the basis for issuance of Voluntary Emission Reductions (VERs/VCUs).

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

- The project activity has been implemented and operated as per the project description (PD) and that all physical features (technology, project equipment, and monitoring and metering equipment) of the project are in place;
- Monitoring report and other supporting documents are complete;
- The data is recorded and stored as per the monitoring methodology and approved monitoring plan.
- To confirm that the monitoring system is implemented and fully functional to generate Voluntary Emission Reductions (VERs/VCUs) without any double counting, and

To establish that the data reported are accurate, complete, consistent, transparent and free of material error or omission by checking the monitoring records and the emissions reduction calculation.

1.2 Scope and Criteria

The verification scope is:

- to verify that actual monitoring systems and procedures are in compliance with the monitoring systems and procedures described in the monitoring plan;
- to evaluate the GHG emission reduction data and express a conclusion with a reasonable level of assurance about whether the reported GHG emission reduction data is free from material misstatement;
- to verify that reported GHG emission data is sufficiently supported by evidence.

The project is assessed against the requirements of VCS version 3 and related rules and guidance. RINA has, based on the recommendations in the latest version of CDM Validation and Verification Manual, and employed a rule-based approach (as criteria) in the verification, focusing on the identification of significant reporting rules and the reliability of project monitoring.

Verification is not meant to provide any consultancy towards the project participants. However, stated requests for clarifications and/or corrective actions may have provided input for improvement of the monitoring.

1.3 Level of Assurance

The verification has been carried out by reviewing the VCS-PD, VCS-MR, emission reduction sheet and supporting documents (refer below section 2.2) made available to the RINA assessment team and information collected through performing interviews and document review. Based on review of above mentioned documents, the assessment team is of the opinion that level of assurance is reasonable and that the GHG assertions are free of material errors, omissions and misrepresentations. The verification opinion is assured provided the credibility of all above document.

The draft final verification report before being submitted to the client were subjected to an independent internal technical review to confirm that all verification activities had been completed according to the pertinent RINA instructions.

The technical review was performed by a technical reviewer(s) qualified in accordance with RINA's qualification scheme for VCS and CDM validation and verification.

The verification team and the technical reviewers consist of the following personnel.

Role	Last Name	First Name	Country
Team Leader, Verifier & Technical Expert TA 13.1	Menon	Rekha	India
Technical Expert TA 1.1	Augustus	Cyril	India
Technical Reviewer	Liu	Huifeng	China

1.4 Summary Description of the Project

The project activity involves installation of an anaerobic wastewater treatment facility, based on Upflow Anaerobic Sludge Blanket (UASB) technology, at a starch manufacturing plant that has been in operation since 1995.

The first phase of the project (UASB 1) was implemented at General Starch Co., Ltd. in 2003 with start up of operations in January 2004 and the second phase of the project (UASB 2) in 2005 with start up of operations in January of 2006 (already verified and reported in previous verification reports) /16/.

The main information of the project is summarized in the table below:

Project Participant(s)	Papop Renewable Co.,Ltd		
Project Title	Wastewater Treatment with Biogas Production (UASB) and Heat Utilization at General Starch Co., Ltd		
Location of the project	Rachasima-Chokchai Road, Amphur Kornburi in Nakorn Rachasima Province of Thailand		
Methodology(ies)	ACM0014, version 06.0, " treatment of wastewater", dated 21/02/2014		
Sectoral Scope(s)	13 and 1	RINA's Technical Area(s)	13.1, 1.1
Renewed PDD	Revision 05 of 04/07/2016		

Starting date of the crediting period	01/01/2014 (Under VCS)
Project's crediting period	01/01/2014 to 31/12/2023
Project documentation link	VCS database: http://vcsprojectdatabase.org/#/projects/st_82/c_TH/ss_0/so_/di_/np_

2 VERIFICATION PROCESS.

2.1 Method and Criteria

Verification was conducted using RINA procedures in line with the requirements specified in the VCS Requirements, i.e. VCS Program Guide, VCS Version 3 (v3.5), Requirements Document of 08/10/2013 and VCS Standard, VCS Version 3 (v3.5), Requirements Document of 25/03/2015. The GHG emission reductions are on the basis of the approved Baseline and monitoring methodology “ACM0014”, “treatment of wastewater”, version 06.0 of 21/02/2014.

The verification consisted of the following three phases

- Document review;
- On-site assessment including Interviews and Site Inspections;
- Resolution of Any Material Discrepancy and the issuance of the final verification report and certification.

The following sections outline each step in more detail.

2.2 Document Review

The monitoring report (MR), version 03 of 13/12/2016 and version 02 of 17/10/2016 **/04/**, the emission reduction calculations spreadsheet (044_GSL_ER2014,2015_ver03_131216.xlsx), version 03 of 13/12/2016) and ER spread sheets(044_GSL_ER2015_ver02_010916.xlsx) version 02 of 01/09/2016 **/15/**, were assessed as part of the verification. In addition the renewed Project Design Document (VCS-DD)**/01/** in particular the baseline estimations and the monitoring plan for the project were reviewed.

The following table lists the documentation that was reviewed during the verification

/01/	South Pole Carbon Asset Management Ltd : VCS-PD for project activity “Wastewater treatment with biogas production (UASB) and heat utilization at General Starch Co.Ltd., version 5.0 of 04/07/2016.
/02/	Verified Carbon Standard: VCS Program Guide v3.5 of 08/10/2013
/03/	Verified Carbon Standard: VCS Standard v3.5 of 25/03/2015
/04/	South Pole Carbon Asset Management Ltd: VCS-MR, version 03 of 13/12/2016 South Pole Carbon Asset Management Ltd: VCS-MR, version 02 of 17/10/2016
/05/	CDM Executive Board: Large scale consolidated Methodology “ treatment of wastewater”, ACM0014, version 06.0 of 21/02/2014
/06/	CDM Executive Board: Tool to calculate baseline , project and/or leakage emissions from

	electricity consumption and monitoring of electricity generation , version 02.0 of 27/11/2015
/07/	VCS: Monitoring report form (MONITORING REPORT: VCS Version 3) , version 03.3 dated 08/10/2013
/08/	RINA: Validation report (renewal of crediting period) (15IQMD38) version 2.2a of 08/07/2016
/09/	Calibration certificates: Endress+Hauser: 1. FM3/6B00EB20000, dated 07/12/2012 and 09/05/2014 2. FM5/6B00E920000, dated 07/12/2012 and 09/05/2014 3. AA083102000/GM4, dated 01/11/2012 and 09/05/2014 4. 9B09BD02000/GM5, dated 01/11/2012 and 09/05/2014 5. C3010D02000/GM1, dated 01/11/2012, 09/05/2014 and 07/10/2015 6. A9059602000/GM2, dated 01/11/2012, 09/05/2014 and 07/10/2015 7. H1120702000/GM6, dated 29/01/2013 and 07/10/2015
/10/	Calibration certificates: Ilab fluid control co ltd: 38397/CS, dated 24/08/2013 My Lab Scale: 14/45856/CS, dated 20/08/2014 Sysprofes: 3.351195.2, dated 09/05/2014 and 19/09/2015 Sysprofes: 3.351191.2, dated 09/05/2014 Thai Steam service and supply Co Ltd: VISIT 04, dated 19/12/2012
/11/	PAPOP Envir Innovation: Open flare specifications for 750m ³ /h
/12/	Verified Emission Reduction Transfer agreement between South Pole Carbon Asset Management Ltd and Papop Renewable Co.Ltd, dated 30/09/2008
/13/	General Starch Co Limited: VER Benefit Share agreement with PAPOP Renewable Co Ltd, dated 24/04/2007.
/14/	TUV NORD CERT GmbH: A combined report for both validation and verification , Report no. 8000349679-07/63 - V01 of 31/08/2007
/15/	South Pole Carbon Asset Management Limited: ER spread sheets (044_GSL_ER2014,2015_ver03_131216.xlsx) version 03 of 13/12/2016 South Pole Carbon Asset Management Limited: ER spread sheets (044_GSL_ER2015_ver02_010916.xlsx) version 02 of 01/09/2016 South Pole Carbon Asset Management Limited: ER spread sheets (044_GSL_ER2015_ver02_010916.xlsx) version 01 submitted on 17/10/2016
/16/	VCS related project documents: http://www.vcsprojectdatabase.org/#/project_details/82 , English website, last accessed on 14/12/2015
/17/	General Starch Co Limited: As built drawing for 34 open lagoons, dated 13/01/2003.
/18/	Meteorological Department , Ministry of Information and Communication Technology : http://www.e-report.energy.go.th/weather.html : The annual average temperature at Chok Chai Station is compiled by Statistical Forecasting Bureau , National Statistical Office: Thai Language, Last accessed on 03/12/2015
/19/	CDM Executive Board: Project and leakage emissions from anaerobic digesters, version

	01.0.0, dated 02/03/2012
/20/	BOT contract between GSL and Papop Co Ltd, dated 04/01/2005
/21/	Wastewater Stabilization Ponds (WSP) For Wastewater Treatment - Table 1, : http://www.eolss.net/sample-chapters/c07/e6-144-12.pdf , English Language: last accessed on 03/12/2015
/22/	South Pole Carbon Asset Management Ltd : VCS-PD for project activity "Wastewater treatment with biogas production (UASB) and heat utilization at General Starch Co.Ltd., version 1.0 submitted on 19/06/2007.
/23/	ALS laboratory Group: COD analysis Test report, dated 26/04/2008, 30/05/2009, 10/05/2010, 23/04/2011,13/05/2012, 18/04/2013
/24/	NCV of methane: The Engineering tool box: http://www.engineeringtoolbox.com/fuels-higher-calorific-values-d_169.html , English Language, last accessed on 14/12/2015
/25/	CDM Executive Board: Tool to determine project emissions from flaring gases containing methane", version 02.00 of 20/07/2012
/26/	2006 IPCC guidelines for national green house gas inventories Global warming potentials derived from IPCC second assessment report http://ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20(Feb%2016%202016).pdf
/27/	CDM Executive Board: Tool to determine the mass flow of greenhouse gas in as gaseous stream" version 03.0 of 27/11/2015
/28/	LOVIBOND Water testing: http://dl.lovibond.com/instructions/cod/ins_md200_00386324_cod_multi_lovi.pdf , photometer system, MD200, dated 09/2013.
/29/	Department of Factory Control, Dept. of Industrial Work: Operational License of the factory, dated 25/05/1993 and extended to dated 13/10/2015
/30/	Ministry of Energy: Thailand Energy Statistic Report from DEDE http://www.dede.go.th/download/state_58/sit_57_58/Thailand%20Energy%20Efficiency%20Situation%202014.pdf , last accessed on 15/12/2015
/31/	Korat waste to Energy Project, Thailand: https://cdm.unfccc.int/methodologies/PAmethodologies/pnm/byref/NM0041-rev2 , last accessed on 15/12/2015
/32/	Standard Methods for 5220 Chemical Oxygen Demand: http://www.standardmethods.org/store/ProductView.cfm?ProductID=37 , Last accessed on 15/12/2015

