**Verification and certification report form for GS project activities**

| VERICATION AND CERTIFICATION REPORT | |
|---|---|
| **Title of the project activity** | UPOIC Wastewater Treatment for Energy Generation, Krabi |
| **GS Reference number of the project activity** | GS 659 |
| **Version number of the verification and certification report** | 2.0 Aa |
| **Completion date of the verification and certification report** | 10/01/2018 |
| **Monitoring period number and duration of this monitoring period** | 1st Monitoring period<br>Duration: 06/05/2014 to 31/07/2014 (both days included) |
| **Version number of monitoring report to which this report applies** | Version 02 of 22/12/2017 |
| **Crediting period of the project activity corresponding to this monitoring period** | Fixed crediting period (10 years)<br>18/10/2011 to 17/10/2021 |
| **Project participant(s)** | Swiss Carbon Assets Ltd.<br>United Palm Oil Industry PCL |
| **Host Party** | Thailand |
| **Sectoral scope(s), selected methodology(ies)** | 1 : Energy industries (renewable - / non-renewable sources)<br>13 : Waste handling and disposal;<br>AMS-III.H. ver. 15 - Methane recovery in wastewater treatment<br>AMS-I.D. ver. 16 - Grid connected renewable electricity generation" |
| **Estimated GHG emission reductions or net anthropogenic GHG removals for this monitoring period in the registered PDD** | 4,291 $tCO_2e$ |
| **Certified GHG emission reductions or net anthropogenic GHG removals for this monitoring period** | 9,746 $tCO_2e$ |
| **Name of DOE** | RINA Services S.p.A. (RINA) |
| **Name, position and signature of the approver of the verification and certification report** | Laura SEVERINO<br>Sustainability & Food Certification Compliance Head |

## SECTION A. Executive summary

**Purpose and general description of the project**

The purpose of the project activity is to extract methane (biogas) from the wastewater stream through the biogas reactors and use of biogas as fuel for electricity generation in a Crude Palm Oil (CPO) plant. The captured biogas is approximately 2,622,256 m3/year piped through 2 sets of 952 kW-generator, to produce electricity which will be self-utilized in the palm oil factory and fed into the electricity grid. Any excess biogas will be flared.

**Location**

The project is located at the factory premise of United Palm Oil Industry Public Company Limited, 96 Moo 6, Nua Klong-Kao Panom Rd, Huay Yoong Sub-district, Nuaklong District, Krabi, Province, 81130 Thailand with latitude 8° 9' 2382" N and longitude 99° 1' 4009" E.

**Scope of verification**

Verification is the periodic independent review and ex-post determination by a DOE of the monitored reductions in GHG emissions that have occurred as a result of the registered GS project activity during a defined monitoring period. Certification is the written assurance by a DOE that, during a specific period in time, a project activity achieved the emission reductions as verified. The objective of this verification is to verify and certify emission reductions reported for the GS project (Reference no. 659) 'UPOIC Wastewater Treatment for Energy Generation, Krabi' for the period 06/05/2014 to 31/07/2014.

The scope of the verification is to verify that:

- The project activity has been implemented and operated in accordance with the registered PDD or any approved revised PDD;
- The monitoring plan, including compliance with any guidance provided by the Board regarding deviations from the provisions of a registered plan and/or methodology;
- The data and calculation of GHG emission reductions have been assessed to correctly support the emission reductions being claimed.

The verification shall ensure that reported emission reductions are complete and accurate in order to be certified.

**Verification process**

Verification is conducted using RINA procedures in line with the GS requirements and requirements specified in the CDM Validation and Verification Standard available at the time of the verification starts, and applying standard auditing techniques. RINA asses and determines that the implementation and operation of the project activity, and steps taken to report emission reductions comply with the GS criteria. The verification assessment involved a document review of relevant documentation and the on-site visit.

