Validation report form for renewal of crediting period for CDM project activities

(Version 03.0)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title and UNFCCC reference number of the project activity	Blue Fire Bio wastewater treatment and biogas utilization project Ref no: 4219
Number and duration of the next crediting period	Second crediting period: 09/04/2018 - 08/04/2025
Version number of the validation report	1.0Aa
Completion date of the validation report	25/12/2019
Version number of PDD to which this report applies	02
Project participants	Blue Fire Bio Co. Ltd. South Pole Carbon Asset Management Ltd.
Host Party	Thailand
Applied methodologies and standardized baselines	AMS-III.H", "Methane recovery in wastewater treatment", version 19 of 14/06/2019 AMS-I.D", "Grid connected renewable electricity generation", version 18 of 28/11/2014
Mandatory sectoral scopes	1. Energy industries (renewable/non-renewable) 13. waste handling and disposal
Conditional sectoral scopes, if applicable	N/A
Estimated amount of annual average GHG emission reductions or GHG removals by sinks in the next crediting period	59,898 tCO_2e
Name and UNFCCC reference number of the DOE	RINA SERVICES SPA E-0037
Name, position and signature of the approver of the validation report	**Laura Severino** (Authorized officer signing for the DOE) Head of Certification Innovation & Sustainability Unit 

SECTION A. Executive summary

>> The proposed project is implemented by Blue Fire Bio Co.,Ltd at the Chaodee Starch (2004) facility in the northeast of Thailand with a total wastewater flow-rate of 5,780 m^3/day and an average COD concentration of 12,000 mg/l. Prior to the implementation of the project, the wastewater was treated by an open lagoon system, consisting of six anaerobic ponds all with a depth of over 4 metres. After the lagoons, the wastewater was re-used for starch cleaning. There was no discharge. Heavy fuel oil was used in boiler for heating purposes and electricity was provided by the grid.
The purpose of the project activity is to extract methane (biogas) from the wastewater stream through the biogas reactors and reuse of biogas as fuel in existing thermal boiler within the plant for starch drying and for power generation. The project planned to install 3.128 MWel gas engines for power generation. However, so far the project has installed 1.128 MWel gas engines and the remaining capacity will be installed based on the performance of biogas system. The generated power after in house application shall be exported to grid. The project is located in Chaodee Starch factory, in Dan Khun Tot district, Nakhorn Ratchasima, Korat, Thailand. It is situated at about 250 km north of Bangkok, in the Northeast of Thailand.

Scope of validation:

The objective of the Validation is to have an independent evaluation of the update PDD's compliance with relevant UNFCCC requirements and host Party criteria to confirm that the original project baseline is still valid or has been updated taking into account of new data where applicable. In particular, the project's baseline, monitoring plan and the project's compliance with relevant UNFCCC requirements and host Party criteria are validated in order to confirm the correctness of the application of the approved baseline methodologies for the determination of the continued validity of the baseline/or its update, and estimation of the emission reductions for the applicable crediting period. The validation scope is to review the updated PDD against the UNFCCC criteria for CDM. UNFCCC criteria for CDM refer to Article 12 of the Kyoto Protocol, the CDM modalities and procedures, the simplified modalities and procedures for small-scale CDM project activities and the subsequent decisions by the CDM Executive Board.

Validation process:

This report summarizes the findings from the validation of the updated PDD of the project, performed on the basis of UNFCCC criteria for CDM, as well as criteria given by the CDM Validation and Verification Standard, CDM Project Cycle Procedure and CDM Project Standard and included an assessment of: (a) The impact of new relevant national and/or sectoral policies and circumstances on the baseline taking into account relevant guidance from the Board with regard to renewal of the crediting period at the time of requesting renewal of crediting period; (b) The correctness of the application of an approved baseline methodology for the determination of the continued validity of the baseline or its update, and the estimation of emission reductions from the applicable crediting period. This validation opinion is also to be seen in conjunction with the validation report at the time of requesting registration for the first crediting period. The Validation Opinion 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 project design.

Conclusion:

RINA, commissioned by South Pole Carbon Asset Management Ltd., has performed the validation for renewal of the crediting period for the registered project activity "Blue Fire Bio wastewater treatment and biogas utilization project " in Thailand. 00 CARs and 05 CLs were raised during the validation. The same has been successfully closed and the information is provided in Appendix-4

of the report. In conclusion, it is RINA's opinion that the project meets all the relevant requirements for the renewal of the crediting period.

SECTION B. Validation team, technical reviewer and approver

B.1. Validation 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/document review	On-site inspection	Interview(s)	Validation findings
1.	Team Leader , Validator and Technical Expert	IR	Menon	Rekha	RINA India	☑	☑	☑	☑
2	Technical Expert	IR	Arokiasamy	Cyril Augustus	RINA India	☑	☑	☑	☑

B.2. Technical reviewer and approver of the validation report for RCP

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	Liu	Huifeng	RINA China
2	Approver	IR	Severino	Laura	RINA HQ

SECTION C. Means of validation

C.1. Desk/document review

The updated PDD, version 1.0 of 12/10/2017 and version 2.0 of 28/11/2019 /02/, in particular the applicability of the methodology, the baseline determination, the emission reduction calculations provided in the form of a spreadsheet "BFB_ER calculation_renewed_v.1.xlsx" version 1 of 28/11/2017 and ER spread sheets in the form of (147_BFB WWT_2ndCP_ER calculation_v2_09122019.xlsx), version 02 of 09/12/2019 /10/, and the documents listed in the Appendix 3 below, were reviewed during the validation.

C.2. On-site inspection

Duration of on-site inspection: 28/11/2017 to 28/11/2017				
No.	**Activity performed on-site**	**Site location**	**Date**	**Team member**
1.	Implementation and operation of the proposed project activity; Validity of baseline scenario Changes in national and sectoral policies Interviewed key personnel of the plant to confirm the operational and data collection procedures; QA QC procedures	Chaodee Starch factory, in Dan Khun Tot district, Nakhorn Ratchasima, Korat, Thailand	28/11/2017	Rekha Menon and Cyril Augustus Arokiasamy

C.3. Interviews

No.	**Interviewee**			**Date**	**Subject**	**Team member**
	Last name	**First name**	**Affiliation**			
1.	Rukwongtrakool	Suwipa	Project Manager, South Pole Group	28/11/2017	PDD CERs calculation Methodology applicability Monitoring, QA/QC procedures	Rekha Menon and Cyril Augustus Arokiasamy
2	Tangpairojwong	Wannasak	Plant Manager, Blue fire Bio	28/11/2017	Project installed equipment; monitoring; calibration; environmental license ; QA/QC procedures	Rekha Menon and Cyril Augustus Arokiasamy
3	Loyma	Kajohn	Farmer	28/11/2017	Sustainability parameters, stakeholder consultation, Grievance mechanism	Rekha Menon

C.4. Sampling approach

>> N/A

C.5. Clarification requests (CLs), corrective action requests (CARs) and forward action requests (FARs) raised

Area of validation findings	**No. of CL**	**No. of CAR**	**No. of FAR**
Compliance with PDD form			
Application and selection of methodologies and standardized baselines	1		
Validity of original baseline or its update	1		
Estimated emission reductions or net anthropogenic removals	1		

Validity of monitoring plan	1		
Crediting period	1		
Project participants			
Post-registration changes			
Others (please specify)			
Total	05		

SECTION D. Validation findings

D.1. Compliance with PDD form

Means of validation	PDD applies the applicable CDM-PDD-FORM: CDM Project design document form for CDM project activities version 11 and complies with the "Instructions for filling out the project design document form for CDM project activities"/41/. The validation team verified that for the renewal crediting period, information transferred to the later valid version of the PDD form is materially the same as that in the registered PDD and the sections of the PDD relating to the baseline, estimated GHG emission reductions, monitoring plan and crediting period have been updtaed in accordance with relevant requirements of the CDM Project Standard /03/ .
Findings	No CAR/CL has been raised
Conclusion	RINA confirms that the PDD is based on the currently valid CDM-PDD-FORM template version 11 and is completed in accordance with the "Instructions for filling out the project design document form for CDM project activities" /41/

D.2. Application and selection of methodologies and standardized baselines

Means of validation	The project was originally registered based the methodology "AMS-III.H Methane Recovery in Wastewater Treatment", version 13 of 17/07/2009 , AMS-I.C, "Thermal energy production with or without electricity", version 16 of 04/12/2009 and "AMS-I.D "Grid connected renewable electricity generation", version 15 of 16/10/2009. As available in the registered PDD /01/ and as verified during the onsite visit, the project boundary is defined as the physical, geographical site where the wastewater and sludge treatment takes place and the site where the renewable energy generation is located /01//02/ The project replaces the existing wastewater treatment practice (open lagoon system) and thus avoids the release of methane into the atmosphere that results from the anaerobic digestion of the organic content in the wastewater treated in the lagoon system. The proposed project entails the installation of two sets of upflow anaerobic sludge blanket technology (UASB) biogas reactors and 3.128MWel gas engines at an existing starch factory in Thailand for: a) the extraction of methane (biogas) from the wastewater stream through the biogas reactors; b) the reuse of biogas as fuel in existing thermal boiler within the plant for starch drying; and c) the reuse of biogas as fuel for power generation. The proposed project is implemented by Blue Fire Bio Co.,Ltd at the Chaodee Starch (2004) facility in the northeast of Thailand with a total wastewater flow-rate of 5,780 m3/day and an average COD concentration of 12,000 mg/l. Therefore, the project activity reduces greenhouse gases due to avoidance of methane emissions from the existing lagoon system and displacement of fossil fuel based electricity from the grid. As confirmed in the registered PDD and verified during the onsite interviews, the project activity is not a debundled component of a large scale project activity /01/. There is no change in the project boundary and in the emission sources and gases that are considered in the emission reduction calculations from the registered PDD /01/ /02/. **RINA verified that the methodology AMS-III.H /06/ is still applicable to the project activity as described below:**