/33/	PAPOP Renewable Co Ltd :VCU-PD“Wastewater Treatment with Biogas production (UASB) and heat utilization at General Starch Co. Ltd, Version 1,0 of 19/06/2007
/34/	Thailand Greenhouse Gas Management Organization: http://tver.tgo.or.th/2015/thai/news_detail.php?id=53 , Thai language, last accessed on 22/04/2016.
/35/	PAPOP Renewable Co Ltd: COD test reports for the period 01/01/2014 to 30/09/2015
/36/	PAPOP Renewable Co Ltd: log book records of FM3 and FM5 for the period 01/01/2014 to 30/09/2015
/37/	PAPOP Renewable Co Ltd: Rpt_Temp_2014.xls Rpt_Temp_2015.xls
/38/	PAPOP Renewable Co Ltd: Log book records of biogas produced from GM1 and GM2 for the period 01/01/2014 to 30/09/2015
/39/	PAPOP Renewable Co Ltd: Log book records of biogas utilized from GM4 and GM5 for the period 01/01/2014 to 30/09/2015
/40/	PAPOP Renewable Co Ltd: Biogas balance check.xls
/41/	PAPOP Renewable Co Ltd: Rpt_BG at boiler.xls Rpt_BG to boiler 2014.xls Rpt_BG to boiler 2015.xls
/42/	PAPOP Renewable Co Ltd: Log book records of methane content in biogas supply for the period 01/01/2014 to 30/09/2015.
/43/	VCS : VCS assessment findings

2.3 Interviews

Interviews: The key personnel interviewed and the main topics of the interviews are summarized in the table below:

	Date	Name and Role	Organization	Topic
/a/	06/10/2015	Ms. Nattaya Lonawan (Project Manager)	South Pole Carbon Asset Management Ltd	ER calculation and project description
/b/		Mr. Krittapak Srisook (Supervisor)	GSL	Project Implementation status, Operation and Maintenance, project boundary, baseline , Data storage and Archiving procedures, Trainings,
/c/		Mr. Meksuwan Khakhanmalee (Biogas Officer)	GSL	
/d/		Mr. Somkiert Korkaew (Forman officer)	GSL	
/e/		Mr. Suchai	Papop Co Ltd	Technology involved, UASB

		Rattananadhekul (Engineering Design Manager)		and flare specification, steps involved in waste water treatment and disposal of sludge
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2.4 Site Inspections

On 06/10/2015, RINA visited the project site in Amphur Kornburi in Nakorn Ratchasima Province in the north east of Thailand to check the Waste water treatment plant and monitoring arrangement as part of project activity. During the on-site assessment of the project RINA assessed the implementation and operation of the proposed project activity, accessed the installed equipment directly, interviewed key personnel of the plant to confirm the operation information, the commissioning of the plant and the GHG Programs undertaken.

2.5 Resolution of Findings

The objective of this phase of the validation is to resolve any outstanding issues which need to be clarified for RINA's positive conclusion on the project description. To guarantee transparency any findings raised regarding to the validation are incorporated in the Appendix A to this report.

2.5.1 Forward Action Requests

Based on the review of VCS validation report (renewal of crediting period)/08/, no FAR was raised during the validation, also this is the first after renewal of crediting period.

2.6 Eligibility for Validation Activities

RINA is accredited for validating and verifying GHG emission reduction project activities falling under sectoral scope 01 Energy industries (renewable/non-renewable sources) and 13 waste handling and disposal.

3 VALIDATION FINDINGS

3.1 Participation under Other GHG Programs

N/A

3.2 Methodology Deviations

N/A

3.3 Project Description Deviations

N/A.

3.4 Grouped Project

N/A

4 VERIFICATION FINDINGS

The findings of the verification related to the monitoring period from 01/01/2014 to 30/09/2015 as documented and described in the VCS monitoring report version 03 of 13/12/2016 and version 02 of 17/10/2016 are stated in the following sections. The verification requirements, the means of verification and the results from verifying the identified criteria are documented in more detail in the Appendix A.

4.1 Project Implementation Status

The project activity involves installation of an anaerobic wastewater treatment facility, based on Upflow Anaerobic Sludge Blanket (UASB) technology, at a starch manufacturing plant that has been in operation since 1995 /14/.

The first phase of the project (UASB 1) was implemented at General Starch Co., Ltd. in 2003 with start-up of operations in January 2004 and the second phase of the project (UASB 2) in 2005 with start-up of operations in January of 2006.

The starch plant has a total production capacity of 600 tonnes of native starch per day, generating an average of 5,000 m³ of wastewater every production day /14/. As a normal practice, the wastewater in the plant is treated through cascading lagoons with a retention time of more than a year. The minimum depth of these ponds is about 10 meters for the first two lagoons and more than 3 m from the water surface for the remaining lagoons /17/. The average atmospheric temperature in the region is 28 degree Celsius and the waste water has a temperature of between 25 and 35 degree Celsius at all times /18/.

These conditions result in anaerobic environment within the ponds, resulting in methane generation from the organic content (characterized by chemical oxygen demand or COD) of the wastewater which is released into the atmosphere.

The use of UASB to treat the wastewater generated in the plant enable the capture of methane produced in the process as well as to meet the effluent standards. This will help reduce the emission of GHG.

The project utilizes the captured methane as fuel in existing heat generating devices in the plant replacing heavy fuel oil, and the surplus methane, if any, is flared in an open flare.

During the site visit , it was noted that the project involves (covered lagoon 3,4) as additional units from the previous version of the registered PD. The new wastewater and biogas flow meters are installed at each unit in order to separate the wastewater and biogas volume from the project activity. From the emission reduction spread sheets /15/, it was confirmed that the emissions from the same are not included in the ER calculations and the covered lagoons are not part of the project boundary.

The implementations are in line with the description in registered VCS-PD /04/. The description in MR /01/ is also consistent with the actual implementation confirmed as above. Therefore RINA confirmed that there is no material discrepancy between the actual project information and the project description.

4.2 Accuracy of GHG Emission Reduction and Removal Calculations

According to the applied methodology “treatment of wastewater”, ACM0014, version 06.0 of 21/02/2014 **/05/**, the emission reductions have been calculated based on the following formula:

$$ER_y = BE_y - PE_y - L_y$$

Where,

ER_y : Emission reductions in year y (tCO₂e/yr)

BE_y : Baseline emissions in year y (tCO₂e/yr)

PE_y : Project emissions in year y (tCO₂e/yr)

L_y : Leakage in year y (tCO₂e/yr)

$$BE_y = BE_{CH_4,y} + BE_{EL,y} + BE_{HG,y} \quad (1)$$

Where:

Parameter	Details
BE_y	Baseline emissions in year y (tCO ₂ e / yr)
$BE_{CH_4,y}$	Methane emissions from anaerobic treatment of the wastewater in open lagoons in the absence of the project activity in year y (tCO ₂ e / yr)
$BE_{EL,y}$	CO ₂ emissions associated with electricity generation that is displaced by the project activity and / or electricity consumption in the absence of the project activity in year y (tCO ₂ e / yr)
$BE_{HG,y}$	CO ₂ emissions associated with fossil fuel consumption for heating equipment that is displaced by the project in year y (tCO ₂ e / yr)

The project will only claim emission reductions from the methane avoidance due to the installation of a new, closed, anaerobic, wastewater-treatment system. Heat generated from the project activity will replace the heat generated from heavy fuel oil that would be occurred in the absence of project activity.

Step 1: Calculation of baseline emissions from anaerobic treatment of the wastewater or sludge

The methodology proposes to use the minimum value between the methane produced after the implementation of the project activity and methane conversion factor method for the estimation of methane emissions from open lagoons in case of the waste water lagoons.

$$BE_{CH_4,y} = \min \{Q_{CH_4,y}; BE_{CH_4,MCF,y}\}$$

$Q_{CH_4,y}$ is measured using the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream “. Since the project is largescale project, option 1 of the tool is applied i.e. the procedure using monitored data.