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

**Conclusion**

RINA commissioned by 'Swiss Carbon Assets Ltd.', has performed the verification of the emission reductions reported for the project activity 'UPOIC Wastewater Treatment for Energy Generation, Krabi', GS Registration Reference No. 659 for the monitoring period 06/05/2014 to 31/07/2014, with regard to the relevant GS requirements and principles for project activities. The project is also registered under CDM with reference number 4322 validated by TUV Sud (validation report N° 1233984 issued on 13/10/2011) and it was registered on 18/10/2011. The GS validation was done by RINA (validation report N° 2014-IQ-20-MD, revision 2.0Aa issued on 12/07/2016) and it was registered on 06/05/2014.

The GHG emission reductions are calculated on the basis of the approved methodology AMS-I.D, version 16, 'Grid connected renewable electricity generation' of 11/06/2010 and AMS-III.H, version 15, 'Methane recovery in wastewater treatment' of 30/07/2010 and the monitoring plan included in the registered PDD version 13 of 07/07/2016. In our opinion the GHG emission reductions reported for the project in the monitoring report version 02 of 22/12/2017 are fairly stated.

## SECTION B. Verification team, technical reviewer and approver

### B.1. Verification team member

| No. | Role | Type of resource | Last name | First name | Affiliation (e.g. name of central or other office of DOE or outsourced entity) | Involvement in | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Desk review | On-site inspection | Interview(s) | Verification findings |
| 1. | Team Leader and technical expert GS | IR | Menon | Rekha | RINA India | √ | | | √ |
| 2. | GS Verifier | IR | Buragohain | Champok | RINA India | √ | √ | √ | √ |

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

| No. | Role | Type of resource | Last name | First name | Affiliation (e.g. name of central or other office of DOE or outsourced entity) |
|---|---|---|---|---|---|
| 1. | Technical reviewer | IR | Liu | Hui Feng | RINA China Office |
| 2. | Approver | IR | Severino | Laura | RINA Central Office |

## SECTION C. Application of materiality

### C.1. Consideration of materiality in planning the verification

The CDM verification covering the monitoring period is already completed and issuance of CERs has happened. Hence, no risk found in planning the verification.

### C.2. Consideration of materiality in conducting the verification

>> The CDM verification covering the monitoring period is already completed and issuance of CERs has happened. Hence, no risk found in planning the verification.

## SECTION D. Means of verification

### D.1. Desk review

The monitoring report, version 01 of 14/11/2017 and version 02 of 22/12/2017 /**01**/, the emission reduction calculations provided in the form of a spreadsheet (UPOIC_ER-Calculation_1stMR_v04_12102015_GS.xlsx) submitted on 14/11/2017 and (UPOIC_ER-Calculation_1stMR_v04_12102015_R2_GS.xlsx) submitted on 22/12/2017 /**02**/ were assessed as part of the verification. In addition the CDM Project Design Document (PDD) and GS PDD **/03/** in particular the baseline estimations and the monitoring plan, the GS passport /**04**/ the GS validation report /**05**/, The CDM verification report covering monitoring period 18/10/2011 to 31/07/2014 /**06**/ for the project were reviewed.
The list of all documents reviewed are referenced during the verification is available in Appendix 3 below.

## D.2. On-site inspection

On 12/01/2015 and 13/01/2015, RINA visited the project facility 'United Palm Oil Industry Public Company Limited factory' located 814 km south of Bangkok in Krabi Province, Thailand. There were no hindrances or barriers that were faced by the verification team while carrying out the site visits. During the on-site assessment of the project RINA assessed the implementation and operation of the proposed project activity, reviewed the information flows for generating, aggregating and reporting the monitoring parameters, interviewed key personnel of the plant to confirm the operational and data collection procedures, cross-checked between information provided in the monitoring report and data plant, checked the monitoring equipment including calibration performance, reviewed calculations and assumptions made in determining the GHG data and emission reductions, checked the quality control and quality assurance procedures in place to prevent or identify and correct any errors or omissions in the reported monitoring parameters.