	In the absence of the Project activity the wastewater would have been treated in existing open lagoons, all with depth greater than 2 meters under anaerobic condition without biogas recovery. The project activity involves the installation of a UASB (Up flow Anaerobic Sludge Blanket) system to treat high COD concentration of wastewater generated and to capture biogas. Therefore, the Project activity involves the introduction of a sequential stage of wastewater treatment with biogas recovery and combustion without sludge treatment, to an anaerobic wastewater treatment system without biogas recovery and hence satisfies the requirement of paragraph 2 (f) of the methodology /06/ /02/. The depth of the open anaerobic lagoons is greater than two meters and do not have any aeration /02/. The monthly average ambient temperature in Nakhorn Ratchasima is above 29°C /26/• Sludge removal frequency is more than 30 days. The recovered biogas from the project activity is utilised for thermal energy and generation of electricity through gas engines. The project activity satisfies paragraph 3 a of the applicability criteria, thus the approved baseline and monitoring methodologies AMS-I.C. and AMS-I.D. are used for the thermal and electricity generation components of the project activity. The project involves a capacity increase of the factory, but it doesn't involve a change in equipment resulting in a capacity addition. The second phase of the project is a new installation and it is therefore considered as a Greenfield project. The location of the wastewater treatment plant has been clearly given in section A.2 of the PDD /02/. The starch factory located at the same location is the source of wastewater generation and the same was verified during onsite visit. The project qualifies as a small-scale project activity (SSC) and will remain under the limits of the cap of 60,000 CERs for type III projects during every year of the crediting period. **RINA verified that the methodology AMS-I.D /07/ is still applicable to the project activity as described below:** The project planned to install 3.128 MWel gas engines for power generation. However, so far the project has installed 1.128 MWel gas engines and the remaining capacity will be installed based on the performance of biogas system. The generated power after in house application shall be exported to grid. The project activity uses a part of biogas (a renewable fuel) which is captured from the methane avoidance component of the project activity to generate electricity in the gas engine . The electricity generated will be exported to the Thai national grid /29/, thus displacing the production of power from fossil sources in the EGAT electricity grid. The project activity installed a power plant at a site where there was no renewable energy power plant operating prior to the implementation of the project. The total generation capacity of the plant is 3.128 MW, which is less than 15MW. The project activity is not a co-generation system since it involves only generation of electricity and does not involve retrofit or replacement energy generation unit. The recovered methane is also used for heat generation and thus AMS-I.C is applied and the same has been justified by PP. The project qualifies as a small-scale project activity and will remain under the limits of the 15 MW of installed capacity for type I projects during the crediting period. RINA verified that the methodology AMS-I.C /07/ has been removed from the revised PDD. During the site visit and interactions with the PP it was informed that the project is not able to afford the installation cost of the equipment and monitoring system in order to monitor the required data, i.e. Qflow, Tin and Tout in every minute. In addition, since its registration under CDM, there was only one issuance of the monitoring data and such issued CERs are still available due to the carbon market situation. In term of the investment analysis (IRR) of the registered, it was included the saving due to fuel replacement and expected CER revenue which the ex ante ERs from I.C was around 12% of the total ex ante ERs. As per the actual impletmentation and removal of the mentioned methodology, this is considered as conservative approach and same was accepted by RINA team. The following tools are also described in the applied methodologies:

	"Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (Version 03.0) /19/ "Tool to calculate the emission factor for an electricity system" (Version 07.0) /15/ "Project emissions from flaring" (Version 03.0) /18/ "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 03.0) /16/ "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period", version 03.0.1 of 02/03/2012 /08/ It is checked that the applicability conditions of the methodological tools has been justified in section B.2 of the revised PDD. RINA team checked the same and accepted the justification provided by the PP.
Findings	CL 1 1. PP is requested to provide the operation licence of the biogas plant and the starch unit. 2. Provide the design layout of the baseline lagoons and clarify the no. of baseline lagoons in the baseline. 3. Provide evidences of the ambient temperature of the region, where project is located, evidences of the sludge removal frequency in the baseline. 4. Not clear, if there is an increase in the capacity for the current crediting period. PP is requested to make the same clear in the same. Also the project description to be made transparent with reference to the current crediting period. 5. Provide evidences of the technical specifications of the gas engines involved, UASB, boiler and flare. 6. It is not clear from the project description that, if the generated power after in house consumption is exported to the grid. Also provide the power purchase agreements with the Thai national grid. 7. Provide inspection reports of the boilers. It is further checked that the PP has included the emission reductions accounted for AMS-I.C. PP to clarify , if the AMS-I.C part is covered in the project boundary. 8. The methodological tools are not justified in the PDD. 9. PP is requested to provide the evidences of the production capacity and quantity of waste generated. More information on how the CL is closed is provided in Appendix-4 of the PDD. CL1 is closed.
Conclusion	RINA confirms that the selected baseline and monitoring methodologies have been previously approved by the CDM Executive Board and are applicable to the project, which complies with all the applicability conditions therein the selected versions are valid at the time of submission of the renewal of crediting period. It is also confirmed that the methodologies are correctly applied by comparing them with the actual text of the applicable versions. The validation team confirms that the same is as per para 404 (b) of the CDM VVS for project activities , version 02.0.

D.3. Validity of original baseline or its update

Means of validation	The baseline was assessed according to the tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period, version 03.0.1" /08/. The following steps were assessed: ***Step 1: Assess the validity of the current baseline for the next crediting period*** The validity of the current baseline is assessed using the following Sub-steps: ***Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies***. RINA verified during the onsite that there are no relevant mandatory national and/or sectoral policies applicable to the project activity that came into effect after the submission of the project activity for validation. Methane avoidance component: RINA verified through the assessment of the local legislation /21/ and other publicly available information /22/ /23/ that the current baseline complies with all relevant mandatory national and/or sectoral policies,

	which have come into effect after the initial crediting period. Electricity generation component: RINA verified through the assessment of the local legislation /24/ and other publicly available information /23/ that the current baseline complies with all relevant mandatory national and/or sectoral policies, which have come into effect after the initial crediting period. **Step 1.2: Assess the impact of circumstances** RINA verified that there are no new relevant national and/or sectoral policies and/or circumstances that affect the baseline scenario; therefore, there is no impact in the project activity and baseline scenario. RINA verified that the Thai Grid is primarily fed by fossil fuel based power plants /17/. **Step 1.3: Assess whether the continuation of the use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which the renewal is requested** As per the assessment of Step 1.1, the project proponent would have used the current baseline in absence of the project implementation as there is no requirements enforce change or modification of the current baselines. Hence it is verified that continuation of the use of current baseline equipment(s) is the most likely scenario for the crediting period for which the renewal is requested. It is further checked that the baseline equipments can still be operational for the next 10 /35/. **Step 1.4: Assessment of the validity of the data and parameters** The baseline emissions of the project activity were updated considering the last version of the methodologies, related applicable tools and IPCC values. The GWP of methane has been updated based on IPCC default values for the 2nd crediting period. Further the combined grid emission factor is also updated based on the recent study by Thai DNA. methodologies, related applicable tools , latest emission factor and IPCC values. **Step 2: Update the current baseline and the data and parameters** **Step 2.1: Update the current baseline** The baseline emissions for the second crediting period have been updated, without reassessing the baseline scenario, based on the latest approved version of the methodologies AMS-III.H /06/ and AMS-I.D /07/. **Step 2.2: Update the data and parameters** The data and/or parameter(s) for the second crediting period were updated. The assessment is described below. As per the result of assessment in Step 1.4 above, all applicable data and parameters for the second crediting period are updated based on the latest version of the methodologies applied in the project activity. The same was confirmed from B.6 and B.7 for the updated data and parameters for the second crediting periodthe second crediting period were updated. The assessment is described below.
Findings	CL 2 1. In the section validity of the original baseline, the PD is not transparent thermal component. PP is requested to refer and provide the relevant laws of the same. 2. “In the situation where the baseline scenario identified at the validation of the project activity was the continuation of the current practice without any investment, an assessment of the changes in market characteristics is required for the renewal of the crediting period. The same is not

	transparent in the PDD. 3. The para "Assess whether the remaining technical lifetime of the equipment that would have continued to be used in the absence of the project activity, as determined in the CDM-PDD or CDM-PDD-REN, exceeds the crediting period for which renewal is requested" is not justified. 4. Not clear on the data and parameters that were only determined at the start of the crediting period and not monitored during the crediting period are still valid or whether they should be updated.
Conclusion	RINA verified that the baseline was assessed according to the tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period, version 03.0.1" /08/. The current project baseline is still valid at the renewal crediting period. The validation team confirms that the same is as per para 404 of the CDM VVS for project activities , version 02.0.

D.4. Estimated emission reductions or net anthropogenic removals

Means of validation

The approved baseline and monitoring methodologies "AMS-III.H", "Methane recovery in wastewater treatment" version 19 of 14/06/2019 /06/ , "AMS-I.D", "Grid connected renewable electricity generation" version 18 of 28/11/2014 /07/ have been applied.

The following parameters are presented in the updated PDD:

	Data/parameter	Unit	Value applied	
1	GWP_{CH4} : Global Warming Potential for methane	tCO_{2e}/tCH_4	25	As per Annex 3, EB 69, following decision 4/CMP.7 the GWP of CH_4 for the second commitment period (from 01/01/2013) is applied /14/ /04/
2	$B_{o,ww}$: Methane producing capacity of the wastewater	kg CH_4/kg COD	0.25	Value applied in accordance with the applied methodology AMS-III.H /06/, hence accepted.
3	UF_{BL}: Model correction factor to account of model uncertainties	-	0.89	Value applied in accordance with the applied methodology AMS-III.H /06/, hence accepted.
4	UF_{PJ}: Model correction factor to account of model uncertainties.	-	1.12	Value applied in accordance with the applied methodology AMS-III.H /06/, hence accepted.
5	$MCF_{ww, treatment,BL,i}$: Methane correction factor for the baseline anaerobic wastewater treatment systems	-	0.8	The baseline anaerobic lagoons are more than 2 meters deep /27/. Corresponding value from the methodology AMS-III.H applied /06/, hence accepted.
6	$MCF_{ww, treatment,PJ,k}$: Methane correction	-	0.8	Post treatment of wastewater treatment system without biogas recovery consists of a succession of lagoons, with

		factor for project wastewater treatment system k			depth greater than 2 metres /27/. Corresponding value from the methodology AMS-III.H applied /06/, hence accepted.
	7	***CFE$_{ww}$:*** Capture efficiency of the biogas recovery equipment in the wastewater Treatment systems	-	0.9	Value applied in accordance with the applied methodology AMS-III.H /06/, hence accepted.
	8	***$\eta_{COD,BL,i}$:*** COD removal efficiency of the baseline system i	%	88.73	The COD removal efficiency value is based on COD campaign data multiplied by a factor of 0.89 to account of uncertainty range due to data from the campaign measurement in the baseline plant. This is in line with the AMS-III.H /06/ given in paragraph 37 (b) which requires a measurement campaign in the baseline wastewater systems for at least 10 days. Value applied is consistent with the registered PDD /01/ for the first crediting period, accepted since there is no change in the treatment system /27/ or in the COD load handled /28/.
	9	***EF$_{grid,y}$***: Combined margin CO_2 emission factor for grid connected power generation in year y	tCO_2/MWh	0.5637	Latest information as provided by Thai DNA has been adopted http://ghgreduction.tgo.or.th/download-tver/68-2017-11-28-06-43-22/353-2559.html /17/
	10	**$\rho_{CH4,n}$:** Density of methane gas at reference conditions	kg/m^3	0.716	Sourced from the Methodological tool "Project emission from flaring" /18/, hence accepted.