The baseline methane emissions from anaerobic treatment of the wastewater in open lagoons (Scenario 1) are estimated based on the chemical oxygen demand (COD) of the wastewater that would enter the lagoon in the absence of the project activity ($COD_{BL,y}$), the maximum methane producing capacity (B_o) and a methane conversion factor ($MCF_{BL,y}$) which expresses the proportion of the wastewater that would decay to methane, as follows:

$$BE_{CH_4,MCF,y} = GWP_{CH_4} * MCF_{BL,y} * B_o * COD_{BL,y} \quad (2)$$

Where:

Parameter	Details
$BE_{CH_4,MCF,y}$	Methane emissions from anaerobic treatment of the wastewater in open lagoons (Scenario 1) or the anaerobic treatment of sludge in sludge pits (Scenario 2) in the absence of the project activity in year y (tCO ₂ e/yr)
GWP_{CH_4}	Global Warming Potential of methane, GWPs derived from the IPCC's Second Assessment Report, (tCO ₂ e/tCH ₄), 21
$MCF_{BL,y}$	Average baseline methane conversion factor (fraction) in year y, representing the fraction of ($COD_{PJ,y} \times B_o$) that would be degraded to CH ₄ in the absence of the project activity, 0.595
B_o	Maximum methane producing capacity, expressing the maximum amount of CH ₄ that can be produced from a given quantity of chemical oxygen demand (tCH ₄ /tCOD), 0.25
$COD_{BL,y}$	Quantity of chemical oxygen demand that would be treated in open lagoons (Scenario 1) in the absence of the project activity in year y (tCOD/yr), 2,03,915

Determination of $COD_{BL,y}$

The baseline chemical oxygen demand ($COD_{BL,y}$) is equal to the chemical oxygen demand that is treated under the project activity ($COD_{PJ,y}$), unless there would have been effluent from the lagoons (Scenario 1) in the baseline, in this case the COD_{PJ} should be adjusted by an adjustment factor which relates the COD supplied to the lagoon or sludge pit with the COD in the effluent.

$$COD_{BL,y} = \rho \left[1 - \frac{COD_{out,x}}{COD_{in,x}} \right] * COD_{PJ,y} \quad (3)$$

Where:

Parameter	Details
$COD_{BL,y}$	Quantity of chemical oxygen demand that would be treated in open lagoons (Scenario 1) in the absence of the project activity in year y (tCOD/yr)
ρ	Discount factor for historical information
$COD_{out,x}$	COD of the effluent in the period x (t COD)
$COD_{in,x}$	COD directed to the open lagoons (Scenario 1) or in sludge pits (Scenario 2) in the period x (t COD)
x	Representative historical reference period
$COD_{PJ,y}$	Quantity of chemical oxygen demand that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity in year y (t COD/yr)

It is noted that $COD_{out,x}$: Calculated from $COD_{in,x}$ with the removal ratio for lagoon from CDM project no.1040 – Korat Waste To Energy at 87.88% and $COD_{in,x}$: From operating data of 2006, already validated and as per the registered previous PD. As per the COD test by external laboratory (once a year) during 2008 to 2013, the COD reduction efficiency by lagoon is above 90% /23/ which is higher than the estimated value, 87.88%. Hence the same was accepted.

$COD_{PJ,y}$ is determined as follows:

$$COD_{PJ,y} = \sum_{m=1}^{12} F_{PJ,dig,m} * COD_{dig,m} \quad (4)$$

Where:

Parameter	Details
$COD_{PJ,y}$	Quantity of chemical oxygen demand that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity in year y (t COD/yr)
$F_{PJ,dig,m}$	Quantity of wastewater or sludge that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity in month m (m ³ /month)
$COD_{dig,m}$	Chemical oxygen demand in the wastewater or sludge that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity in month m (t COD / m ³)
m	Months of year y of the crediting period

The values for $F_{PJ,dig,m}$ and $COD_{dig,m}$ is referred in appendix 2 of the PD, which is further sourced from page 16 of the 1st monitoring report, already verified and registered. Thus, the same is accepted by RINA.

Determination of $MCF_{BL,y}$

The quantity of methane generated from COD disposed to the open lagoon (Scenario 1) depends mainly on the temperature and the depth of the lagoon or sludge pit. Accordingly, the methane conversion factor is calculated based on a factor f_d , expressing the influence of the depth of the lagoon or sludge pit on methane generation, and a factor $f_{T,y}$ expressing the influence of the temperature on the methane generation. In addition, a conservativeness factor of 0.89 is applied to account for the considerable uncertainty associated with this approach. $MCF_{BL,y}$ is calculated as follows:

$$MCF_{BL,y} = f_d * f_{T,y} * 0.89 \quad (5)$$

Where:

Parameter	Details
$MCF_{BL,y}$	Average baseline methane conversion factor (fraction) in year y , representing the fraction of $(COD_{PJ,y} \times B_o)$ that would be degraded to CH_4 in the absence of the project activity
f_d	Factor expressing the influence of the depth of the lagoon or sludge pit on methane generation
$f_{T,y}$	Factor expressing the influence of the temperature on the methane generation in year y
0.89	Conservativeness factor

Determination of f_d

f_d represents the influence of the average depth of the lagoons or sludge pit on methane generation.

$$f_d = \begin{cases} 0 ; & \text{if } D < 1m \\ 0.5 ; & \text{if } 1m \leq D < 2m \\ 0.7 ; & \text{if } D \geq 2m \end{cases} \quad (6)$$

Where:

Parameter	Details
f_d	Factor expressing the influence of the depth of the lagoon or sludge pit on

	methane generation
D	Average depth of the lagoons or sludge pits (m)

Determination of $f_{T,y}$

An increase in temperature in the lagoon has several benefits to generate more methane, including an increasing solubility of the organic compounds, enhanced biological and chemical reaction rates. The factor $f_{T,y}$ is calculated using a monthly stock change model which aims at assessing how much COD degrades in each month.

For each month m , the quantity of wastewater directed to the lagoon or sludge directed to a pit, the quantity of organic compounds that decay and the quantity of any effluent water from the lagoon is balanced, giving the quantity of COD that is available for degradation in the next month: the amount of organic matter available for degradation to methane ($COD_{available,m}$) is assumed to be equal to the amount of organic matter directed to the open lagoon or sludge pit, less any effluent, plus the COD that may have remained in the lagoon or sludge pit from previous months, as follows:

$$COD_{available,m} = COD_{BL,m} + (1 - f_{T,m-1}) * COD_{available,m-1} \text{ with} \quad (8)$$

$$COD_{BL,m} = \left(1 - \frac{COD_{out,x}}{COD_{in,x}}\right) * COD_{PJ,m} \quad \text{and} \quad (9)$$

$$COD_{PJ,m} = F_{PJ,dig,m} * COD_{dig,m} \quad (10)$$

Where:

Parameter	Details
$COD_{available,m}$	Quantity of chemical oxygen demand available for degradation in the open lagoon in month m (t COD/month)
$COD_{BL,m}$	Quantity of chemical oxygen demand that would be treated in open lagoons (Scenario 1) in the absence of the project activity in month m (t COD/month)
$COD_{PJ,m}$	Quantity of chemical oxygen demand that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity in month m (t COD/month)
$F_{PJ,dig,m}$	Quantity of wastewater that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity in month m (m ³ /month)
$COD_{dig,m}$	Chemical oxygen demand in the wastewater that is treated in the anaerobic digester or under clearly aerobic conditions in the project activity in month m (t COD/m ³)
$f_{T,m-1}$	Factor expressing the influence of the temperature on the methane generation in month m
m	Months of year y of the crediting period
$COD_{in,x}$	COD of the effluent in the period x (t COD)
$COD_{out,x}$	COD directed to the open lagoons (Scenario 1) or in sludge pits (Scenario 2) in the period x (t COD)
x	Representative historical reference period

In case of emptying the lagoon, the accumulation of organic matter restarts with the next inflow and the COD available from the previous month should be set to zero. The monthly factor to account for the influence of the temperature on methane generation is calculated based on the following “van’t Hoff – Arrhenius” approach:

$$f_{T,m} = \begin{cases} 0 ; & \text{if } T_{2,m} < 278 \text{ K} \\ e^{\frac{E \cdot (T_{2,m} - T_1)}{R \cdot T_1 \cdot T_{2,m}}} ; & \text{if } 278 \text{ K} \leq T_{2,m} \leq 302.5 \text{ K} \\ 0.95 ; & \text{if } T_{2,m} > 302.5 \text{ K} \end{cases} \quad (11)$$

Where:

Parameter	Details
$f_{T,m}$	Factor expressing the influence of the temperature on the methane generation in month m
e	Activation energy constant (15,175 cal/mol)
$T_{2,m}$	Average temperature at the project site in month m (K)
T_1	303.16 K (273.16 K + 30 K)
R	Ideal gas constant (1.987 cal/K mol)
m	Months of year y of the crediting period

The annual value $f_{T,y}$ is calculated as follows:

$$f_{T,y} = \frac{\sum_{m=1}^{12} f_{T,m} * COD_{available,m}}{\sum_{m=1}^{12} COD_{BL,m}} \quad (12)$$

Where:

Parameter	Details
$f_{T,y}$	Factor expressing the influence of the temperature on the methane generation in year y
$f_{T,m}$	Factor expressing the influence of the temperature on the methane generation in month m
$COD_{available,m}$	Quantity of chemical oxygen demand available for degradation in the open lagoon or sludge pit in month m (t COD/month)
$COD_{BL,m}$	Quantity of chemical oxygen demand that would be treated in open lagoons (Scenario 1) or in sludge pits (Scenario 2) in the absence of the project activity in month m (t COD/month)
m	Months of year y of the crediting period

Baseline under a suppressed demand scenario

Suppressed demand scenario may only be applied if the procedure to determine the baseline scenario identifies W2, W6 and/or W8 as the scenario for the treatment of at least 50 per cent of

the domestic wastewater in the project boundary. This scenario is not applicable for this project activity.

Step 2: Baseline emissions from generation and/or consumption of electricity

In this step, baseline emissions from consumption of electricity associated with the treatment of wastewater (Scenario 1) are estimated. Since the project activity does not generate the electricity from biogas, the baseline emission from generation and/or consumption of electricity is considered as 0.

Step 3: Baseline emissions from the generation of heat

This step is applicable if the biogas captured from the new anaerobic digester is utilized in the project scenario for heat generation. In this case, for the application of the baseline Scenarios H2, fossil fuels from the generation of heat in boilers are displaced and baseline emissions are calculated as follows:

$$BE_{HG,y} = \frac{HG_{PJ,y} * EF_{CO2,FF,boiler}}{\eta_{BL,boiler}} \quad (14)$$

Where:

Parameter	Details
$BE_{HG,y}$	CO ₂ emissions associated with fossil fuel combustion for heating equipment that is displaced by the project in year y (tCO ₂ /yr)
$HG_{PJ,y}$	Net quantity of heat generated in year y with biogas from the new anaerobic digester (GJ).
$EF_{CO2,FF,boiler}$	CO ₂ emission factor of the fossil fuel type used in the boiler for heat generation in the absence of the project activity (tCO ₂ /GJ), 0.0774
$\eta_{BL,boiler}$	Efficiency of the boiler that would be used for heat generation in the absence of the project activity, 90%

Determination of $EF_{CO2,FF,boiler}$

The heavy fuel oil was used in the industrial facility that generates the wastewater for heating purposes before the implementation of the project activity. A value of 0.0774 tCO₂/GJ is used as per the IPCC default values /26/.