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

| | Date | Name and Role | Organization | Topic |
|---|---|---|---|---|
| /a/ | 12/01/2015 – 13/01/2015 | Ladaporn Kat Khunikakorn (CDM- Project Manager) | Swiss Carbon Asset Ltd. | Project implementation and operation.<br>Technical equipment, calibration and monitoring observation.<br>Management of the electricity meter and data collection.<br>Monitoring plan and monitoring parameters.<br>Preparation of the Monitoring Report (MR), calculation of the ER. |
| /b/ | 12/01/2015 – 13/01/2015 | Tawatchai Jaikliang (Project Coordinator) | UPOIC | Monitoring plan and monitoring parameters.<br>Management of the meter devices.<br>Technical equipment, calibration and monitoring observation.<br>Information flows for generating, aggregating and reporting the monitoring parameters.<br>Cross-check of information in the monitoring report and data source. |
| /c/ | 12/01/2015 – 13/01/2015 | Surat Aramging (Plant Supervisor) | UPOIC | |
| /d/ | 12/01/2015 – 13/01/2015 | Supathrapong Chanpanich (Factory Manager) | UPOIC | |

The project is registered under retroactive registration and first monitoring period is from 06/05/2014 to 31/07/2014. Therefore, site visit was done considering GS validation and verification of above monitoring period.

## D.3. Sampling approach

>> Sampling approach were followed for some monitoring parameters which have been already discussed under the CDM verification report. No sampling approach has been followed for GS monitoring parameters.

## D.4. Clarification requests, corrective action requests and forward action requests raised

| Areas of verification findings | No. of CR | No. of CAR | No. of FAR |
|---|---|---|---|
| Compliance of the monitoring report with the monitoring report form | - | - | - |
| Compliance of the project implementation with the registered PDD | - | - | - |
| Post-registration changes | - | - | - |
| Compliance of the monitoring plan with the monitoring methodology including applicable tool and standardized | - | - | - |

| | | | |
|---|---|---|---|
| baseline | | | |
| Compliance of monitoring activities with the registered monitoring plan | - | - | - |
| Compliance with the calibration frequency requirements for measuring instruments | - | - | - |
| Assessment of data and calculation of emission reductions or net removals | - | 1 | - |
| Others (monitoring of GS sustainable development parameters) | - | 1 | - |
| **Total** | 0 | 2 | 0 |

## SECTION E. Verification findings

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

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| **Means of verification** | Comparing the monitoring report /**01**/ with the monitoring report form provided by GS. |
| **Findings** | N/A |
| **Conclusion** | Gold Standard version 2.2 does not provide any specific monitoring report template. PP has used its own template covering monitoring parameters applicable as per GS passport. Other parameters related to emission reductions are already covered under CDM monitoring report and addressed in the CDM verification report. Hence, accepted by RINA. |

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

>> Based on the review of validation report /**05**/ and GS registration review /**13**/, no FAR found raised during the validation.

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

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| **Means of verification** | **Actual implementation of the registered project activity**:<br>During this site visit, RINA verified the actual implementation of the project and confirmed that the project is implemented and operated as described in the registered PDD version 11 dated 11/10/2011 /**03**/. The project activity involves the installation of an anaerobic wastewater treatment facility with methane capture, based on the Completely Stirred Tank Reactor (CSTR) to treat wastewater from the existing crude palm oil extraction mill and also biogas utilization for electricity generation. RINA verified the commissioning certificate of biogas plant (digester capacity 12,000 $m^3$) from ERDI (the technology supplier) dated 01/10/2009 and confirm that the project technology is as per the registered PDD /**06**/. The captured biogas is sent to two biogas engine of 952 kW each (model: SFGLD 560 with serial number 330491 and 330492) /**06**/. Electricity generated in this project activity is used for project's own consumption (gas engine system, biogas system and control room) and thereafter the net electricity is exported to the mill and to the national grid of Thailand. Excess biogas is routed to a high temperature, open flare to destroy the biogas. The details on the anaerobic digester, palm oil mill effluent (POME) entering the digester and utilization of biogas are verified to be consistent with the details provided in the registered CDM PDD /**03/**.<br>The project activity was verified on-site to consume electricity from the grid for backup and start-up purposes. RINA was able to verify this during the physical inspection of the power generation facilities on-site. The volume of wastewater entering to the digester is monitored using a flow meter (ABB, FEP311.XXX.AIAI01, serial number 1401123), the COD of wastewater before entering the digester and after treatment is measured applying closed-reflux method. This is in line with the registered PDD /**03**/. The volume of biogas generated is monitored continuously using a flow meter (KOBOLD, DOG-1120, serial number 5843), the biogas flared is monitored using a flow meter (KOBOLD, DOG-1120, serial number 5594) and volume of biogas used for power generation in two gas engines with separate flow meters (KOBOLD, DOG-1120, serial number 5592 in generator 1 and KOBOLD, DOG-1120, serial number 5593 in generator 2). The amount of electricity generated from both the gas engine (952 kW each) is monitored continuously using separate |