Baseline emissions:

Baseline emissions for methane avoidance component:

As per equation 1 of the methodology AMS-III.H /06/:

$BE_y = BE_{elec,y} + BE_{power,y} + BE_{ww,treatment,y} + BE_{s,treatment,y} + BE_{ww,discharge,y} + BE_{s,final,y}$

Where,

	BE_y	=	Baseline emissions in year y (t CO_2e)
	$BE_{elec,y}$	=	Baseline emissions from electricity generation component (t CO_2e)
	$BE_{power,y}$	=	Baseline emissions from electricity or fuel consumption in year y (t CO_2e)
	$BE_{ww,treatment,y}$	=	Baseline emissions of the wastewater treatment systems affected by the project activity in year y (t CO_2e)
	$BE_{s,treatment,y}$	=	Baseline emissions of the sludge treatment systems affected by the project activity in year y (t CO_2e). There is no baseline sludge treatment system /01/. Therefore, this baseline emission source is excluded from further consideration, conservative, hence accepted.
	$BE_{ww,discharge,y}$	=	Baseline methane emissions from degradable organic carbon in treated wastewater discharged into sea/river/lake in year y (tCO_2e). In the baseline treatment system the wastewater is not discharged into a sea/lake/river /01/, therefore this baseline emission source is excluded from further consideration, conservative, hence accepted.
	$BE_{s,final,y}$	=	Baseline methane emissions from anaerobic decay of the final sludge produced in year y (t CO_2e). The baseline treatment system would not have generated any sludge /01/. Therefore, this baseline emission source is excluded from further consideration, conservative, hence accepted.
	$BE_{power,y}$ - The baseline emissions from electricity and fossil fuel consumption are not considered as the electricity consumption of the open anaerobic lagoons in the baseline scenario was very low. Furthermore, it is conservative to neglect this emission source. The baseline emissions from fuel consumption are zero as no fossil fuels have been consumed in the operation of the open anaerobic lagoons in the baseline scenario /02/. Therefore, $BE_{power,y}$ is assumed zero and removed from further consideration.		
	$BE_{ww,treatment,y}$ - are determined using the COD removal efficiency of the baseline plant as per equation 2 of the methodology AMS-III.H /06/: $BE_{ww,treatment,y} = \Sigma_i (Q_{ww,i,y} \times COD_{inflow,i,y} \times \eta_{COD,BL,i} \times MCF_{ww,treatment,BL,i}) \times B_{o,ww} \times UF_{BL} \times GWP_{CH4}$		
	$Q_{ww,i,y}$	=	Volume of wastewater treated in baseline wastewater treatment system i in year y (m3). For ex ante estimation, wastewater generation volume from the technical proposal /26/ is applied. However, the ex-post emissions reduction calculation shall be based on the actual monitored volume of treated wastewater, consistent with the methodology /06/ hence accepted. Value applied 1,849,600 m^3 /01/ /36/.
	$COD_{inflow,i,y}$	=	Chemical oxygen demand of the wastewater inflow to the baseline treatment system i in year y (t/m^3). Obtained from COD campaign data /01/. Value applied is 12000 mg/l /01/ /28/.
	$\eta_{COD,BL,i}$	=	COD removal efficiency of the baseline treatment system i, determined as per the paragraphs 37 b of the applied methodology AMS-III.H.
	$MCF_{ww,treatment,BL,i}$	=	Methane correction factor for baseline wastewater treatment systems I, value applied 0.8; the baseline anaerobic lagoons are more than 2 meters deep /27/. Corresponding value from the methodology AMS-III.H applied /06/, hence accepted.

	i	=	Index for baseline wastewater treatment system
	$B_{o,ww}$	=	Methane producing capacity of the wastewater, IPCC value of 0.25 kg CH_4/kg COD applied. Consistent with the methodology /06/
	UF_{BL}	=	Model correction factor to account for model uncertainties, value applied is 0.89, consistent with the methodology /06/
	GWP_{CH4}	=	Global Warming Potential for methane, value applied 25, As per Annex 3, EB 69, following decision 4/CMP.7 the GWP of CH4 for the second commitment period (from 01/01/2013) is applied /14/.
	$BE_{ww,treatment,y}$ =		= 1,849,600 x 12,000/ 1000000 x 88.73% x 0.8) x 0.25 x 0.89 x 25 = 87,633 tCO_2e

Baseline emission for Electricity generation component:

As per equation 1 of the methodology AMS-I.D /07/:

$$BE_y = EG_{PJ,y} \times EF_{grid,y}$$

Where,

BE_y	=	Baseline emissions in year y (t CO2)
$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh). Value applied based on the efficiency of the gas engine as 10,300 kJ/kWh , 40% biogas used for generation and net calorific value of methane.
$EF_{grid,y}$	=	Combined margin CO2 emission factor for grid connected power generation in year y calculated using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO_2/MWh) /15/. Value applied 0.5637 tCO_2/MWh /17/.

Hence $BE_{elec,y}$ is calculated to be 3,887 tCO_2e

The total baseline emissions is calculated to be 91,520 tCO_2e

Project emissions:

Project emissions for methane avoidance component AMS-III.H /06/:

As per equation 8 of the methodology AMS-III.H /06/:

$$PE_y = \{PE_{power,y} + PE_{ww,treatment,y} + PE_{s,treatment,y} + PE_{ww,discharge,y} + PE_{s,final,y} + PE_{fugitive,y} + PE_{biomass,y} + PE_{flaring,y}\}$$

Where,

PE_y	=	Project activity emissions in the year y (t CO_2e)
$PE_{power,y}$	=	Emissions from electricity or fuel consumption in the year y (tCO_2e).
$PE_{ww,treatment,y}$	=	Methane emissions from wastewater treatment systems

			affected by the project activity, and not equipped with biogas recovery, in year y (t CO2e). Calculated to be 22,057 tCO2e as per equation 2 of the methodology AMS-III.H /06/, with
	$MCF_{ww,treatment,PJ,k}$	=	Methane correction factor for project wastewater treatment system *k,* value applied 0.8; the baseline anaerobic lagoons are more than 2 meters deep /27/. Corresponding value from Table 2 of the methodology AMS-III.H applied /06/, hence accepted.
	$\eta_{,PJ,k,y}$	=	Chemical oxygen demand removal efficiency of the project wastewater treatment system *k* in year *y* (t/m^3), measured based on inflow COD and outflow COD in system *k,* value applied 88.73 /01/.
	UF_{PJ}	=	Uncertainty factor - Project emissions, 1.12 as per the applied methodology AMS-III.H /06/
	$PE_{s,treatment,y}$	=	Methane emissions from sludge treatment systems affected by the project activity, and not equipped with biogas recovery, in year y (t CO_2e). There is no sludge treatment system prior to the implementation of the project activity. Therefore, this parameter is not applicable in the calculations and has been excluded from further consideration /01/.
	$PE_{ww,discharge,y}$	=	Methane emissions from degradable organic carbon in treated wastewater in year y (tCO_2e). In the project activity, the treated wastewater will not be discharged into to a river, sea or lake. Therefore, project emissions from this component have not been included in the assessment /01/
	$PE_{s,final,y}$	=	Methane emissions from anaerobic decay of the final sludge produced in year y (t CO_2e). It is not expected that the project activity will generate significant amount of sludge. The excess sludge may be used for starting up other systems equipped with biogas recovery or for soil application under aerobic conditions. Therefore, considered 0. The final disposal of sludge shall be monitored during the crediting period. In case the application of sludge cannot be monitored, as a conservative measure, it will be assumed that the sludge removed would have decayed in anaerobic manner. The emissions will be accounted as per equation provided in the methodology/06/.
	$PE_{fugitive,y}$	=	Methane emissions from biogas release in capture systems inyear y, calculated as per paragraph 40 of the methodology AMS-III.H /06/ as detailed below (t CO_2e).
	$PE_{flaring,y}$	=	Methane emissions due to incomplete flaring in year y (t CO_2e).
	$PE_{biomass,y}$	=	Methane emissions from biomass stored under anaerobic conditions. There is no biomass storage in the project activity /01/. Therefore, this source of emissions has been excluded from further consideration, consistent with site visit observations, hence accepted.
	$PE_{power,y}$ – Emissions from electricity or fuel consumption :		

Project emissions due to electricity consumption attributed to the project activity, is calculated based on paragraph 26 of the applied methodology AMS-III.H /06/, whereas $PE_{power,y}$ shall be estimated according to the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption", valid version of the this tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"/19/ is used as under:

The *Scenario A: Electricity consumption from the grid* will be applied to the project activity for electricity imported from the grid. The generic approach is used to calculate the project emissions as follows:

$$PE_{power,y} = \sum EC_{PJ,j,y} \times EF_{EL,j,y} \times (1+TDL_{j,y})$$

Where:

$PE_{power,y}$ (tCO_2/yr)	=	Project emissions from electricity consumption in year y
$EC_{PJ,j,y}$	=	Quantity of electricity consumed by the project activity in year y (MWh/yr). Value applied 2691, this is ssuming that all relevant electrical equipments operate at full capacity, plus 10% to account for distribution losses, for 8760h/y. This is as per the registered PDDand since there is no changes in the equioments installed, RINA accepted the justification and value provided by the PP used in the ER calculations.
$EF_{EL,j,y}$	=	Emission factor for electricity generation source j in year y (tCO_2/MWh) Value applied 0.5637 tCO_2/MWh /17/.
$TDL_{j,y}$	=	Average technical transmission and distribution losses for providing electricity to source j in year y. Value applied 6.11% , which is based on the based on most recent report published by World Bank /40/
j	=	Source of electricity consumption in the project

Determination of emission factor for the electricity generation ($EF_{EL,j,y}$)
Option A1 has been used to determine emission factor. This option proposes to calculate the combined margin emission factor of the applicable electricity system, using the procedures in the latest approved version of the "Tool to calculate the emission factor for an electricity system"/15/ ($EF_{EL,j,y} = EF_{grid,CM,y}$).

Determination of average technical transmission and distribution losses
$TDL_{j,y}$ will be taken from the recent data available within the host country, for ex-ante estimations the most recent data published by the WB is used /40/.

Project activity emissions from methane release in capture systems are determined based on the methane emission potential of wastewater and/or sludge as per equation 9 of the methodology AMS-III.H /06/:

$$PE_{fugitive,y} = PE_{fugitive,ww,y} + PE_{fugitive,s,y}$$

where

$PE_{fugitive,ww,y}$	=	Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems in the year y (t CO_2e), estimated as per equation 10 of the methodology AMS-III.H /06/
$PE_{fugitive,s,y}$	=	Fugitive emissions through capture inefficiencies in the anaerobic sludge treatment systems in the year y (t CO2e). There is no anaerobic sludge treatment in the project activity. Therefore, this source of emissions is excluded from further consideration /01/.

$$PE_{fugitive,ww,y} = (1- CFE_{ww}) \times MEP_{ww,treatment,y} \times GWP_{CH4}$$

Where

CFE_{ww} = Capture efficiency of the biogas recovery equipment in the wastewater treatment systems, value applied 0.9, consistent with the methodology AMS-III.H /06/, hence accepted.

$MEP_{ww,treatment,y}$ = Methane emission potential of wastewater treatment systems equipped with biogas recovery system in year y (t), estimated as per equation 11 of the methodology AMS-III.H /06/ as below.

$MEP_{ww,treatment,y} = Q_{ww,y} \times B_{o,ww} \times UF_{PJ} \times \Sigma_k COD_{removed,PJ,k,y} \times MCF_{ww,treatment,PJ,k}$

where

$COD_{removed,PJ,k,y}$ = The chemical oxygen demand removed by the treatment system k of the project activity equipped with biogas recovery in the year y (t/m^3)

$MCF_{ww,treatment,PJ,k}$ = Methane correction factor for the project wastewater treatment system k equipped with biogas recovery equipment, value applied 0.8, Post treatment of wastewater treatment system without biogas recovery consists of a succession of lagoons, with depth greater than 2 meters /27/. Corresponding value from Table 2 of the methodology AMS-III.H applied /06/, hence accepted.

UF_{PJ} = Model correction factor to account for model uncertainties, value applied 1.12, in accordance with the applied methodology AMS-III.H /06/, hence accepted.

Hence $PE_{fugitive,y=} PE_{fugitive,ww,y}$ is calculated to be 7,955 tCO_2e.

$PE_{flaring,y}$ - Methane emissions due to incomplete flaring:
The calculation procedures provided below determine 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 flare ($F_{CH4,RG,m}$). The flare efficiency is determined for each minute *m* of year *y* based either on monitored data or default values.