Determination of $\eta_{BL,boiler}$

The heating combustion efficiency is 90%, default value for the new oil fired boiler as the tool "tool to determine the baseline efficiency of thermal or electricity generation system", version 01./10/

Determination of $HG_{PJ,y}$

In order to calculate the quantity of fuel that is displaced by biogas, the two fuels are substituted on the basis of equivalent delivered energy. The following energy densities are used:

- The NCV of CH₄ is 39820 kJ/Nm³ or 39.82 MJ/Nm³ and 39.77 MJ/litre for fuel oil /24/ (Thailand Energy Statistic Report from DEDE)/30/
 - Combustion efficiency on HFO as well as biogas is considered to be 90 %.
 - Therefore : $HG_{PJ,y} \text{ (GJ)} = \frac{F_{biogas,boiler,y} \text{ (Nm}^3\text{)} * NCV_{CH_4} \text{ (MJ/Nm}^3\text{)} * W_{CH_4,biogas,y} * 90\%}{1,000}$

Baseline emissions= 39,785 tCO₂e

Project Emissions

Since the project activity introduces an anaerobic digester for the treatment of wastewater. The tool “Project and leakage emissions from anaerobic digesters version 01.0.0” is applied to calculate project and leakage emissions.

The following sources of project emissions are accounted for in this tool:

- (a) CO₂ emissions from consumption of electricity associated with the operation of the anaerobic digester;
- (b) CO₂ emissions from consumption of fossil fuels associated with the operation of the anaerobic digester;
- (c) CH₄ emissions from the digester (emissions during maintenance of the digester, physical leaks through the roof and side walls, and release through safety valves due to excess pressure in the digester); and
- (d) CH₄ emissions from flaring of biogas.

The project emissions associated with the anaerobic digester ($PE_{AD,y}$) are determined as follows:

$$PE_{AD,y} = PE_{EC,y} + PE_{FC,y} + PE_{CH_4,y} + PE_{flare,y} \quad (1)$$

Where:

Parameter	Details
$PE_{AD,y}$	Project emissions associated with the anaerobic digester in year y (t CO ₂ e)
$PE_{EC,y}$	Project emissions from electricity consumption associated with the anaerobic digester in year y (t CO ₂ e)

$PE_{FC,y}$	Project emissions from fossil fuel consumption associated with the anaerobic digester in year y (t CO ₂ e)
$PE_{CH_4,y}$	Project emissions of methane from the anaerobic digester in year y (t CO ₂ e)
$PE_{flare,y}$	Project emissions from flaring of biogas in year y (t CO ₂ e)

These parameters are determined through the steps outlined below.

Step 1: Determination of the quantity of methane produced in the digester ($Q_{CH_4,y}$)

The project activity is large scale project. The Option 1 is used to determine the quantity of methane produced in the digester in year y ($Q_{CH_4,y}$).

Option 1: Procedure using monitored data

$Q_{CH_4,y}$ shall be measured using the *Tool to determine the mass flow of a greenhouse gas in a gaseous stream*.

Follow the same calculating step for Option C in baseline emission calculation step1.

Step 2: Determination of project emissions from electricity consumption ($PE_{EC,y}$)

The project activity consumes the electricity supplied from grid. The Option 2 is used for $PE_{EC,y}$ calculation.

Option 2 : Procedure using a default value

Project emissions from electricity consumption associated with the anaerobic digester are calculated as follows:

$$PE_{EC,y} = Q_{CH_4} * F_{EC,default} * EF_{EL,default} \quad (3)$$

Where :

Parameter	Details
$PE_{EC,y}$	Project emissions from electricity consumption in year y (t CO ₂ e)
Q_{CH_4}	Quantity of methane produced in the anaerobic digester in year y (t CH ₄),
$F_{EC,default}$	Default factor for the electricity consumption associated with the anaerobic digester per ton of methane generated (MWh / t CH ₄), 0.01

$EF_{EL,default}$	Default emission factor for the electricity consumed in year y (t CO ₂ / MWh). 0.5897
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Step 3: Determination of project emissions from fossil fuel consumption ($PE_{FC,y}$)

Where the anaerobic digester facility uses fossil fuels, project participants shall calculate $PE_{FC,y}$ using the “Tool to calculate project or leakage CO₂ emissions from fossil fuel combustion”. The project emission source j referred to in the tool is fossil fuel consumption associated with the anaerobic digestion facility (not including fossil fuels consumed for transportation of feed material and digester or any other on-site transportation). The $PE_{FC,y}$ is 0 for this project activity. The same was crosschecked during the site visit and found to be satisfactory.

Step 4: Determination of project emissions of methane from the anaerobic digester ($PE_{CH_4,y}$)

Project emissions of methane from the anaerobic digester include emissions during maintenance of the digester, physical leaks through the roof and side walls, and release through safety valves due to excess pressure in the digester. These emissions are calculated using a default emission factor ($EF_{CH_4,default}$), as follows:

$$PE_{CH_4,y} = Q_{CH_4,y} * EF_{CH_4,default} * GWP_{CH_4} \quad (4)$$

Where :

Parameter	Details
$PE_{CH_4,y}$	Project emissions of methane from the anaerobic digester in year y (t CO ₂ e)
$Q_{CH_4,y}$	Quantity of methane produced in the anaerobic digester in year y (tCH ₄), 5,075
$EF_{CH_4,default}$	Default emission factor for the fraction of CH ₄ produced that leaks from the anaerobic digester (fraction), 0.05
GWP_{CH_4}	Global warming potential for CH ₄ (t CO ₂ / t CH ₄), 21

Step 5: Determination of project emissions from flaring of biogas ($PE_{flare,y}$)

If the project activity includes flaring of biogas, then project emissions from flaring of biogas ($PE_{flare,y}$) shall be estimated using the “Tool to determine project emissions from flaring gases containing methane” version 02.0.0/25/. The following applies:

- The tool provides default factors for the flare efficiency, which can be used for large or small scale projects as described in the tool.

The calculation procedure in this tool determines the project emissions from flaring the residual gas ($PE_{flare,y}$) based on the flare efficiency ($\eta_{flare,m}$) and the mass flow of methane to the flare ($F_{CH_4,RG,m}$). The flare efficiency is determined for each minute m of year y based either on monitored data or default values.

The project emission calculation procedure is given in the following steps:

Step 1: Determination of the methane mass flow in the residual gas

The “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” shall be used to determine the following parameter:

Parameter	Details
$F_{CH_4,m}$	Mass flow of methane in the residual gaseous stream in the minute m (kg)

The following requirements apply:

- The gaseous stream tool shall be applied to the residual gas;
- The flow of the gaseous stream shall be measured continuously;
- CH₄ is the greenhouse gas i for which the mass flow should be determined;
- The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 and 17 in the tool); and
- The time interval t for which mass flow should be calculated is every minute m .

$F_{CH_4,m}$, which is measured as the mass flow during minute m , shall then be used to determine the mass of methane in kilograms fed to the flare in minute m ($F_{CH_4,RG,m}$). $F_{CH_4,m}$ shall be determined on a dry basis.

Step 2: Determination of flare efficiency

The flare efficiency depends on the efficiency of combustion in the flare and the time that the flare is operating. For open flares a default value must be applied.

Open flare

In the case of open flares, the flare efficiency in the minute m ($\eta_{flare,m}$) is 50% when the flame is detected in the minute m ($Flame_m$), otherwise $\eta_{flare,m}$ is 0%.

Step 3: Calculation of project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions for each minute m in year y , based on the methane mass flow in the residual gas ($F_{CH_4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows:

$$PE_{flare,y} = GWP_{CH_4} * \sum_{m=1}^{525600} F_{CH_4,RG,m} * (1 - \eta_{flare,m}) * 10^{-3} \quad (15)$$

Where:

Parameter	Details
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$PE_{flare,y}$	Project emission from flaring of the residual gas stream in year y (tCO ₂ e)
GWP_{CH_4}	Global warming potential of methane valid for the commitment period (tCO ₂ e/tCH ₄)
$F_{CH_4, RG, m}$	Mass flow of methane in the residual gas in the minute m (kg)
$\eta_{flare, m}$	Flare efficiency in minute m , 0%

Project emissions= 3,185 tCO₂e

Leakage

The project activity introduces an anaerobic digester for the treatment of wastewater , the latest approved version of the tool “*Project and leakage emissions from anaerobic digesters*” is applied to calculate leakage emissions.

However , according to ACM0014 version 06.0.0 “*Additionally leakage emissions are calculated for Scenario 1 type projects that include the treatment of solid materials in the digester in the project activity*”. Since there is no treatment of solid materials , there is no leakage applicable to the project activity.

Net GHG Emission Reductions and Removals

Emission reductions for any given year of the crediting period are obtained by subtracting project emissions from baseline emissions:

$$ER_y = BE_y - PE_y - LE_y \quad (24)$$

Where:

Parameter	Details
ER_y	Emissions reductions of the project activity in year y (tCO ₂ e/year)
BE_y	Baseline emissions in year y , (tCO ₂ e/year)
PE_y	Project emissions in year y , (tCO ₂ e/year)
LE_y	Leakage emissions in year y , (tCO ₂ e/year)

The estimation of the emission reductions can be replicated using the data and parameter values provided in the VCS-PD /1/ and supporting files /14/ /15/. The data sources mentioned have been verified by RINA and confirms that the GHG emissions reduction calculation is complete and transparent, and the data accuracy has been verified.