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| | energy meter (Carlo Gavazzi, WM3-96, serial number BI1290012101P from generator 1 and Carlo Gavazzi, WM3-96, serial number BI0980037101I from generator 2) with accuracy class 0.2S, the auxiliary electricity consumption is monitored in a separate energy meter (Merlin Gerin, PM210, serial number 0058033222), the grid energy consumption is monitored in a separated energy meter (Merlin Gerin, PM210, serial number 0058010741). The electricity exported to grid is monitored using an energy meter (EDMI, Mk6, serial number 206500126) and the export to the CPO mill is monitored in an energy meter (Schneider, PM710, serial number 4A943A98). All the above monitoring arrangements are as per the registered PDD and were found in place.<br>During the site visit, no changes have been observed or identified which may impact the additionality as there was no change in the effective output capacity, no addition of component nor extension of technology, no addition nor removal of project sites since there is only one site of the project activity, no change of values of the actual operational parameter relevant to determination of emission reductions which are within the control of the PP; no change has been observed or identified that may impact the scale of the project activity or applicability of the monitoring methodology AMS-III.H version 15 /**11**/ and AMS-I.D version 16 /**12**/.<br>In conclusion, RINA is able to confirm that: the implementation and operation of the project during this monitoring period is consistent with the registered PDD /**03**/ and the information provided in the MR /**01**/ is also in accordance with the description of the registered PDD /**03**/. |
| **Findings** | N/A |
| **Conclusion** | RINA was able assess all physical features (technology, project equipment, monitoring and metering equipment) are in place during site visit and confirms the implementation and operation of the project during this 1st monitoring period is consistent with the registered PDD; the information provided in the MR is also in accordance with the description of the registered PDD. |

## E.4. Post-registration changes

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

>>N/A

### E.4.2. Corrections

>>N/A

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

>>N/A

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

>>N/A

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

>>N/A

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

>>N/A

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

>>N/A

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

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| **Means of verification** | During this monitoring period, the validated and registered monitoring plan was found to be in accordance with the applied methodology /**11**/, **/12**/. |
| **Findings** | N/A |
| **Conclusion** | All monitoring parameters, monitoring and calibration procedures follow the methodology requirements. No recommendation was made during this verification. |