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

Step 1: Determination of the methane mass flow in the residual gas
This step determines the mass flow of methane ($F_{CH4,m}$) as kg unit in the residue gaseous stream in the minute *m* as per the guidance given in the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"/16/.

$F_{CH4,RGm}$, 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* ($F_{CH4,RG,m}$). $F_{CH4,m}$ shall be determined on a dry basis. Therefore, the measurement option A as per the Table 2 of the tool is selected to determine the volume flow and the volumetric fraction of the residue gaseous stream on the dry basis. The temperature of the gaseous stream (T_t) is less than 60 deg C at the flow measurement point. Therefore as per Option A (b), the gaseous stream is considered dry.

$F_{CH4,m}$ is determined as following equation;

$F_{CH4,m} = V_{m,db} \times v_{CH4,m,db} \times \rho_{CH4,m}$

Where:

$F_{CH4,m}$ = Mass flow of greenhouse gas CH_4 in the residual gaseous stream in the minute m (kg gas/m)

	$V_{m,db}$ = Volumetric flow of the residual gaseous stream in minute m on dry basis (Nm^3 dry gas/m) $v_{CH4,m,db}$ = Volumetric fraction of the greenhouse gas CH_4 in the gaseous stream in minute m on dry basis (%) $\rho_{CH4,m}$ = Density of greenhouse gas CH_4 in the gaseous stream in minute m (0.716 kg/m^3) at reference conditions *Step 2: Determination of flare efficiency* The open flare is used in the project activity. As per the tool of project emission from flaring, 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 (Flarem), otherwise 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 residue gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follow: $$PE_{flare,y} = GWP_{CH4} * \sum_{m=1}^{525600} F_{CH4,RG,m} * (1 - \eta_{flare,m}) * 10^{-3}$$ where: $PE_{flare,y}$ = Project emissions from flaring of the residual gas in year *y* (tCO_2e) GWP_{CH4} = Global warming potential of methane valid for the commitment period (tCO_2e/tCH_4) $F_{CH4,RG,m}$ = Mass flow of methane in the residue gas in the minute *m* (kg) $\eta_{flare,m}$ = Flare efficiency in minute m For ex-ante estimation, there is no biogas expected to be flared as this would happen only in the case of emergencies or surplus. **Project emission for Electricity generation component: (AMS-I.D) /07/:** As per AMS-I.D, paragraph 39, for the most renewable energy project activity, PEy = 0. The project emission under AMS-I.D are considered zero, since the emissions from electricity consumption are already accounted in AMS-III.H component ($PE_{power,y}$) and only the net electricity exported is accounted for emission reduction calculations. **The total project emissions is calculated to be 31,622 tCO_2e** **Leakage emissions (LE_y)** The project activity is not using equipment transferred from another activity; therefore there is no leakage to be considered, hence accepted. **Emission reduction:** **Emission reduction calculation for the methane avoidance component AMS-III.H /06/:** Emission reductions shall be estimated ex ante as per equation 14 of the methodology: $ER_{y,ex,ante} = ER_{y,ex,ante} - (PE_{y,\ ex\ ante} + LE_{y,\ ex\ ante})$ Where $ER_{y,ex,ante}$ = Ex ante emission reduction in year y ($t\ CO_2e$) $LE_{y,\ ex\ ante}$ = Ex ante leakage emissions in year y ($t\ CO_2e$) $PE_{y,\ ex\ ante}$ = Ex ante project emissions in year y calculated as above (tCO_2e) $BE_{y,\ ex\ ante}$ = Ex ante baseline emissions in year y calculated as

	calculated above (t CO_2e) Hence the emission reductions are calculated to be 59,898 tCO_2e Emission reductions shall be estimated ex post as per equation 15 of the methodology: $ER_{y,ex,post} = min\ ((BE_{y,\ ex\ post} - PE_{y,\ ex\ post} - LE_{y,expost}),\ (MD_{y,} - PE_{power,y} - PE_{biomass,y} - LE_{y,expost}))$ where $ER_{y,ex,post}$ = Emission reductions achieved by the project activity based on monitored values for year y (t CO2e) $BE_{y,\ ex\ post}$ = Baseline emissions calculated as per ex post monitored values (t CO2e) $PE_{y,\ ex\ post}$ = Project emissions calculated as per ex post monitored values (tCO2e) $MD_{y,}$ = Methane captured and destroyed/gainfully used by the project activity in the year y (t CO2e), calculated as per equation 16 of the methodology AMS-III.H /06/ as below. $MD_{y,} = BG_{burnt,y} \times W_{CH4,y} \times D_{CH4} \times FE \times GWP_{CH4}$ $BG_{burnt,y}$ = Biogas flared/combusted in year y (m^3) $W_{CH4,y}$ = Methane content of the biogas in the year y (volume fraction) D_{CH4} = Density of methane at the temperature and pressure of the biogas in the year y (t/m^3) FE = Flare efficiency in year y (fraction). If the biogas is combusted for gainful purposes, e.g. fed to an engine, an efficiency of 100 per cent may be applied **Emission reduction calculation for the Electricity generation component: (AMS-I.D) /07/:** $ER_y = BE_y - PE_y - LE_y$ Where ER_y = Emission reductions in year y (t CO_2) BE_y = Baseline Emissions in year y (t CO_2) PE_y = Project emissions in year y (t CO_2) LE_y = Leakage emissions in year y (t CO_2) As detailed above, since PE_y and LE_y are Zero, $ER_y = BE_y$
Findings	CL 3 1. Please justify, if the COD removal efficiency of the baseline system I is as per para 38, 39 or 40 of the methodology AMS-III.H. 2. Specific heat of oil: The reference provided doesn't work. Further provide more justification on value used. 3. Efficiency of thermal oil boiler: Pls provide the evidence for the value choosen. Efficiency to be determined based on the "Tool to determine baseline efficiency of thermal and electricity systems" 4. Net calorific value of heavy fuel oil: Pls provide the exact reference. Should be based on para 39 or 40 of the methodology. 5. Density of fossil fuel: The weblink doesn't open to the exact page. Also it shows thai lang. 6. Density of fluid used for heating purposes: The reference link provided doesn't open. 7. PP to clarify on why flare related parameters are not included in parameters available at validation.

	8. Evidences on the quantity of waste water , COD inflow, historical consumptions of HFO, 9. Clarify if , Is it EFHFO or EFFF? Cause in monitoring parameters it states EFHFO. 10. The Formula used in the calculation of EGthermal, provide the reference for the same. 11. $EG_{PJ,y}$ is 5,794 MWh, provide justification on the calculation and reference for the same. 12. PP to clarify if the grid emission factor is calculated as per the "Tool to calculate the emission factor for an electricity system (version 05.0) paragraph 84 (b), which requires to apply WOM = 0.25 and WBM = 0.75 for the second crediting period. 13. Evidences for $\eta_{,PJ,k,y.}$ 14. How is $EC_{PJ,j,y}$ calculated and provide references for the same along with evidences. For more information on how the CL is closed , please refer to Appendix-4 of the report. CL3 is closed.
Conclusion	It is RINA's opinion: (a) All assumptions and data used by the PP are listed in the PDD; (b) All documentation used by the PP as the basis for assumption and source of data is correctly quoted and interpreted in the PDD . (c) All values used in the PDD and CERs spreadsheet. including GWPs are considered reasonable in the context of the proposed project activity (d) The baseline methodology and methodological tools have been applied correctly to calculate project emissions, baseline emissions, leakage and emission reductions; All estimates of the baseline and project emissions can be replicated using the data and parameters values provided in the PDD and CERs spreadsheet. The validation team confirms that the same is as per para 412 (a) of the CDM VVS for project activities , version 02.0.

D.5. Validity of monitoring plan

Means of validation

The approved baseline and monitoring methodologies "AMS-III.H", "Methane recovery in wastewater treatment" version 19 of 14/06/2019 /06/, and "AMS-I.D", "Grid connected renewable electricity generation" version 18 of 28/11/2014 /08//07/ have been applied.

Parameters monitored ex-post

The assessment of the ex-post parameters are described in the table below:

Parameter	Description/Assessment
$Q_{ww,i,y}$: The flow of wastewater in m^3/month.	Measured continuously using volumetric flow meter installed before UASB and will be recorded in manually in log sheets on a daily basis. The data is later transferred to electronic files i.e. excel sheet template. The flow meter will be calibrated at regular intervals based on the manufacturer's recommendation or instrument specification. The calibration will be performed by a certified testing agency using national/international standards.
$COD_{ww,untreated,y}$: The chemical oxygen demand of the wastewater before the treatment system	Wastewater samples will be collected at the inlet of the anaerobic treatment system (project system). The COD content will be analyzed using a close reflux titrimetric method in the on-site laboratory.

	affected by the project activity in tCOD/m^3	Samples and measurements shall ensure a 90/10 confidence/precision level. The COD test results will be logged manually in the plant operation report on a daily basis. Samples collection and analysis for COD will be done at least once per day. The checmicals used in the COD analysis would be certified.
	$COD_{ww,treated,k,y}$: The chemical oxygen demand of the wastewater after the treatment system affected by the project activity in tCOD/m^3	Wastewater samples will be collected at the outlet of the anaerobic treatment system (project system). The COD content will be analyzed using a close reflux titrimetric method in the on-site laboratory. Samples and measurements shall ensure a 90/10 confidence/precision level. The COD test results will be logged manually in the plant operation report on a daily basis. Samples collection and analysis for COD will be done at least once per day. The checmicals used in the COD analysis would be certified.
	***$S_{final,PJ,y}$*:** Amount of dry matter in the sludge in tonnes.	Measured using weigh bridge, The total quantity of sludge on wet basis shall be measured using weighbridge when the sludge is removed from the wastewater treatment system. Representative samples are taken to determine the moisture content to calculate the total sludge amount on dry basis. If the sludge is controlled combusted, disposed of in a landfill with methane recovery, or used for soil application, then the end-use of final sludge, i.e. destination and application, shall be recorded in the logbook. 100% of the sludge amount will be monitored through continuous or batch measurement. To ensure the 90/10 confidence/precision level, representative samples are taken to determine the moisture content. The weigh bridge at the starch plant shall be calibrated at regular intervals based on the local legal requirement. The calibration will be performed by the officer from Central Bureau of Weights and Measures using national/international standards. Value applied 0. Consistent with methodology /06/, hence accepted.
	***$BG_{burnt,flared,y}$*:** Amount of biogas that is flared in Nm^3.	Measured with Gas Flow meter provided at the inlet of flare system installed after the blowers and before the flare. In case the flare operated, the amount of biogas sent to the flare will be measured continuously (at least hourly measurement will be undertaken and if less, confidence level of 90/10 shall be attained) using flow meter installed after blower and before the flare. The data will be recorded manually in monthly log sheet on a daily basis and later transferred to electronic files. The flow meter will be calibrated at regular intervals based on instrument specification and/or manufacturer's recommendation. The calibration will be performed by a certified testing agency using national/international standards. Value applied 0. Consistent with methodology /06/, hence accepted.
	***$BG_{burnt,generator,y}$*:** Amount of biogas that is used in	Measured continuously on a dry basis – Gas flow meter provided at the inlet of the electricity