The net GHG emission reductions for this monitoring period is **36, 600 tCO₂e**

Parameters Determined Ex-ante

The ex-ante parameters that are mentioned in the methodology are included in the VCS PD and are provided in compliance with the methodology:

	Data / Parameter	Unit	Value applied	Assessment
1	$COD_{out,x}$ $COD_{in,x}$ (COD of the effluent in the period x COD directed to the open lagoons (Scenario 1) in the period x)	t COD	$COD_{out,x}$ 2,674.52 $COD_{in,x}$ 22,066.994	Sourced from $COD_{out,x}$: Calculated from $COD_{in,x}$ with the removal ratio for lagoon from CDM project no.1040 – Korat Waste To Energy at 87.88% /31/. $COD_{in,x}$: From operating data of 2006 /22/ As per the COD test by external laboratory (once a year) during 2008 to 2013 , the COD reduction efficiency by lagoon is above 90% /23/ which is higher than the estimated value , 87.88%. The same was accepted since its conservative.
2	X Representative historical reference period	Time	1 year	Taken as per the previous registered PD /22/.
3	ρ Discount factor for historical information		0.89	The value of 0.89 for the case where there is no one year historical data is to account for the uncertainty

				range (of 30% to 50%) associated with this approach as compared to one-year historical data. The values are taken as per the methodology and the same is accepted.
4	B ₀ Maximum methane producing capacity, expressing the maximum amount of CH ₄ that can be produced from a given quantity of chemical oxygen demand (COD).	tCH ₄ /tCOD	0.25	2006 IPCC Guidelines/26/. The same is as per the methodology. Hence accepted.
5	D Average depth of the lagoons	m	5.32	Sourced from the design pf baseline lagoon system. RINA checked the lagoon layout design and the same is accepted /17/.
6	EC _{BL} Annual quantity of electricity that would be consumed in the absence of the project activity for the treatment of the wastewater (Scenario 1).	MWh/yr	0	The open lagoon system is designed for gravity flow. There is no electricity consumed equipment installed in the absence of project activity. The same was checked during the site visit and

				accepted /17/.		
7	EF _{CO2,FF,boiler} CO ₂ emission factor of the fossil fuel type used in the boiler for heat generation in the absence of the project activity.	tCO ₂ /GJ	0.0774	IPCC default values used from the most recent version of IPCC Guidelines for National Greenhouse Gas Inventories/26/. The same is as per the methodology. Hence accepted.		
8	GWP _{CH4} Global warming potential for CH ₄	tCO ₂ e/tCH ₄	21	IPCC default value /26/. GWPs derived from the IPCC's Second Assessment Report,		
9	R _u Universal ideal gases constant	Pa.m ³ /kmol.K	8,314	Taken as per “Tool to determine the mass flow of greenhouse gas in as gaseous stream” version 03.0 /27/		
10	MM _i molecular mass of greenhouse gas i	kg/kmol	Compound	Structure	Molecular mass (kg / kmol)	Taken as per “Tool to determine the
			Carbon dioxide	CO ₂	44.1	determine the
			Methane	CH ₄	16.04	mass flow of
			Nitrous oxide	N ₂ O	44.02	greenhouse gas
			Sulfur hexafluoride	SF ₆	146.06	in as gaseous
			Perfluoromethane	CF ₄	88.00	stream” version
			Perfluoroethane	C ₂ F ₆	138.01	03.0 /27/
			Perfluoropropane	C ₃ F ₈	188.02	
			Perfluorobutane	C ₄ F ₁₀	238.03	
			Perfluorocyclobutane	c-C ₄ F ₈	200.03	
			Perfluoropentane	C ₅ F ₁₂	288.03	

			Perfluorohexane	C ₆ F ₁₄	338.04		
11	P _n Total pressure at normal condition	Pa	101,325			Taken as per "Tool to determine the mass flow of greenhouse gas in as gaseous stream" version 03.0 /27/	
12	T _n Temperature at normal condition	K	273.15			Taken as per "Tool to determine the mass flow of greenhouse gas in as gaseous stream" version 03.0 /27/	
13	ρ _{CH₄} Density of methane at normal condition	t CH ₄ / Nm ³ CH ₄	0.00067			Default value. Taken as per the methodological tool "Project and leakage emissions from anaerobic digesters" version 01.0.0 /19/	
14	EF _{CH₄,default} Default emission factor for the fraction of CH ₄ produced that leaks from the anaerobic digester	t CH ₄ leaked / t CH ₄ produced	0.05			IPCC default values for UASB type digesters taken as per the methodology /05/.	
15	F _{EC,default} Default factor for the electricity consumption associated with the anaerobic digester per ton of CH ₄ generated	MWh / t CH ₄ produced	0.01			Default values for UASB, taken as per the methodological tool "Project and leakage emissions from anaerobic digesters"	

				version 01.0.0 /19/
16	EF _{EL,default} Default emission factor for the electricity consumed in year y	t CO ₂ / MWh	0.5897	Methodological tool ; Baseline , project and/or leakage emissions from electricity consumption and monitoring of electricity generation /06/. The scenario A : Electricity consumption from the grid is chosen scenario in this case. PP has chosen the published combined grid emission actor values from Thailand Greenhouse Gas Management Organization. The data chosen is for the year 2012 to 2014 /34/. This approach is in line with the condition identified in clause 19 : option A1 of the methodological tool and accepted by RINA.

Parameters Monitored Ex-post

The ex-post parameters that are mentioned in the methodology are included in the VCS-PD and are provided in compliance with the methodology, and they will be monitored during the crediting period:

	Parameter	Description/Assessment																			
1	$F_{PJ,dig,m}$ (m ³ /month)	Quantity of wastewater that is treated in the anaerobic digester in the project activity in month <i>m</i> . Value: <table><tr><td>01-Jan-14 to 31-Dec-14</td><td>425,335 /36/</td></tr><tr><td>01-Jan-15 to 30-Sep-15</td><td>145,548 /36/</td></tr></table> Source of data:measured Measuring equipment: waste water flow meters at the inlets of UASB1 and 2. <table><tr><th>Instrument Se.No</th><th>Type/model</th><th>Accuracy</th><th>Calibration date</th><th>Frequency calibration</th></tr><tr><td>FM3/6B00 EB20000</td><td>Endress+Hauser-Promag</td><td>0.5%</td><td>07/12/2012 09/05/2014 /09/</td><td>Once every 3 years</td></tr><tr><td>FM5/6B00 E920000</td><td>Endress+Hauser-Promag</td><td>0.5%</td><td>07/12/2012 09/05/2014 /09/</td><td>Once every 3 years</td></tr></table> Measuring frequency: Measured continuously by flow meters installed at the inlet of UASB no.1 and 2 and recorded daily in log books. Flow meters will undergo maintenance / calibration subject to appropriate industry standards, at least once every 3 years. The approach used in the project activity is consistent with the methodology applied /05/, hence accepted.	01-Jan-14 to 31-Dec-14	425,335 /36/	01-Jan-15 to 30-Sep-15	145,548 /36/	Instrument Se.No	Type/model	Accuracy	Calibration date	Frequency calibration	FM3/6B00 EB20000	Endress+Hauser-Promag	0.5%	07/12/2012 09/05/2014 /09/	Once every 3 years	FM5/6B00 E920000	Endress+Hauser-Promag	0.5%	07/12/2012 09/05/2014 /09/	Once every 3 years
		01-Jan-14 to 31-Dec-14	425,335 /36/																		
		01-Jan-15 to 30-Sep-15	145,548 /36/																		
		Instrument Se.No	Type/model	Accuracy	Calibration date	Frequency calibration															
		FM3/6B00 EB20000	Endress+Hauser-Promag	0.5%	07/12/2012 09/05/2014 /09/	Once every 3 years															
FM5/6B00 E920000	Endress+Hauser-Promag	0.5%	07/12/2012 09/05/2014 /09/	Once every 3 years																	
2	$COD_{dig,m}$ (t COD / m ³)	Chemical oxygen demand in the wastewater that is treated in the anaerobic digester in the project activity in month <i>m</i> . Value: <table><tr><td>01-Jan-14 to 31-Dec-14</td><td>0.019 /35/</td></tr><tr><td>01-Jan-15 to 30-Sep-15</td><td>0.021 /35/</td></tr></table> Measuring equipment: spectrophotometer <table><tr><th>Instrument Se.No</th><th>Type/model</th><th>Accuracy</th><th>Calibration date</th><th>Frequency of calibration</th><th>Calibration Entity</th></tr><tr><td>38397/CS</td><td>Tintometer</td><td>3.5%</td><td>24/08/2013 /10/</td><td>Once every 3 years</td><td>Ilab fluid control co ltd</td></tr></table>	01-Jan-14 to 31-Dec-14	0.019 /35/	01-Jan-15 to 30-Sep-15	0.021 /35/	Instrument Se.No	Type/model	Accuracy	Calibration date	Frequency of calibration	Calibration Entity	38397/CS	Tintometer	3.5%	24/08/2013 /10/	Once every 3 years	Ilab fluid control co ltd			
		01-Jan-14 to 31-Dec-14	0.019 /35/																		
		01-Jan-15 to 30-Sep-15	0.021 /35/																		
Instrument Se.No	Type/model	Accuracy	Calibration date	Frequency of calibration	Calibration Entity																
38397/CS	Tintometer	3.5%	24/08/2013 /10/	Once every 3 years	Ilab fluid control co ltd																