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

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

**Means of verification**

| DATA/PARAMETER<br>Unit | Source of data | Reported value for the project period | Assessment/Observation |
|---|---|---|---|
| Quantity of FFB processed per annum ($Q_{FFB}$) | Data based on registered PDD /03/ and validation report /04/ | Approximately 175,200 ton FFB/y | The value is as per the registered PDD, which has been justified and validated by validation DOE to follow the applied methodology and tool and already approved by EB /03/, /04/. |
| Volume of wastewater from the mill to the lagoons per annum in project baseline ($Q_{ww}$) | Data based on registered PDD /03/ and validation report /04/ | 102,730 | The value is as per the registered PDD, which has been justified and validated by validation DOE to follow the applied methodology and tool and already approved by EB /03/, /04/. |
| Chemical Oxygen Demand (COD) level of the untreated wastewater entering<br>anaerobic lagoons in project baseline ($COD_{untreated}$) | Data based on registered PDD /03/ and validation report /04/ | 0.0646 tons/$m^3$ | The value is ex-ante fixed for 10 years crediting period as per the registered PDD, which has been justified and validated by validation DOE to follow the applied methodology and tool and already approved by EB /03/, /04/. |
| Global Warming Potential of methane ($GWP_{CH4}$) | Data based on registered PDD /03/ and validation report /04/ | 21 $tCO_{2e}/tCH_4$ for first commitment period upto 31/12/2012 and 25 from 01/01/2013 onwards. | The value is ex-ante fixed for 10 years crediting period as per the registered PDD, which has been justified and validated by validation DOE to follow the applied methodology and tool and already approved by EB /03/, /04/. |
| Methane generation capacity of COD in waste water ($B_{o,ww}$) | Data based on registered PDD /03/ and validation report /04/ | 0.25 kg $CH_4$/kg COD | The value is ex-ante fixed for 10 years fixed crediting period as per the registered PDD, which has been justified and validated by validation DOE to follow the applied methodology and tool and already approved by EB /03/, /04/. |

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| | Model correction factor to account of model uncertainties ($UF_{BL}$) | Data based on registered PDD /03/ and validation report /04/ | 0.89 | The value is ex-ante fixed for 10 years fixed crediting period as per the registered PDD, which has been justified and validated by validation DOE to follow the applied methodology and tool and already approved by EB /03/, /04/. |
| | Model correction factor to account of model uncertainties ($UF_{PJ}$) | Data based on registered PDD /03/ and validation report /04/ | 1.12 | The value is ex-ante fixed for 10 years fixed crediting period as per the registered PDD, which has been justified and validated by validation DOE to follow the applied methodology and tool and already approved by EB /03/, /04/. |
| | Methane correction factor for the baseline anaerobic wastewater treatment systems ($MCF_{WW,treatment,BL}$) | Data based on registered PDD /03/ and validation report /04/ | 0.8 for anaerobic deep lagoon and 0.3 for aerobic poor managed. | The value is ex-ante fixed for the fixed 10 years crediting period as per the registered PDD, which has been justified and validated by validation DOE to follow the applied methodology and tool and already approved by EB /03/, /04/. |
| | The chemical oxygen demand removed by the anaerobic wastewater treatment system in the project baseline ($COD_{removal,y}$) | Data based on registered PDD /03/ and validation report /04/ | 0.0622 from anaerobic pond and 0.00048 from aerobic, poor managed pond. | The value is ex-ante fixed for the fixed 10 years crediting period as per the registered PDD, which has been justified and validated by validation DOE to follow the applied methodology and tool and already approved by EB /03/, /04/. |
| | Methane correction factor based on discharge pathway in the baseline situation / Methane correction factor based on discharge pathway in the project situation ($MCF_{WW,BL,discharge}$/$MCF_{ww,PJ,discharge}$) | Data based on registered PDD /03/ and validation report /04/ | 0.1 | The value is ex-ante fixed for the fixed 10 years crediting period as per the registered PDD, which has been justified and validated by validation DOE to follow the applied methodology and tool and already approved by EB /03/, /04/. |
| | Methane correction factor for project wastewater treatment system equipped with biogas recovery and combustion ($MCF_{WW,treatment,PJ}$) | Data based on registered PDD /03/ and validation report /04/ | 0.8 | The value is ex-ante fixed for 10 years fixed crediting period as per the registered PDD, which has been justified and validated by validation DOE to follow the applied methodology and tool and already approved by EB /03/, /04/. |