	electricity generator in Nm^3.	generators system. The amount of biogas sent to the electricity generators will be continuously measured using flow meter installed after blower and before the generators. Data will be logged manually in the log records and transferred to electronic file i.e. excel sheet template on a daily basis. The flow meter will be calibrated at regular intervals based on instrument specification and/or manufacturer's recommendation. The calibration will be performed by a certified testing agency using national/international standards. Consistent with methodology /06/, hence accepted.
	$w_{CH4,y}$: Methane content in biogas.	Measured on a dry basis - portable gas analyser. The methane content shall be measured by using portable methane analyser The measurement shall be carried out close to the biogas flow measurement for use of gas engines takes place. The methane content is recorded manually into log records at least four times per day. The gas analyser will be calibrated at regular intervals based on instrument specification and/or manufacturer's recommendation. The calibration will be performed by a certified testing agency using national/international standards. Consistent with methodology /06/, hence accepted.
	$T_{EG,m}$: Temperature of the exhaust gases of the enclosed flare in minute m in °C	In case the flare operated, the temperature will be continuously measured using thermocouple sensor installed at the stack at appropriate level as per the manufacturer's design.. The thermocouple will be calibrated at regular intervals based on instrument specification and/or manufacturer's specification. The calibration will be performed by a certified testing agency using national/international standards. If there is no record of $T_{EG,m}$, it shall be assumed that the flare efficiency is zero. Consistent with the methodology /06/ and tools /16//18/ applied.
	$v_{CH4,RG,m}$: Volumetric fraction of component *methane* in the residual gas on a dry basis in minute m	Measured on a dry basis using a continuous gas analyser. In case the flare operated, this parameter will be measured by using continuous gas analyser. The data on a minute basis shall be recorded through the automatic data logging (Supervisory Control And Data Acquisition system – SCADA) on minute basis. The gas analyser will be calibrated at regular intervals based on instrument specification and/or manufacturer's recommendation. The calibration will be performed by a certified testing agency using national/international standards. If there is no record of $v_{CH4,RG,m}$, it shall be assumed that the flare efficiency is zero. Consistent with the methodology /06/ and tools /16//18/ applied. Value applied 65%.
	$V_{RG,m}$: Volumetric flow of the residual gas on dry basis at normal conditions in the minute m in Nm^3	Measured on a dry basis using Gas flow meter provided at the inlet of flare system (same gas flow meter for $BG_{burnt,flared,y}$). Consistent with the methodology /06/ and tools /16//18/ applied.
	$Flame_m$: Flame detection of flare in the minute m and measured as Flame on or Flame off	Measured using UV flame detector. In case the flare operated, the Flamem will be measured using a fixed installation optical flame detector on a minute basis. Equipment shall be maintained and calibrated in accordance with manufacturer's

		recommendations. If there is no record of $Flame_m$, it shall be assumed that the flare efficiency is zero. Consistent with the methodology /06/ and tools /16//18/ applied.
	$\eta_{flare,m}$: Flare efficiency of the open flare	A default value of 50% will be used. 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%.
	$EC_{PJi,y}$: Quantity of electricity consumed by the project activity in year y in MWh	Measured with electricity meters maintained by PEA. The electricity meter is owned and maintained by Provincial Electricity Authority (PEA). Monthly reports / invoices shall be used get the amount of power consumed from grid. The calibration of meter, including the frequency of calibration, shall be done in accordance with national standards and requirements set by the grid operator (PEA). The meter maintenance is not under the jurisdiction of project proponent. Consistent with methodology /07/, hence accepted.
	$EG_{PJ,y}$: Quantity of net electricity generation that is produced and fed into the grid by the project activity in year y in MWh	Measured with electricity meters maintained by PEA. The electricity meter is owned and maintained by Provincial Electricity Authority (PEA). Monthly report / invoices shall be used get the amount of power supplied to the grid The calibration of meter, including the frequency of calibration, shall be done in accordance with national standards and requirements set by the grid operator (PEA). The meter maintenance is not under the jurisdiction of project proponent. Consistent with methodology /07/, hence accepted.
	$TDL_{j,y}$: Average technical transmission and distribution losses for providing electricity to the project activity (electricity import).	As per the guidance given in the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" /19/, most recent data available within the host country will be used during monitoring and verification. The value used for ex-ante estimation is of the year 2014, is the latest value published by The World Bank /40/, hence accepted. It is noted that this value will be monitored annually, in the absence of data from the relevant year; most recent figures should be used, but not older than 5 years.

Management system and quality assurance

An onsite inspection has been performed on 28/11/2017 and it is confirmed that the monitoring arrangements in the monitoring plan are feasible within the project design. The monitoring is based only on data measured. The energy delivered to the grid and energy consumed from the grid are continuously monitored by energy meters and the values are sourced from PEA reports / invoices. Data for the grid emission factor calculation are provided by Thai DNA /17/. The updated PDD /02/ describes that Data monitored and required for verification and issuance will be kept for two years after the end of the crediting period.

Findings	CL4 1. Not clear on the calibration requirements of Close reflux titrimetric method, used in COD analysis. 2. The wastewater samples collected from the last open lagoons prior to discharge. As per the industrial requirements, this needs to be tested from certified external laboratory using national/international standards. PP is requested to include both internal and external values and use the most

	conservative in ER calculations. For more information, please refer to Appendix-4. CL4 is closed.
Conclusion	It is RINA's opinion that the monitoring plan is in accordance with the monitoring methodology; the monitoring plan will give opportunity for real measurement of achieved emission reductions. RINA has checked all the parameters presented in the monitoring plan against the requirements of the methodology and methodological tools; no deviations relevant to the project activity have been found in the plan. RINA confirms that the monitoring arrangements described in the monitoring plan, including the data management and quality assurance and quality control procedures, are feasible within the project design, and the means of implementation of the monitoring plan are sufficient to ensure the emission reductions achieved by/resulting from the proposed CDM project activity can be reported ex post and verified. The validation team confirms that the same is as per para 412(a) of the CDM VVS for project activities , version 02.0.

D.6. Crediting period

Means of validation	The second crediting period starts from 09/04/2018. This is noted to be in line with the end of the first crediting period.
Findings	CL 5 PP is requested to provide the notification of the intention to request a renewal of the crediting period. The same must be 180 days before the expiration of first crediting period. For more information please refer to appendix-4 of the PDD. CL 5 is closed.
Conclusion	RINA confirms that the second crediting period of the registered CDM project activity commences on the day immediately after the expiration of the current crediting period . The validation team confirms that the same is as per para 412 a (V) of the CDM VVS for project activities , version 02.0.

D.7. Project participants

Means of validation	The project participants described in the PDD South Pole Carbon Asset Management Ltd and Blue Fire Bio Co. Ltd. consistent with the project page in UNFCCC website /20/, hence accepted.
Findings	N/A
Conclusion	RINA verified that the project participants included in the PDD are consistent with the names of the project participants in the project view page and the MOC's available in the site. The validation team confirms that the same is as per para 412 a (vi) of the CDM VVS for project activities , version 02.0.

D.8. Post-registration changes

Type of post-registration changes (PRCs)	Confirmation (Y/N)	Validation report for PRCs	
		Version	Completion date
Temporary deviations from the registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents[1]	N	N/A	N/A
Corrections	N	N/A	N/A
Change to the start date of the crediting period	N	N/A	N/A
Inclusion of a monitoring plan	N	N/A	N/A
Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied	N	N/A	N/A

[1] Other standards, methodologies, methodological tools and guidelines (to be) applied in accordance with the applied(selected) methodologies are collectively referred to as the other (applied) methodological regulatory documents).

methodologies, standardized baselines, or other methodological regulatory documents			
Changes to the project design	N	N/A	N/A
Changes specific to afforestation and reforestation project activities	N	N/A	N/A

SECTION E. Internal quality control

>> Internal quality control within the team is assured by means of a technical review process that takes place after the on-site assessment and after closure of findings. The internal quality control in the validation process is given by the final decision Validation Opinion) made by the Certification Body.

SECTION F. Validation opinion

>> RINA has performed a validation of the updated PDD for the project activity "Blue Fire Bio wastewater treatment and biogas utilization project" in Thailand, CDM Registration Reference N° 4219 The validation of the updated PDD has performed for the second renewal crediting period (from 09/04/2018 to 08/04/2025) and is based on the information made available to us.

RINA has performed this validation in accordance with Clean Development Mechanism Validation and Verification Standard version 02.0 of 28/11/2019 and included an assessment of:

- An impact of new relevant national and/or sectoral policies and circumstances on the baseline taking into account relevant guidance from the Board with regard to renewal of the crediting period at the time of requesting renewal of crediting period:
- The correctness of the application of an approved baseline methodology for the determination of the continued validity of the baseline or its update, and the estimation of emission reductions for the applicable crediting period.

During the validation, there are not proposed post-registration changes for the next crediting period that is submitted together with the request for renewal of crediting period of the registered CDM project activity.

The review of the updated project design documentation and additional documents related to baseline and monitoring methodology; the subsequent background investigation, follow-up interviews have provided RINA with sufficient evidence to validate the fulfillment of the stated criteria applicable for RCP.

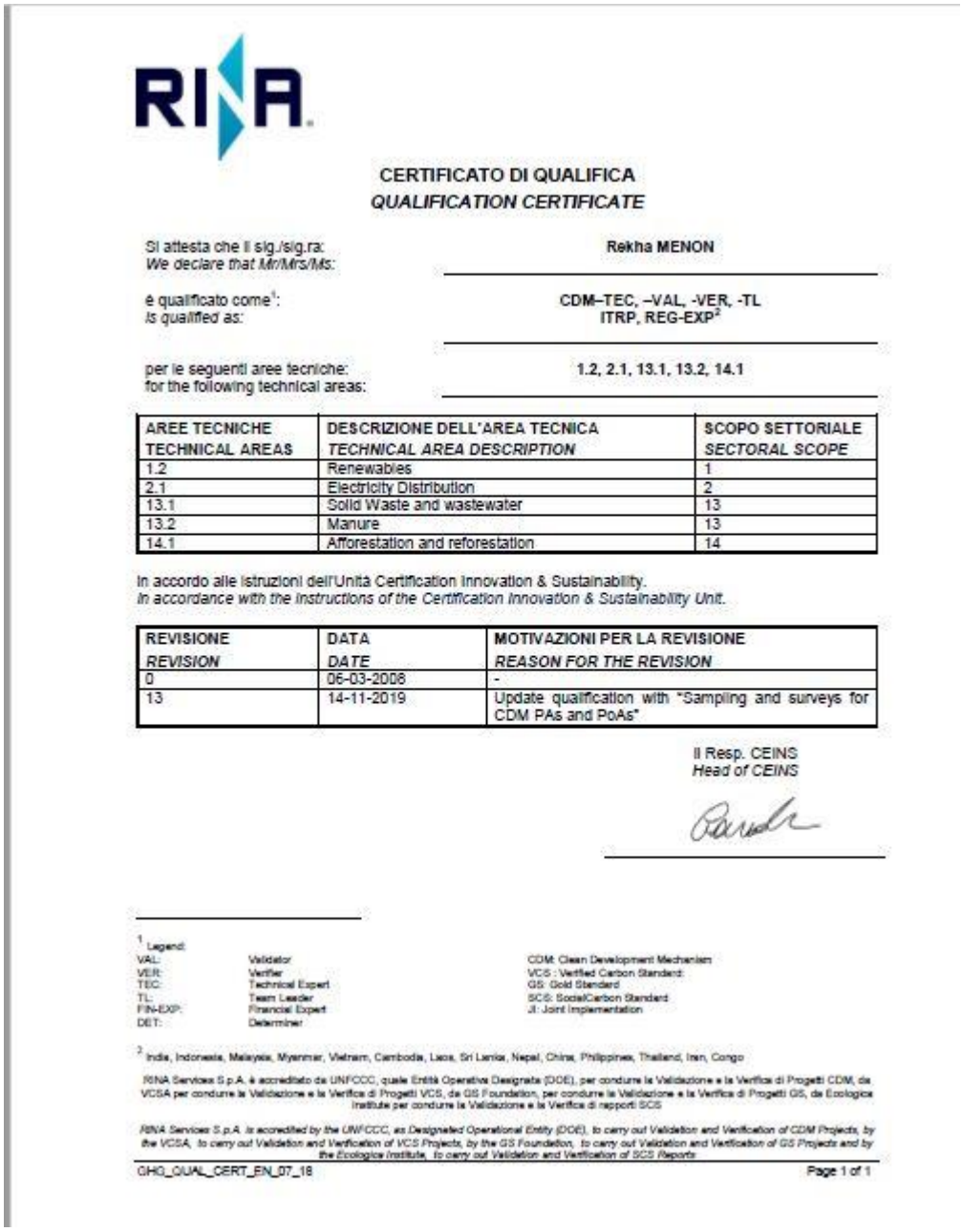
The review of the PDD and the subsequent follow-up interviews has provided RINA with sufficient evidence to determine the validity of the original baseline scenario. The project correctly applies the baseline and monitoring methodologies. The total emission reductions from the project activity "Blue Fire Bio wastewater treatment and biogas utilization project" are estimated to be on an average 59,898 tCO_2e per year over the selected 7 years renewable crediting period. The emission reduction forecast has been checked and it is deemed likely that the stated amount is achieved given that the underlying assumptions do not change.