		<table><tr><td>14/458 56/CS</td><td>Lovibon : COD Vario MD200</td><td>53/525 ppm COD</td><td>20/08/2 014 /10/</td><td>Once every 3 years</td><td>My Lab Scale</td></tr></table> COD is measured for every 4 hours and recorded in log books. The average values are taken for the daily reports. The COD is measured by means of Spectrophotometer for Colorimetric analysis, USEPA approved for wastewater analysis (standard method 5220 D). The same is accepted as its an international standard 132I. If COD is measured more than once per month, the average value of the measurements is used. The spectrophotometer is calibrated once in every three years, which is as per the previous registered PD. RINA further checked the manufacturer specifications for Lovibond MD 200 /28/, noted that the measurement device require no maintenance.	14/458 56/CS	Lovibon : COD Vario MD200	53/525 ppm COD	20/08/2 014 /10/	Once every 3 years	My Lab Scale																
14/458 56/CS	Lovibon : COD Vario MD200	53/525 ppm COD	20/08/2 014 /10/	Once every 3 years	My Lab Scale																			
3	T _{2,m} (K)	Average temperature at the project site in month <i>m</i>. Value: <table><tr><td>01-Jan-14 to 31-Dec-14</td><td>298.05 /37/</td></tr><tr><td>01-Jan-15 to 30-Sep-15</td><td>300.05 /37/</td></tr></table> Taken as per the” National published report”; the monthly average temperature of Nakornratchasima province /18/. The same was accepted. Monitored continuously, aggregated in monthly average values	01-Jan-14 to 31-Dec-14	298.05 /37/	01-Jan-15 to 30-Sep-15	300.05 /37/																		
01-Jan-14 to 31-Dec-14	298.05 /37/																							
01-Jan-15 to 30-Sep-15	300.05 /37/																							
4	HG _{PJ,y} (GJ/year)	Net quantity of heat generated in year <i>y</i> with biogas from the new anaerobic digester. Value: <table><tr><td>01-Jan-14 to 31-Dec-14</td><td>95,965.28</td></tr><tr><td>01-Jan-15 to 30-Sep-15</td><td>57,326.30</td></tr></table> Measuring equipment: The biogas flow meters are installed at the outlet of gas storage , before entering blower station (GM4,GM5). <table><tr><td>Instrument Se.No</td><td>Type/m odel</td><td>Accura cy</td><td>Calibrat ion date</td><td>Frequ ncy of calibrati on</td><td>Calibrat ion Entity</td></tr><tr><td>AA0831 02000/ GM4</td><td>E+H - Proline 65I</td><td>1.50%</td><td>01/11/2 012 09/05/2 014 /09/</td><td>Once in 3 years</td><td>Endres s+Haus er</td></tr><tr><td>9B09B D02000 /GM5</td><td>E+H - Proline 65I</td><td>1.50%</td><td>01/11/2 012 09/05/2 014 /09/</td><td>Once in 3 years</td><td>Endres s+Haus er</td></tr></table> The value is calculated on the basis of measurement of the	01-Jan-14 to 31-Dec-14	95,965.28	01-Jan-15 to 30-Sep-15	57,326.30	Instrument Se.No	Type/m odel	Accura cy	Calibrat ion date	Frequ ncy of calibrati on	Calibrat ion Entity	AA0831 02000/ GM4	E+H - Proline 65I	1.50%	01/11/2 012 09/05/2 014 /09/	Once in 3 years	Endres s+Haus er	9B09B D02000 /GM5	E+H - Proline 65I	1.50%	01/11/2 012 09/05/2 014 /09/	Once in 3 years	Endres s+Haus er
01-Jan-14 to 31-Dec-14	95,965.28																							
01-Jan-15 to 30-Sep-15	57,326.30																							
Instrument Se.No	Type/m odel	Accura cy	Calibrat ion date	Frequ ncy of calibrati on	Calibrat ion Entity																			
AA0831 02000/ GM4	E+H - Proline 65I	1.50%	01/11/2 012 09/05/2 014 /09/	Once in 3 years	Endres s+Haus er																			
9B09B D02000 /GM5	E+H - Proline 65I	1.50%	01/11/2 012 09/05/2 014 /09/	Once in 3 years	Endres s+Haus er																			

		volume of biogas captured and used for heat generation /38/ multiplied by methane content of biogas , NCV of methane /24/ , and the efficiency of the boiler during the project (i.e. with biogas). The biogas flowmeters of thermal mass type with temperature and pressure measuring for display in Nm³ are installed. Flow meters will undergo maintenance/calibration subject to appropriate industry standards, at least once every 3 years.																						
5	F _{biogas,y} (Nm ³ /yr)	Total amount of biogas collected in the outlet of the new digester in year y. Value: <table><tr><td>01-Jan-14 to 31-Dec-14</td><td>4,865,986 /38/</td></tr><tr><td>01-Jan-15 to 30-Sep-15</td><td>2,799,432 /38/</td></tr></table> Measuring equipment: The biogas flow meters installed at the outlet of biogas from UASB no.1 and 2 (GM1 and GM2). <table><tr><th>Instrum ent Se.No</th><th>Type/m odel</th><th>Accura cy</th><th>Calibrat ion date</th><th>Freque ncy of calibrati on</th><th>Calibrat ion Entity</th></tr><tr><td>C3010 D02000 /GM1</td><td>E+H - Proline 65l</td><td>1.50%</td><td>01/11/2 012 09/05/2 014 07/10/2 015</td><td>Once in 3 years</td><td>Endres s+Haus er</td></tr><tr><td>A90596 02000/ GM2</td><td>E+H - Proline 65l</td><td>1.50%</td><td>01/11/2 012 08/05/2 014 07/10/2 015</td><td>Once in 3 years</td><td>Endres s+Haus er</td></tr></table> The biogas flow meters are installed at the outlet of biogas from UASB no.1 and 2. Parameter monitored continuously but aggregated annually for calculations. Flow meters will undergo maintenance/calibration subject to appropriate industry standards, at least once every 3 years.	01-Jan-14 to 31-Dec-14	4,865,986 /38/	01-Jan-15 to 30-Sep-15	2,799,432 /38/	Instrum ent Se.No	Type/m odel	Accura cy	Calibrat ion date	Freque ncy of calibrati on	Calibrat ion Entity	C3010 D02000 /GM1	E+H - Proline 65l	1.50%	01/11/2 012 09/05/2 014 07/10/2 015	Once in 3 years	Endres s+Haus er	A90596 02000/ GM2	E+H - Proline 65l	1.50%	01/11/2 012 08/05/2 014 07/10/2 015	Once in 3 years	Endres s+Haus er
01-Jan-14 to 31-Dec-14	4,865,986 /38/																							
01-Jan-15 to 30-Sep-15	2,799,432 /38/																							
Instrum ent Se.No	Type/m odel	Accura cy	Calibrat ion date	Freque ncy of calibrati on	Calibrat ion Entity																			
C3010 D02000 /GM1	E+H - Proline 65l	1.50%	01/11/2 012 09/05/2 014 07/10/2 015	Once in 3 years	Endres s+Haus er																			
A90596 02000/ GM2	E+H - Proline 65l	1.50%	01/11/2 012 08/05/2 014 07/10/2 015	Once in 3 years	Endres s+Haus er																			
6	W _{CH4,biogas,y} (kg CH ₄ / m ³)	Concentration of methane in the total biogas supply in the outlet of the new digester. Value: <table><tr><td>01-Jan-14 to 31-Dec-14</td><td>0.37 /42/</td></tr><tr><td>01-Jan-15 to 30-Sept-15</td><td>0.38 /42/</td></tr></table> Measuring equipment: continuous gas analyser <table><tr><th>Instrum ent Se.No</th><th>Type/m odel</th><th>Accura cy</th><th>Calibrat ion date</th><th>Freque ncy of calibrati on</th><th>Calibrat ion Entity</th></tr><tr><td>505</td><td>VISIT 04</td><td>2%</td><td>19/12/2 012 /10/</td><td>Once in 3 years</td><td>Thai Steam service and</td></tr></table>	01-Jan-14 to 31-Dec-14	0.37 /42/	01-Jan-15 to 30-Sept-15	0.38 /42/	Instrum ent Se.No	Type/m odel	Accura cy	Calibrat ion date	Freque ncy of calibrati on	Calibrat ion Entity	505	VISIT 04	2%	19/12/2 012 /10/	Once in 3 years	Thai Steam service and						
01-Jan-14 to 31-Dec-14	0.37 /42/																							
01-Jan-15 to 30-Sept-15	0.38 /42/																							
Instrum ent Se.No	Type/m odel	Accura cy	Calibrat ion date	Freque ncy of calibrati on	Calibrat ion Entity																			
505	VISIT 04	2%	19/12/2 012 /10/	Once in 3 years	Thai Steam service and																			

							supply Co Ltd																
		3.3511 95.2	ABB - EL 3040	1%	09/05/2 014 and 19/09/2 015 /10/	Once in 3 years	Sysprof es																
		3.2413 76.5	ABB - EL 1020	1%	19/09/2 015 /10/	Once in 3 years	Sysprof es																
		3.3516 39.4	ABB- EL3040	1%	19/09/2 015 /10/	Once in 3 years	Sysprof es																
		The values are recorded daily in log books and average values are taken monthly and then yearly. Is measured by means of calibrated continuous gas analyzer or alternatively with periodical measurement at 95% confidence level. Gas analyzer will undergo maintenance/calibration subject to appropriate industry standards, at least once every 3 years.																					
7	V _{RG,y} (Nm ³ /yr)	Volumetric flow of the residual gas on a dry basis at reference conditions. Measured by means of the biogas flow meters installed at the flare. Value: <table><tr><td>01-Jan-14 to 31-Dec-14</td><td>0</td></tr><tr><td>01-Jan-15 to 30-Sep-15</td><td>0</td></tr></table> Measuring equipment: The biogas flow meters are installed at the flare (GM6). <table><tr><td>Instrum ent Se.No</td><td>Type/m odel</td><td>Accu racy</td><td>Calibratio n date</td><td>Frequ ncy of calibrati on</td><td>Calibrat ion Entity</td></tr><tr><td>H11207 02000/ GM6</td><td>E+H - Proline 65I</td><td>1.50 %</td><td>29/01/201 3 07/10/201 5 /09/</td><td>Once in 3 years</td><td>Endres s + Hauser</td></tr></table> Parameter monitored continuously but aggregated annually for calculations. Flow meters will undergo maintenance/calibration subject to appropriate industry standards, at least once every 3 years.						01-Jan-14 to 31-Dec-14	0	01-Jan-15 to 30-Sep-15	0	Instrum ent Se.No	Type/m odel	Accu racy	Calibratio n date	Frequ ncy of calibrati on	Calibrat ion Entity	H11207 02000/ GM6	E+H - Proline 65I	1.50 %	29/01/201 3 07/10/201 5 /09/	Once in 3 years	Endres s + Hauser
01-Jan-14 to 31-Dec-14	0																						
01-Jan-15 to 30-Sep-15	0																						
Instrum ent Se.No	Type/m odel	Accu racy	Calibratio n date	Frequ ncy of calibrati on	Calibrat ion Entity																		
H11207 02000/ GM6	E+H - Proline 65I	1.50 %	29/01/201 3 07/10/201 5 /09/	Once in 3 years	Endres s + Hauser																		

4.3 Quality of Evidence to Determine GHG Emission Reductions and Removals

During the site visit, RINA checked the correctness of all the documents, required in emission reduction calculations, also referred in the above section.

RINA checked the COD test reports, Quantity of waste water treated from UASB, Biogas generated, biogas sent to the boilers, biogas flared and methane concentration of biogas provided in the ER spread sheets with the plant log books and the same was found to be in order.