It is RINA's opinion that the project "Blue Fire Bio wastewater treatment and biogas utilization project" in Thailand meets all the relevant requirements for the renewal of the crediting period. Hence RINA requests the renewal of the crediting period of the project activity.

Appendix 1. Abbreviations

Abbreviations	Full texts
BE	Baseline Emissions
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CDM M&P	Modalities and Procedures CDM
CER(s)	Certified Emission Reduction(s)
CH4	Methane
CL	Clarification Request
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DCI	Certification Division of RINA Services Spa
DNA	Designated National Authority
DOE	Designated Operational Entity
EB	Executive Board
EGAT	Electricity Generating Authority of Thailand
ER	Emission Reductions
FAR	Forward Action Request
GHG(s)	Greenhouse gas(es)
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
LoA	Letter of Approval
MoV	Means of Verification
MR	Monitoring Report
NGO	Non-governmental Organization
ODA	Official Development Assistance
PDD	Project Design Document
PE	Project Emission
PEA	Provincial Electricity Authority
PP(s)	Project Participant(s)
PPA	Power Purchase Agreement
Ref.	Document Reference
RINA	RINA Services Spa
SS(s)	Sectoral Scope(s)
SPCAML	South Pole Carbon Asset Management Limited
TA(s)	Technical Area(s)
UNFCCC	United Nations Framework Convention on Climate Change
VVS	Validation and Verification Standard

Appendix 2. Competence of team members and technical reviewers



RINA

CERTIFICATO DI QUALIFICA
QUALIFICATION CERTIFICATE

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

è qualificato come[1]: / *is qualified as:* **CDM–TEC, –VAL, -VER, -TL ITRP, REG-EXP**[2]

per le seguenti aree tecniche: / *for the following technical areas:* **1.2, 2.1, 13.1, 13.2, 14.1**

AREE TECNICHE *TECHNICAL AREAS*	DESCRIZIONE DELL'AREA TECNICA *TECHNICAL AREA DESCRIPTION*	SCOPO SETTORIALE *SECTORAL SCOPE*
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

In accordo alle istruzioni dell'Unità Certification Innovation & Sustainability.
In accordance with the instructions of the Certification Innovation & Sustainability Unit.

REVISIONE *REVISION*	DATA *DATE*	MOTIVAZIONI PER LA REVISIONE *REASON FOR THE REVISION*
0	06-03-2006	-
13	14-11-2019	Update qualification with "Sampling and surveys for CDM PAs and PoAs"

Il Resp. CEINS
Head of CEINS

[1] Legend:
VAL: Validator
VER: Verifier
TEC: Technical Expert
TL: Team Leader
FIN-EXP: Financial Expert
DET: Determiner
CDM: Clean Development Mechanism
VCS : Verified Carbon Standard;
GS: Gold Standard
SCS: SocialCarbon Standard
JI: Joint Implementation

[2] India, Indonesia, Malaysia, Myanmar, Vietnam, Cambodia, Laos, Sri Lanka, Nepal, China, Philippines, Thailand, Iran, Congo

RINA Services S.p.A. è accreditato da UNFCCC, quale Entità Operativa Designata (DOE), per condurre la Validazione e la Verifica di Progetti CDM, da VCSA per condurre la Validazione e la Verifica di Progetti VCS, da GS Foundation, per condurre la Validazione e la Verifica di Progetti GS, da Ecologics Institute per condurre la Validazione e la Verifica di rapporti SCS

RINA Services S.p.A. is accredited by the UNFCCC, as Designated Operational Entity (DOE), to carry out Validation and Verification of CDM Projects, by the VCSA, to carry out Validation and Verification of VCS Projects, by the GS Foundation, to carry out Validation and Verification of GS Projects and by the Ecologics Institute, to carry out Validation and Verification of SCS Reports

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CERTIFICATO DI QUALIFICA
QUALIFICATION CERTIFICATE

Si attesta che il sig./sig.ra: **Amalorpavanathan Cyril AUGUSTUS AROKIASAMY**

We declare that Mr/Mrs/Ms:

è qualificato come[1]: **CDM-TEC, CDM-VAL, CDM-VER, CDM-TL, ITRP, REG-EXP[2]**
is qualified as:

per le seguenti aree tecniche: **1.1, 1.2, 3.1, 5.1, 13.1**
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

in accordo alle istruzioni della Unità Certification Innovation and Sustainability.
in accordance with the instructions of the Certification Innovation and Sustainability Unit.

REVISIONE *REVISION*	DATA *DATE*	MOTIVAZIONI PER LA REVISIONE *REASON FOR THE REVISION*
0	30/06/2010	-
13	31/03/2017	Updated qualification as ITRP
14	20/09/2018	Update qualification as REG-EXP
15	15/11/2019	Update qualification with "Sampling and surveys for CDM PAs and PoAs"

Il Resp. CEINS
Head of CEINS

[1] Legend:
VAL: Validator
VER: Verifier
TEC: Technical Expert
TL: Team Leader
FIN-EXP: Financial Expert
DET: Determiner

CDM: Clean Development Mechanism
VCS : Verified Carbon Standard:
GS: Gold Standard
SCS: SocialCarbon Standard
JI: Joint Implementation

[2] Ghana, Azerbaijan, China, Sri Lanka, Bangladesh, Nepal, Thailand, Indonesia, Singapore, Malaysia, Cambodia, Vietnam, Philippines, UAE and Iraq, Brazil, Japan.

RINA Services S.p.A. è accreditato da UNFCCC, quale Entità Operativa Designata (DOE), per condurre la Validazione e la Verifica di Progetti CDM, da VCSA per condurre la Validazione e la Verifica di Progetti VCS, da GS Foundation, per condurre la Validazione e la Verifica di Progetti GS, da Ecologica Institute per condurre la Validazione e la Verifica di rapporti SCS

RINA Services S.p.A. is accredited by the UNFCCC, as Designated Operational Entity (DOE), to carry out Validation and Verification of CDM Projects, by the VCSA, to carry out Validation and Verification of VCS Projects, by the GS Foundation, to carry out Validation and Verification of GS Projects and by the Ecologica Institute, to carry out Validation and Verification of SCS Reports

CERTIFICATO DI QUALIFICA
QUALIFICATION CERTIFICATE

Si attesta che il sig./sig.ra: **Hui Feng LIU**

We declare that Mr/Mrs/Ms:

è qualificato come[1]: **CDM –TEC, -VAL,- VER, -TL ITRP, REG-EXP[2]**
is qualified as:

per le seguenti aree tecniche: **1.1, 1.2, 8.1, 9.2, 13.1**
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

in accordo alle istruzioni della Unità Certification Innovation and Sustainability.
in accordance with the instructions of the Certification Innovation and Sustainability Unit.

REVISIONE *REVISION*	DATA *DATE*	MOTIVAZIONI PER LA REVISIONE *REASON FOR THE REVISION*
0	10/09/2010	-
11	31/03/2017	Updating qualification as ITRP
12	30/07/2018	Updating qualification as REG-EXP
13	15/11/2019	Update qualification with "Sampling and surveys for CDM PAs and PoAs"

Il Resp. CEINS
Head of CEINS

[1] Legend:
VAL: Validator
VER: Verifier
TEC: Technical Expert
TL: Team Leader
FIN-EXP: Financial Expert
DET: Determiner

CDM: Clean Development Mechanism
VCS : Verified Carbon Standard:
GS: Gold Standard
SCS: SocialCarbon Standard
JI: Joint Implementation

[2] China

RINA Services S.p.A. è accreditato da UNFCCC, quale Entità Operativa Designata (DOE), per condurre la Validazione e la Verifica di Progetti CDM, da VCSA per condurre la Validazione e la Verifica di Progetti VCS, da GS Foundation, per condurre la Validazione e la Verifica di Progetti GS, da Ecologica Institute per condurre la Validazione e la Verifica di rapporti SCS

RINA Services S.p.A. is accredited by the UNFCCC, as Designated Operational Entity (DOE), to carry out Validation and Verification of CDM Projects, by the VCSA, to carry out Validation and Verification of VCS Projects, by the GS Foundation, to carry out Validation and Verification of GS Projects and by the Ecologica Institute, to carry out Validation and Verification of SCS Reports

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Appendix 3. Documents reviewed or referenced

No.	Author	Title	References to the document	Provider
1	SPCAML	Registered CDM-SSC-PDD for the project activity titled “Blue Fire Bio wastewater treatment and biogas utilization project”	Version 02.6 of 18/11/2010	Others
2	SPCAML	Updated CDM-SSC-PDD for the project activity titled “Blue Fire Bio wastewater treatment and biogas utilization project”	Version 1.0 of 12/10/2017 and version 02 of 28/11/2019	PP
3	CDM Executive Board	CDM project standard for project activities	Version 02 of 29/11/2018	Others
4	CDM Executive Board	CDM validation and verification standard	Version 02 of 29/11/2018	Others
5	CDM Executive Board	CDM project cycle procedure for project activities	Version 02 of 29/11/2018	Others
6	CDM Executive Board	AMS-III.H”, “Methane recovery in wastewater treatment”	Version 18 of 16/10/2015 and version 19 of 14/06/2019	Others
7	CDM Executive Board	AMS-I.D”, “Methane recovery in wastewater treatment”	Version 18 of 16/10/2015	Others
8	CDM Executive Board	“Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period’	version 03.0.1 of 02/03/2012	Others
9	CDM Executive Board	CDM-PDD-FORM	version 10.1 of 28/06/2017	Others
10	SPCAML	Emission reduction calculation spreadsheet “BFB_ER calculation_renewed_v.1.xlsx” and 147_BFB WWT_2ndCP_ER calculation_v2_09122019.xlsx	Version 1 submitted on 28/11/2017 and version 02 of 09/12/2019	PP
11	TUV Rheinland	Validation report for the project titled “Blue Fire Bio wastewater treatment and biogas utilization project”	Version 03 of 08/12/2010	Others
12	Ministry of Industry	Notification of Ministry of Industry, Industrial effluent standard, issued on 30/05/2017	Issued on 30/05/2017	PP
13	IPCC	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Chapter 1	http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf , in English language retrieved on 04/11/2016.	Others
14	IPCC	Fourth Assessment Report	http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html	Others

			in English language retrieved on 04/11/2016.	
15	CDM Executive Board	Methodological tool "Tool to calculate the emission factor for an electricity system"	version 07 of 31/08/2018	Others
16	CDM Executive Board	Methodological tool "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"	Version 03.0 of 27/11/2015	Others
17	Thailand Greenhouse Gas Organization (TGO)	"Thailand Grid Emission Factor for GHG Reduction Project/ Activity, 2017	28/09/2017	PP
18	CDM Executive Board	Methodological tool "Project emissions from flaring"	version 03.0 of 28/03/2019	Others
19	CDM Executive Board	Methodological tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"	version 03.0 of 22/09/2017	Others
20	UNFCCC website Project 4219	"Blue Fire Bio wastewater treatment and biogas utilization project" in Thailand	http://cdm.unfccc.int/Projects/DB/TUEV-RHEIN1291833824.78/view , in English language, retrieved on 15/11/2019	Others
21	Pollution Control Department, Thailand	Thai Environmental regulations	http://www.pcd.go.th/indexEng.cfm in English language, retrieved on 15/11/2019	Others
22	FAO	Existing cassava processing / environment knowledge base	http://www.fao.org/docrep/007/y2413e/y2413e0e.htm in English language, retrieved on 15/11/2019	Others
23	IIP	Rapid Deployment of Industrial Biogas in Thailand: Factors of Success	https://www.eceee.org/library/conference_proceedings/eceee_Industrial_Summer_Study/2012/6-the-role-of-financing-to-improve-industrial-efficiency-global-perspective/rapid-deployment-of-industrial-biogas-in-thailand-factors-of-success/ in English language, retrieved on 15/11/2019	Others
24	Department of Alternative Energy Development and Efficiency	Annual report 2011	http://e-lib.dede.go.th/mm-data/Bib2969-2011.pdf in English language, retrieved on 15/11/2019	Others

25	The World Bank	http://ghgreduction.tgo.or.th/download-tver/68-2017-11-28-06-43-22/353-2559.html	http://data.worldbank.org/indicator/EG.ELC.LOSS.ZS in English language, retrieved on 15/11/2019	
26	Energy Policy and Planning Office, Ministry of Energy	Monthly ambient temperature for the period from 2018 to 2019	http://www.e-report.energy.go.th/weather.html in English language, retrieved on 15/11/2019	PP
27	Blue Fire Bio Co. Ltd.	Layout of open lagoons & details of anaerobic pond	-	PP
28	Biofuel Co Ltd	Wastewater characteristic report Chaodee Starch Factory	Date 07-17/10/2005	PP
29	Blue Fire Bio Co. Ltd.and PEA	Power Purchase Agreement between Blue Fire Bio Co. Ltd. and PEA	Dated 12/01/2009	PP
30	Bio-fuel Co Ltd	Flare specifications	27/04/2012	PP
31	Operation and maintanace manual of 500GF1-1RZ sewage gas generator set	Technical data of gas engine	-	PP
32	Bio-fuel Co Ltd	Thermal specifications of oil boiler		PP
33	Department of Industrial works, Thailand	Operation license of Chaodee Starch (2004) Co.,Ltd for the starch production	dated 29/03/2004	Others
34	Department of Industrial works, Thailand	Operation license of Blue Fire Bio Co.,Ltd for the biogas production	dated 11/08/2006	Others
35	Certified license Engineer	Confirmation letter of the wastewater treatment system and biogas utlization confirming the treatment system can be operational for more than 10 years.	Dated 01/05/2019	PP
36	Executive summary by Bio fuel co ltd	Starch Production capacity and wastewater flow rate for line 1 and line 2	Dated 11/03/2011	PP
39	EPPO	Energy statistics of Thailand	2018	
40	The World Bank	Electric Power Transmission & Distribution losses -Thailand	https://data.worldbank.org/indicator/EG.ELC.LOSS.ZS?locations=TH in English Language, last	PP

			accessed on 01/11/2019	
41	CDM Executive Board	CDM-PDD-FORM: Project design document form for CDM project activities, including Attachment: Instructions for filling out the project design document form for CDM project activities	version 11 of 31/05/2019	Others
42	Department of Industrial works, Thailand	Operation license of Blue Fire Bio Co.,Ltd for the electricity generation	dated 16/07/2010	PP

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

Table 1. CL from this validation

CL ID	01	**Section no.**	D.2	**Date:** 01/12/2017
Description of CL				
1. PP is requested to provide the operation licence of the biogas plant and the starch unit. 2. Provide the design layout of the baseline lagoons and clarify the no. of baseline lagoons in the baseline. 3. Provide evidences of the ambient temperature of the region, where project is located, evidences of the sludge removal frequency in the baseline. 4. Not clear, if there is an increase in the capacity for the current crediting period. PP is requested to make the same clear in the same. Also the project description to be made transparent with reference to the current crediting period. 5. Provide evidences of the technical specifications of the gas engines involved, UASB, boiler and flare. 6. It is not clear from the project description that, if the generated power after in house consumption is exported to the grid. Also provide the power purchase agreements with the Thai national grid. 7. Provide inspection reports of the boilers. It is further checked that the PP has included the emission reductions accounted for AMS-I.C. PP to clarify, if the AMS-I.C part is covered in the project boundary. *8.* The methodological tools are not justified in the PDD. *9.* PP is requested to provide the evidences of the production capacity and quantity of waste generated.				
Project participant response				**Date:** 09/12/2019

1. The following licenses have been provided to DOE
   - Operation license date 29/03/2004 of Chaodee Starch (2004) Co.,Ltd for the starch production
   - Operation license date 11/08/2006 of Blue Fire Bio Co.,Ltd for the biogas production
   - Operation license date 16/07/2010 of Blue Fire Bio Co.,Ltd for the electricity generation
2. The design layout of the baseline lagoons has been provided to DOE. The layout was prepared by the biogas digester system developer (Biofuel Co.,Ltd.) before the construction of the biodigester. The no. of open lagoons in baseline situation was 15 lagoons with a depth greater than two meters.
3. The monthly average ambient temperature of Nakhorn Ratchasima province, where the project is located, during September 2018 – August 2019 has been provided to DOE. The average ambient temperature over the period is 29°C.
4. There was no change in the capacity of the starch factory and the biogas system during the current crediting period. The project description has been revised with reference to the current crediting period.
5. The evidences of the technical specifications of the biogas reactor, gas engines and flare have been provided to DOE. Regarding the boiler technical specification, since the activity relevant to the methodology AMS.I.C is not considered as part of the project activity, the evidence has not been made available to DOE.
6. The electricity after the biogas plant consumption is exported to the grid under the power purchase agreement (PPA). The evidence of the signed PPA has been provided to DOE.
7. The activity relevant to the methodology AMS.I.C is not considered as part of the project boundary. Therefore, the inspection reports of the boilers have not been made available to DOE.
8. The justification of the methodological tools has been provided in the revised PDD.
9. The evidences of the production capacity and the quantity of wastewater generated as per the design of biogas reactor have been provided as CL01_9.

Documentation provided by project participant

Folder CL01

1. Subfolder CL01_1
   - Operation license date 29/03/2004 of Chaodee Starch (2004) Co.,Ltd for the starch production
   - Operation license date 11/08/2006 of Blue Fire Bio Co.,Ltd for the biogas production
   - Operation license date 16/07/2010 of Blue Fire Bio Co.,Ltd for the electricity generation
2. Subfolder CL01_2
   - Layout of open lagoon system
3. Subfolder CL01_3
   - Monthly average temperature
4. Refer to the same documents in Subfolder CL01_1
5. Subfolder CL01_5
   - Technical specification of biogas reactor
   - Technical specification of gas engine
   - Technical specification of flare
6. Subfolder CL01_6
   - The signed PPA between Blue Fire Bio Co.,Ltd and Provincial Electricity Authority (PEA) date 12 January 2009
7. Subfolder CL01_9
   - Production capacity of 1st production line
   - Production capacity of 2nd production line

DOE assessment	**Date:** 12/12/2019

1. Operation license date 16/07/2010 of Blue Fire Bio Co.,Ltd for the electricity generation checked. Operation license date 11/08/2006 of Blue Fire Bio Co.,Ltd for the biogas production checked and Operation license date 29/03/2004 of Chaodee Starch (2004) Co.,Ltd for the starch production checked and accepted.
2. design layout of the baseline lagoons checked and noted that there are in total 15 lagoons with depths ranging from 4m to 6m.
3. Monthly ambient temperature checked from 2018 to 2019 and noted that the average temperature is 29°C. checked against It is reported by the Energy Policy and Planning Office, Ministry of Energy. Available from: http://www.e-report.evnergy.go.th/weather.html.
4. The updated PDD is made transparent on the capacity and noted there is no change in the capacity.
5. Technical specifications of flare, gas engine and UASB provided by PP was checked against the name plates during the site visit and the same is accepted.
6. The signed PPA between Blue Fire Bio Co.,Ltd and Provincial Electricity Authority (PEA) dated 12/01/2009 checked. It is also made clear that the extra electricity is exported after the internal consumption.
7. Justification provided by PP is accepted. Since the same is conservative.
8. The methodological tools has been justified in the revised pdd, section B.7.2.
9. The starch production capacity and wastewater flow rate for line 1 were checked against the executive summary provided by technology provider as part of the technical proposal. For line 2 it was checked against the documents that were submitted to bank for loan application. Since these parameters were checked during the first crediting period and there is no change in the design specifications or production capacity. The justification provided by the PP is acceptable.

Based on the above justifications CL1 is closed.

CL ID	02	**Section no.**	D.3	**Date:** 01/12/2017

Description of CL

1. In the section validity of the original baseline, the PD is not transparent thermal component. PP is requested to refer and provide the relevant laws of the same.
2. "In the situation where the baseline scenario identified at the validation of the project activity was the continuation of the current practice without any investment, an assessment of the changes in market characteristics is required for the renewal of the crediting period. The same is not transparent in the PDD.
3. The para "Assess whether the remaining technical lifetime of the equipment that would have continued to be used in the absence of the project activity, as determined in the CDM-PDD or CDM-PDD-REN, exceeds the crediting period for which renewal is requested" is not justified.
4. Not clear on the data and parameters that were only determined at the start of the crediting period and not monitored during the crediting period are still valid or whether they should be updated.