During the site visit, it was noted that the biogas generated from the covered lagoons (which is not part of the project boundary) and the UASB are measured from the same flow meters GM4 and GM5. It was also confirmed that there is no flow meter installed at the entrance to boiler since as per the design, the amount of biogas sent from blowers and fired at boilers, should be equal. Thus the biogas produced from UASB (GM1 and GM2) is used for the biogas utilized at boiler and flare without considering the gas produced from the covered lagoons. It was also confirmed that the emissions from the covered lagoons are not included in the ER calculations. The biogas balance check was checked with biogas balance check.xls /40/. Noted that the amount of biogas produced from UASB and CL system is less than the amount of biogas utilized and flared; at 1.42% and 0.49% for 2014 and 2015 respectively. PP (technology provider) has confirmed that these difference percentages can be from the error of the meters. As the calculation is done by using the readings from eight biogas flow meters (GM1, GM2, GM3, GM8, GM4, GM5, GM6 and GM7). These biogas flow meters are the same model, which has the accuracy of 1.5% as per the technical specification defined by manufacturer. The possible maximum error from eight flow meters which can be occurred is $1.5\% \times 8$ or 12%. This was also confirmed by the calibration certificates /09/. Thus, Referring to the VCS standard clause 5.3.1 / 4) The threshold for materiality with respect to the aggregate of errors, omissions and misrepresentations relative to the total reported GHG emission reductions and/or removals shall be five percent for projects and one percent for large projects. Hence the unbalance of biogas produced The difference values of 1.42% and 0.49% is acceptable.

As discussed, above the biogas consumption at each boiler is not measured by means of flow meter. The biogas consumption at each boiler is calculated by means of operational hours of the boilers /41/ into the average consumption of biogas gas, which is determined operation of boilers at full load and records the biogas consumption at each boiler at full load. Further, the biogas consumption at each boiler is added up and the percentage of biogas consumption at each boiler on daily basis is estimated. This percentage value is used in estimating the amount biogas consumed at each boiler using the total biogas measured at GM4 and GM5. The same method was accepted by VCS board in the previous verification.

4.4 Non-Permanence Risk Analysis

The project is non-AFOLU project activity. Hence, not applicable.

5 VERIFICATION CONCLUSION

RINA Service Spa (RINA) has performed verification of the emission reductions reported for the project activity "Wastewater treatment with biogas production (UASB) and heat utilization at General Starch Co. Ltd", in Thailand with VCS project ID 82, for the period 01/01/2014 to 30/09/2015 with regard to the relevant requirements for VCS and CDM activities.

The project participants of the "Wastewater treatment with biogas production (UASB) and heat utilization at General Starch Co. Ltd" project are responsible for:

- The preparation of greenhouse gas emissions data and the reported greenhouse gas emission reductions from the project on the basis set out in the monitoring plan contained in the registered project design document, version 5.0 of 04/07/2016.
- The development and maintenance of records and reporting procedures in accordance with that plan, including the calculation and determination of greenhouse gas emission reductions of the project

It is the responsibility of RINA to express an independent verification opinion about the project's conformity with the requirements of VCSA and on the reported greenhouse gas emission reductions from the project.

Based on documented evidence and corroborated by an on-site assessment RINA can confirm that:

- the project has been implemented and operated as per the registered VCS-PD;
- the monitoring report and other supporting documents provided are complete and verifiable and in accordance with the applicable CDM and VCS requirements;
- the monitoring is in place as per the applied baseline and monitoring methodology;
- the monitoring complies with the monitoring plan in the registered VCS-PD;
- the monitoring plan in the registered VCS-PD is as per the applied baseline and monitoring methodology.

It is RINA's opinion that the GHG emission reduction stated in the monitoring report version 03 of 13/12/2016 for the "Wastewater treatment with biogas production (UASB) and heat utilization at General Starch Co.Ltd" project in Thailand for the period 01/01/2014 to 30/09/2015 are fairly stated. The GHG emission reductions were calculated correctly on the basis of the approved monitoring methodology ACM0014, "treatment of wastewater" version 06.0 of 21/02/2014 and the monitoring plan contained in the registered VCS-PD.

Hence RINA is able to certify that the emission reductions from the project during the monitoring period 01/01/2014 to 30/09/2015 as follows:

01/01/2014 to 31/12/2014: 25, 397 tCO₂e

01/01/2015 to 30/09/2015: 11, 203 tCO₂e

Total: 36,600 tCO₂e.

It is to be noted that during the VCS review of the project for the monitoring period 01/01/2012 to 31/12/2013 /43/, assessment finding was raised on 18/07/2016 and closed on 28/10/2016. The conclusion of the assessment finding required that the project deduct 14,558 tCO₂e from the subsequent monitoring period. In line with the same, 14,558 tCO₂e are deducted from this monitoring period and the same was accepted by RINA.

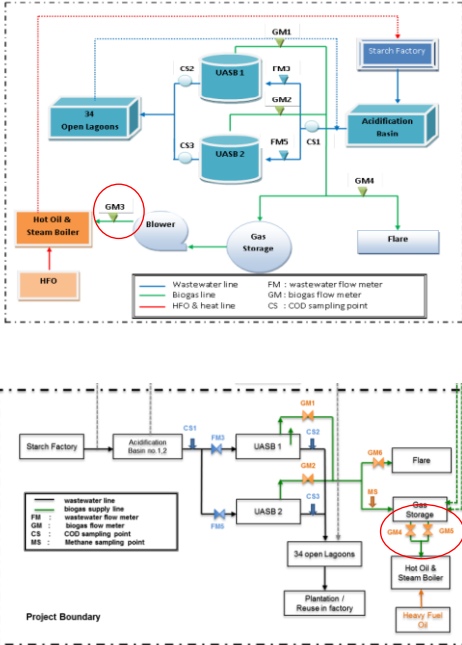
Year	Net GHG emission reductions or removals (tCO ₂ e)
Year 2014	10,839
Year 2015	11,203
Total	22,042

APPENDIX-A: RESOLUTION OF CORRECTIVE ACTION REQUESTS AND CLARIFICATION REQUESTS

Corrective action and/ or clarification requests	Reference to Report	Response by project participants	Verification Conclusion
CL 1 PP is requested to provide evidences for the chronology of events listed in table-1 of the -MR.	4.1	1 st response on 13/12/2016 The memo letters from GSL are provided for the evidences.	PP has provided the the evidences for the chronology of events CL 1 is closed.
CL 2 - In the parameters available ex-ante , the value mentioned for $EF_{EL,default}$ (Default emission factor for the electricity consumed in year y is not consistent with the MR and the PDD renewed for the 2nd crediting period. - It is noted that , during the current monitoring period from 01/01/2014 to 30/09/2015, to measure the COD, two spectrophotometers were used. 1. 38397/CS, calibrated o 24/08/2013, which has got a due date on 23/08/2015 and 2. 14/45856/CS, calibrated on 20/08/2014, which has got a due date on 19/08/2016. The MR is not transparent if the photometer 38397/CS was replaced with 14/45856/CS and the reasons for replacement. Justify the same with evidences.	4.2	1 st response on 13/12/2016 - The $EF_{EL,default}$ in PDD and MR is revised to be 0.5897 , the same value is used in ER calculation , sheet 'Input' , cell 'D15'. - The photometer 38397/CS was broken and replaced by 14/45856/CS on 11/11/2014 , the reference memo is provided.	- It is checked that the MR and Emission Reduction spread sheets have been revised with the value 0.5897, which as per the combined margin emission factor for Grid system in Thailand is calculated and reported by Thailand Greenhouse Gas Management Organization. The same was accepted by RINA. - Checked the reference memom provided by the PP. It is confirmed that photometer S/N 38397/CS for COD analysis could not work properly. The new photometer S/N 14/45856/CS is used for wastewater analysis from 11/11/2014 onwards. The old instrument will be disposed.

Corrective action and/ or clarification requests	Reference to Report	Response by project participants	Verification Conclusion
3. The accuracy of biogas flow meters are not transparent (GM3,4,5,6,7,8,9 and 10). 4. <i>The calibration certificates for GM5 for the biogas flowmeter installed at the outlet of the gas storage, refers to GM3. PP is requested to clarify the same.</i>		3. All GMs are the same type : E+H Proline t-mass 65I. In the technical specification provided by manufacturer , the maximum error of this model is 1.5% of reading for gas. The reference link is provided ¹ , under 'Features and specifications'. Max. measured error Gas: 1.5% o.r. (10 to 100% o.f.s.), 0.15% o.f.s. (1 to 10% o.f.s.) 4. Previously , there was only one flow meter at the outlet of gas storage – GM3. After the installation of CLs with more biogas production , there was modifications at the gas blower piping to separate the discharge into two lines with two flow meters , GM4 and GM5. Thus the ex-GM3 meter is changed to GM5 meter , with another new meter GM4 at the position of the outlet from gas storage. Refer to Table 5 in the MR , the 'grey' is the old meter , the 'blue' is the present meter.	3. The reference link and therevised MR checked and the same is accepted by RINA. 4. RINA accepts the justification provided by the PP. The same was also confirmed during the site visit.

¹ <http://www.th.endress.com/en/Field-instruments-overview/Flow-measurement-product-overview/Product-Thermal-flowmeter-t-mass-65I>

Corrective action and/ or clarification requests	Reference to Report	Response by project participants	Verification Conclusion
5. PP is requested to provide evidences for the cross-check between the amount of biogas sent to boilers and biogas consumed by boilers.		 5. There is no flow meter installed at the entrance to boiler since as per the design, the amount of biogas sent from blowers and fired at boilers, should be equal. Which can be checked by the pressure at the discharge header and destination is maintained the same, to ensure there is no leakage in between. Which is the same design as the previous crediting period. That the biogas produced should be equal to the amount of biogas consumption at boiler and flare, for UASB system without the CLs. In this crediting period, since the biogas	5. The biogas consumption at each boiler is not measured by means of flow meter. The biogas consumption at each boiler is calculated by means of operational hours of the boilers /41/ into the average consumption of biogas gas, which is determined operation of boilers at full load and records the biogas consumption at each boiler at full load. Further, the biogas consumption at each boiler is added up and the percentage of biogas consumption at each boiler on daily basis is estimated. This percentage value is used in estimating the amount biogas consumed at each boiler using the total biogas measured at GM4 and GM5. The same method was