Project participant response **Date:** 09/12/2019

1. The assessment for thermal component has not been provided since the activity relevant to the methodology AMS.I.C is not considered as part of the project activity.
2. Since there are no mandatory national and/or sectoral policies requirement for the implementation of a specific wastewater treatment technology, the project proponent would have used the current baseline in absence of the project implementation. In addition, the necessary requirements both in terms costs and skills to operate and maintain the current baseline is much lower than the use of biogas system. An investment is not the most likely scenario for the renewal of the crediting period, therefore, an assessment of the changes in market characteristics is not required for the renewal of the crediting period. The explanation has been provided as per step 1.1 under section B.4 of the revised PDD.
3. The justification for the remaining technical lifetime of the equipment has been provided as per step 1.3 under section B.4 of the revised PDD.
4. The assessment of the validity of the data and parameters as per step 1.4 has been provided in the revised PDD.

Documentation provided by project participant

Folder CL02

- Letter confirmation of the equipment lifetime

DOE assessment **Date:** 12/12/2019

1.2. 4Since the client is not claiming the thermal component part. The assessment for AMS-I.C is not provided in the PDD, which is accepted by the validation team. Further to this an assessment of the changes in the market characteristics, the validity of the data and parameters under step 1.4 is updated in the revised PDD.
3. Confirmation letter , dated 10/05/2019 from the certified engineer confirming the biogas plant can be operational for 10 more years with proper operation and maintenance.

Based on the above justifications, CL 2 is closed.

CL ID	03	**Section no.**	D.4	**Date:** 01/12/2017
Description of CL				

1. Please justify, if the COD removal efficiency of the baseline system I is as per para 38, 39 or 40 of the methodology AMS-III.H.
2. Specific heat of oil: The reference provided doesn't work. Further provide more justification on value used.
3. Efficiency of thermal oil boiler: Pls provide the evidence for the value choosen. Efficiency to be determined based on the "Tool to determine baseline efficiency of thermal and electricity systems"
4. Net calorific value of heavy fuel oil: Pls provide the exact reference. Should be based on para 39 or 40 of the methodology.
5. Density of fossil fuel: The weblink doesn't open to the exact page. Also it shows thai lang.
6. Density of fluid used for heating purposes: The reference link provided doesn't open.
7. PP to clarify on why flare related parameters are not included in parameters available at validation.
8. Evidences on the quantity of waste water , COD inflow, historical consumptions of HFO,
9. Clarify if , Is it EFHFO or EFFF? Cause in monitoring parameters it states EFHFO.
10. The Formula used in the calculation of EGthermal, provide the reference for the same.
11. $EG_{PJ,y}$ is 5,794 MWh, provide justification on the calculation and reference for the same.
12. PP to clarify if the grid emission factor is calculated as per the "Tool to calculate the emission factor for an electricity system (version 05.0) paragraph 84 (b), which requires to apply WOM = 0.25 and WBM = 0.75 for the second crediting period.
13. Evidences for $\eta_{,PJ,k,y.}$
14. How is $EC_{PJ,j,y}$ calculated and provide references for the same along with evidences.

Project participant response	**Date:** 09/12/2019

1. In the first crediting period, the project activity was registered under the version 13 of AMS III.H and there was no at least one year historical data available. The COD removal efficiency was determined by a measurement campaign in the baseline wastewater systems for at least 10 days. Due to these reasons, the paragraph 36, 37 (a), 37 (c) and 38 of AMS III.H version 19 cannot be applied in the renewal of crediting period.
   As per paragraphs 37 (b) of the methodology, the measurements in the lagoons system have been conducted during a 10 day campaign prior the project start date. Therefore, the chemical oxygen demand removal efficiency of the baseline wastewater treatment system is calculated based on these values of the COD of the wastewater discharge from the starch factory before treatment and at the last lagoon of baseline treatment, multiplied by 0.89 to account for the uncertainty range. Actual reduction across the system is approximately 99% as per the 10 day measurement campaign, therefore, a value of 89% for the COD removal efficiency is used for the baseline.

   The same explanation has been provided in section B.4 of the revised PDD.

2. The parameter of specific heat of oil has been removed from the revised PDD and ER sheet since the activity relevant to the methodology AMS.I.C is not considered as part of the project activity.
3. The parameter of efficiency of thermal oil boiler has been removed from the revised PDD and ER sheet since the activity relevant to the methodology AMS.I.C is not considered as part of the project activity.
4. The parameter of net calorific value of heavy fuel oil has been removed from the revised PDD and ER sheet since the activity relevant to the methodology AMS.I.C is not considered as part of the project activity.
5. The parameter of density of fossil fuel has been removed from the revised PDD and ER sheet since the activity relevant to the methodology AMS.I.C is not considered as part of the project activity.
6. The parameter of density of fluid used for heating has been removed from the revised PDD and ER sheet since the activity relevant to the methodology AMS.I.C is not considered as part of the project activity.
7. Flare parameters have been provided in section B.7.1 of the revised PDD.
8. The evidence on the quantity of wastewater and COD inflow have been provided to the DOE as CL03_8
9. The parameter of EF_{HFO} or EF_{FF} has been removed from the revised PDD and ER sheet since the activity relevant to the methodology AMS.I.C is not considered as part of the project activity.
10. The formula used in the calculation of $EG_{thermal}$ has been removed from the revised PDD and ER sheet since the activity relevant to the methodology AMS.I.C is not considered as part of the project activity.
11. The annual power supplied to the grid ($EG_{PJ,y}$) has been estimated based on the planned amount of biogas fed to the gas engines (40%) and the required gas consumption in kJ/kWh as per the technical specification of gas engine and the NCV of methane. The evidence of gas engine technical specification has been provided the DOE as CL03_14.
12. The original grid emission factor (EF_{grid}) of 0.5637 tCO2/MWh was based on the study “Thailand Grid Emission Factor for GHG Reduction Project Activity” carried out in 2017 (the most recent study) by the Thai DNA in accordance with the Methodological Tool: “Tool to calculate the emission factor for an electricity system version 05.0.
    However, according to the validity of the methodological tool, the project has applied the tool version 07.0. Since there was no change/revision of the equations used to calculate the grid emission factor from the tool version 05.0, the PP has referred the values of $EF_{grid,OM}$ and $EF_{grid,BM}$ from the study report in 2017 to calculate the combined margin emission factor ($EF_{grid,y)}$ using the default value of w_{OM} = 0.25 and w_{BM} = 0.75 for the second crediting period in line the paragraph 6 (b) of the tool. Therefore, the $EF_{grid,y}$ for the project activity is 0.5637 tCO_2/MWh. The calculation of the $EF_{grid,y}$ has been provided in the ER sheet.

13. The evidence for $\eta_{,PJ,k,y}$ has been provided to the DOE as CL03_12.
14. The evidence for $EC_{PJ,j,y}$ has been provided to the DOE as CL03_13.

Documentation provided by project participant

Folder CL03

1. CL03_8: The Project Summary for the Managing Director provided by Biofuel Co.,Ltd.
2. CL03_12: Wastewater Characteristic Report of Chaodee Starch Factory provided by Biofuel Co.,Ltd.
3. Subfolder CL03_11
   - The study "Thailand Grid Emission Factor for GHG Reduction Project Activity" carried out in 2017 (the most recent study) by the Thai DNA
   - Calculation of grid emission factor
4. CL03_13
   - Load power for BFR1,2
   - Load power for BFR3
5. CL03_14: Technical specification of gas engine

DOE assessment	**Date:** 12/12/2019

1.COD removal efficiency is taken as per 10 day campaign prior the project start date since historical data is not available. The same is accepted as per para 37 (b) of the methodology. The updated PDD checked and closed.
2. i. 4.5.6.9: t is noted that the parameter for specific heat of oil, efficiency of boiler, NCV of FO, density of FO, density of fluid, EF_{HFO} or EF_{FF} has been removed since AMS-I.C component is not claimed in the project.
7. flare related parameters are updated in the revised PDD.
8. Checked the project summary report, which provide the values for COD inflow and the quantity of waste water. Accepted and closed.
10. Formula used in the calculation of EGthermal has been removed, since the thermal component is not claimed in the project.
11. Technical specifications of gas engine checked and noted that the electricity export is calculated based on the 40% biogas fed to the gas engines and the required gas consumption in kJ/kWh as per the technical specification of gas engine and the NCV of methane. The same is accepted by RINA team.
12. The grid emission factor is calculated as per the latest tool to calculate grid emission factor, version 07. The values of OM and BM were updated as per the 2nd crediting period . checked and accepted.
12. Evidences for $\eta_{PJ,k,}$checked . The campaign data performed by bio fuel co ltd from 7th to 17th October checked and accepted. The same was also accepted in the first validation.
13. the electricity consumption is calculated based on the designed capacities of auxiliary equipment's. List of equipment's checked, which were checked against technical specifications and name plates

Based on the above justifications, CL3 is closed.

CL ID	04	**Section no.**	D.5	**Date:** 01/12/2017

Description of CL

1. Not clear on the calibration requirements of Close reflux titrimetric method, used in COD analysis.
2. The wastewater samples collected from the last open lagoons prior to discharge. As per the industrial requirements, this needs to be tested from certified external laboratory using national/international standards. PP is requested to include both internal and external values and use the most conservative in ER calculations.

Project participant response	**Date:** 09/12/2019

1. Since there is no use of digital/online equipment for COD measurement, the calibration cannot be conducted. Therefore, the certificate of chemical solution valid for each monitoring period shall be provided and the measurement shall ensure a 90/10 confidence/precision level.
2. In the project activity, since the discharge of the wastewater is not allowed as per the conditions in the operation license, the test by certified external laboratory is not required regularly. Therefore, the external value is not included in the ER calculations.

Documentation provided by project participant

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DOE assessment	**Date:** 12/12/2019

1. The justification provided by PP is acceptable.
2. RINA accepts the justification provided by the PP and confirms that there is no discharge of wastewater. Hence there is no requirement of COD samples to be tested by external labs.

Based on the above justifications, CL 04 is closed.

CL ID	05	Section no.	D.6	Date: 01/12/2017
Description of CL				
PP is requested to provide the notification of the intention to request a renewal of the crediting period. The same must be 180 days before the expiration of first crediting period.				
Project participant response				**Date:** 09/12/2019
The copy of the notification sent to the secretariat has been provided to DOE as CL05. According to the evidence provided, the notification of the intention to request a renewal of the crediting period was not received by the secretariat 180 days prior to the date of expiration of the current crediting. However, the latest requirement as per the EB 105th meeting states that the deadline for the submission of renewable requests is set as 30 September 2020 for the project activities with renewable crediting period that expired before or on 31 December 2018.				
Documentation provided by project participant				
CL05: Email communication for submission of the notification of the intention to request a renewal of the crediting period on 03/11/2017.				
DOE assessment				**Date:** 12/12/2019
RINA accepts the justification provided by the PP since as per the EB 105TH meeting the extension of RFR deadline has been extended from 31/12/2018 to 30/09/2020. Based on the above justification CL05 is closed.				

Table 2. CAR from this validation

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

Table 3. FAR from this validation

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

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Document information

Version	*Date*	*Description*
03.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM validation and verification standard for project activities" (CDM-EB93-A05-STAN) and version 02.0 of the "CDM project cycle procedure for project activities" (CDM-EB93-A06-PROC); • Make editorial improvements.
02.0	31 October 2017	Revision to align with the requirements of the "CDM validation and verification standard for project activities" (version 01.0).
01.0	23 March 2015	Initial publication.

Decision Class: Regulatory
Document Type: Form
Business Function: Renewal of crediting period
Keywords: crediting period, project activities, validation report