Corrective action and/ or clarification requests	Reference to Report	Response by project participants	Verification Conclusion
		generated from the cover lagoon system is also sent to the same storage , and to the same delivery line to boilers , which is measured by GM4 and GM5. The file 'Biogas Balance Check' is provided as reference. The amount of of biogas produced from UASB and CL system is less than the amount of biogass utilized and flared ; at 1.42% and 0.49% for 2014 and 2015 respectively. These diffence percentages can be from the error of the meters. As the calculation is done by using the readings from eight biogas flow meters (GM1,GM2,GM3,GM8,GM4,GM5,GM6 and GM7). These biogas flow meters are the same model , which has the accuracy of 1.5% as per the technical specification defined by manufacturer. The possible maximum error from eight flow meters which can be occured is $1.5\% \times 8$ or 12%. Referring to the VCS standard² clause 5.3.1 / 4) The threshold for materiality with respect to the aggregate of errors, omissions and misrepresentations relative to the total reported GHG emission reductions and/or removals shall be five percent for projects and one percent for large projects. Hence the unbalance of biogas producesd The difference values of 1.42% and 0.49% is acceptable.	accepted by VCS board in the previous verification. The biogas produced from UASB (GM1 and GM2) is used for the biogas utilized at boiler and flare without considering the gas produced from the covered lagoons. It was also confirmed that the emissions from the covered lagoons are not included in the ER calculations. The biogas balance check was checked with biogas balance check.xls. Noted that the amount of of biogas produced from UASB and CL system is less than the amount of biogass utilized and flared ; at 1.42% and 0.49% for 2014 and 2015 respectively. PP (technology provider) has confirmed that these diffence percentages can be from the error of the meters. As the calculation is done by using the readings from eight biogas flow meters (GM1,GM2,GM3,GM8,GM4,GM5, GM6 and GM7). These biogas flow meters are the same model , which has the accuracy of 1.5% as per the technical specification defined by manufacturer. The possible maximum error from eight flow meters which can be

² http://database.v-c-s.org/sites/vcs.benfredaconsulting.com/files/VCS_Standard_v3.6.pdf

Corrective action and/ or clarification requests	Reference to Report	Response by project participants	Verification Conclusion
6. PP is requested to provide the calibration certificate of methane analyser (type: VISIT04) and also clarify the no. of methane analysers used in the monitoring. It is seen that there are three methane analysers, PP to clarify, which one is for which monitoring parameter as this is not clear from table-3 discussed in the MR. 7. PP is requested to provide calibration certificate of GM6 for the year 2015.		This data is presented and explained in Annex 1 – Table 6 of the revised MR. The difference 6. There are 3 gas analyzers installed at the site; - At Boiler : ABB-EL1020 S/N 3.241376.5 and ABB-EL 3040 S/N 3.351195.2 - At UASB: ABB-EL3040 S/N 3.241376.5 The monitored value is from two gas analyzers at boiler. The old gas analyzer VISIT 04 was replaced by ABB-EL 3040 S/N 3.351195.2 on 9-May-14 , which is installation and calibration date of the new one. 7. The calibration report of GM6 for 2015 is submitted.	occured is 1.5% x 8 or 12%. This was also confirmed by the calibration certificates /09/. 6. The calibration certificate of old gas analyzer VISIT 04 checked. The clarification provided by PP on the methane analysers is accepted by RINA. 7. The calibration certificate of GM6 for 2015, dated 07/10/2015 , calibrated by Endress & Hauser checked and the same is accepted. CL 2 is closed
CL 3 1. PP is requested to provide the ER spread sheets for both the years 2014 and 2015 in a single spread sheet. PP is also requested to provide the COD test reports for the specific monitoring period. 2. PP is requested to clarify on why the	4.3	1st response on 13/12/2016 1. The update ER calculation spread sheet is submitted. The example of COD test reports (excel and log sheet) , one month from 2014 and 2015 for each UASBs , are provided. 2. Please refer to the clarification provided for CL2.4-5 above.	1.The ER spread sheets updated with data for the year 2014 and 2015. 2. Please refer to the justification provided

Corrective action and/ or clarification requests	Reference to Report	Response by project participants	Verification Conclusion
values for GM1 +GM2 are used for GM3+GM4 in the ER calculations, when the measurement devices are separate for generation of biogas and storage of biogas. Further the values are not consistent with the biogas usage at boiler provided in GSL daily report 2014. Same is for the year 2015. 3. Evidences for the amount of sludge applied to the land monitored.		3. There is no sludge removed from UASB , no monitoring record is available.	in point 5 of CL 2 3. There is no sludge removed from the UASB. The same was also confirmed during the site visit by interacting with the techonology provider. CL 3 is closed.



CERTIFICATO DI QUALIFICA PER GLI SCHEMI VOLONTARI*
QUALIFICATION CERTIFICATE FOR VOLUNTARY SCHEMES*

Si attesta che il sig./sig.ra:
We declare that Mr/Mrs/Ms:

Rekha Menon

è qualificato come:
is qualified as:

TEC, VAL, VER, TL, ITRP

per le seguenti aree tecniche:
for the following technical areas:

AREE TECNICHE <i>TECHNICAL AREAS</i>	DESCRIZIONE DELL'AREA TECNICA <i>TECHNICAL AREA DESCRIPTION</i>	SCOPO SETTORIALE <i>SECTORAL SCOPE</i>
1.2	Renewables	1
2.1	Electricity distribution	2
13.1	Solid waste and wastewater	13
13.2	Manure	13
14.1	Afforestation and reforestation	14

REVISIONE <i>REVISION</i>	DATA <i>DATE</i>	MOTIVAZIONI PER LA REVISIONE <i>REASON FOR THE REVISION</i>
0	19/07/2016	First issue with new template (this certificate is linked to CDM qualification)

Responsabile di schema
Scheme Leader
 Rita Valeroso

*SCHEMI VOLONTARI/ VOLUNTARY SCHEMES: ACR American Carbon Registry, CCB The Climate, Community & Biodiversity Alliance, GS Gold Standard, JI Joint Implementation, SCS Social Carbon Standard, VCS Verified Carbon Standard.

TEC: Technical expert; VAL: Validator; VER: Verifier; TL: Team leader; FIN EXP: Financial Expert; ITRP: Independent technical reviewer

RINA Services S.p.A. è accreditato/riconosciuto da
RINA Services S.p.A. is accredited /recognized by

UNFCCC	quale Entità Operativa Designata (DOE), per condurre la Validazione e la Verifica di Progetti CDM <i>as Designated Operational Entity (DOE), to carry out Validation and Verification of CDM Projects</i>
VCSA	per condurre la Validazione e la Verifica di Progetti VCS <i>to carry out Validation and Verification of VCS Projects</i>
GS Foundation	per condurre la Validazione e la Verifica di Progetti GS <i>to carry out Validation and Verification of GS Projects</i>
Ecologica Institute	per condurre la Validazione e la Verifica di rapporti SCS <i>to carry out Validation and Verification of SCS Reports</i>
American Carbon Registry ACR	per condurre la Validazione e la Verifica di Progetti ACR <i>to carry out Validation and Verification of ACR projects</i>
The Climate, Community & Biodiversity Alliance CCB	per condurre la Validazione e la Verifica di Progetti co-benefit CCB <i>to carry out Validation and Verification of co-benefit CCB projects</i>



CERTIFICATO DI QUALIFICA PER GLI SCHEMI VOLONTARI*
QUALIFICATION CERTIFICATE FOR VOLUNTARY SCHEMES*

Si attesta che il sig./sig.ra:
 We declare that Mr/Mrs/Ms:

Cyril Augustus Arokiasamy Amalorpavanathan

è qualificato come:
 is qualified as:

TEC, VAL, VER, TL

per le seguenti aree tecniche:
 for the following technical areas:

AREE TECNICHE TECHNICAL AREAS	DESCRIZIONE DELL'AREA TECNICA TECHNICAL AREA DESCRIPTION	SCOPO SETTORIALE SECTORAL SCOPE
1.1	Thermal energy generation	1
1.2	Renewables	1
3.1	Energy Demand	3
5.1	Chemical industry	5
13.1	Solid Waste and wastewater	13

REVISIONE REVISION	DATA DATE	MOTIVAZIONI PER LA REVISIONE REASON FOR THE REVISION
0	19/07/2016	First issue with new template (this certificate is linked to CDM qualification)

Responsabile di schema
 Scheme Leader
 Rita Valoroso

*SCHEMI VOLONTARI/ VOLUNTARY SCHEMES: ACR American Carbon Registry, CCB The Climate, Community & Biodiversity Alliance, GS Gold Standard, JI Joint Implementation, SCS Social Carbon Standard, VCS Verified Carbon Standard.

TEC: Technical expert; VAL: Validator; VER: Verifier; TL: Team leader; FIN EXP: Financial Expert; ITRP: Independent technical reviewer

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UNFCCC	quale Entità Operativa Designata (DOE), per condurre la Validazione e la Verifica di Progetti CDM as Designated Operational Entity (DOE), to carry out Validation and Verification of CDM Projects
VCSA	per condurre la Validazione e la Verifica di Progetti VCS to carry out Validation and Verification of VCS Projects
GS Foundation	per condurre la Validazione e la Verifica di Progetti GS to carry out Validation and Verification of GS Projects
Ecologica Institute	per condurre la Validazione e la Verifica di rapporti SCS to carry out Validation and Verification of SCS Reports
American Carbon Registry ACR	per condurre la Validazione e la Verifica di Progetti ACR to carry out Validation and Verification of ACR projects
The Climate, Community & Biodiversity Alliance CCB	per condurre la Validazione e la Verifica di Progetti co-benefit CCB to carry out Validation and Verification of co-benefit CCB projects

**CERTIFICATO DI QUALIFICA PER GLI SCHEMI VOLONTARI***
QUALIFICATION CERTIFICATE FOR VOLUNTARY SCHEMES*

Si attesta che il sig./sig.ra:
We declare that Mr/Mrs/Ms:

Hui Feng Liu

è qualificato come:
is qualified as:

TEC, VAL, VER, TL, ITRP

per le seguenti aree tecniche:
for the following technical areas:

AREE TECNICHE TECHNICAL AREAS	DESCRIZIONE DELL'AREA TECNICA TECHNICAL AREA DESCRIPTION	SCOPO SETTORIALE SECTORAL SCOPE
1.1	Thermal energy generation	1
1.2	Renewables	1
8.1	Mining and mineral processes	8
9.2	Iron, steel and Ferro alloy production	9
13.1	Solid waste and wastewater	13

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