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| | Capture efficiency of the biogas recovery equipment in the wastewater treatment ($CFE_{WW}$) | Data based on registered PDD /03/ and validation report /04/ | 0.9 | The value is ex-ante fixed for 10 years fixed crediting period as per the registered PDD, which has been justified and validated by validation DOE to follow the applied methodology and tool and already approved by EB /03/, /04/. |
| | Grid emission factor of Thailand ($EF_{y,grid}/EF_{y,consumed}$) | Data based on registered PDD /03/ and validation report /04/ | 0.52 $tCO_2/MWh$ | The value is ex-ante fixed for 10 years fixed crediting period as per the registered PDD, which has been justified and validated by validation DOE to follow the applied methodology and tool and already approved by EB /03/, /04/. |
| | Density of methane at normal conditions ($\rho_{CH4}$) | Data based on registered PDD /03/ and validation report /04 | 0.716 $kg/m^3$ | The value is ex-ante fixed for 10 years fixed crediting period as per the registered PDD, which has been justified and validated by validation DOE to follow the applied methodology and tool and already approved by EB /03/, /04/. |
| **Findings** | N/A | | | |
| **Conclusion** | RINA is able to confirm that the Data and parameters fixed ex ante have been implemented in full compliance with the registered monitoring plan | | | |

### E.6.2. Data and parameters monitored

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| **Means of verification** | Data parameters monitored related to GHG emission reductions covering monitoring period 18/10/2011 to 31/07/2014 has already been verified and certified under CDM /**06**/. Since, the GS verification period (06/05/2014 to 31/07/2014) is within the verified GS verification period; data parameters are not repeated here. The CDM monitoring report and verification report is referred /**14**/, /**06**/. The certified emission reduction worksheet as available at UNFCCC for the CDM verification period (18/10/2011 to 31/07/2014) has been referred and values from 06/05/2014 to 31/07/2014 (GS monitoring period) is taken for GS labelling. The data has been already verified and hence, accepted. |
| **Findings** | N/A |
| **Conclusion** | RINA confirms:<br>- That all the parameters stated in the approved monitoring plan have been monitored;<br>- The responsibilities and authorities for monitoring and reporting are in accordance with those stated in the approved monitoring plan;<br>- The monitoring results are consistently recorded as per the approved frequency;<br>- Quality assurance and quality control procedure have been applied in accordance with the registered PDD. |

### E.6.3. Implementation of sampling plan

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| **Means of verification** | Sampling approach are followed for some monitoring parameters related to GHG emission reduction estimation which have been already discussed under the CDM verification report **/06/** and CDM monitoring report /**14**/. No sampling approach has been followed for GS monitoring parameters. |
| **Findings** | N/A. |
| **Conclusion** | RINA confirms that the sampling size and the method of onsite verification was in line with the requirements of the sampling standard /**15**/. |

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

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| **Means of verification** | Calibration frequency and requirements for measuring instruments related to GHG emission reductions covering monitoring period 18/10/2011 to 31/07/2014 has already been verified and certified under CDM /**06**/. Since, the GS verification period (06/05/2014 to 31/07/2014) is within the verified GS verification period; Calibration frequency and requirements for measuring instruments are not repeated here. The CDM monitoring report and verification report is referred /**14**/, /**06**/. |
| **Findings** | N/A |
| **Conclusion** | N/A |

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

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

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| **Means of verification** | Baseline emission ($BE_{y,ex\ post}$) for AMS III.H:<br>The baseline emissions using ex-post monitored value involve only the component of baseline emissions of the wastewater treatment system as described in the PDD /**03**/ and is calculated as:<br>$BE_{y,ex\ post} = BE_{CH4,y} = BE_{ww,treatment,y} + BE_{ww,discharge,y}$<br><br>Where,<br>$BE_{ww,treatment,y} = \Sigma Q_{ww,i,y} * COD_{removed,i,y} * MCF_{ww,treatment,BL,i} * B_{o,ww} * UF_{BL} * GWP_{CH4}$<br><br>Flow of wastewater treated in the year y ($Q_{ww,y}$): The reported value during the monitoring period is 40,651 $m^3$. RINA has verified the values in the monitoring report /**14**/ against the daily recording of volume of the wastewater treated digesters/**06**/, which is in line with the requirements of the registered monitoring plan /**03**/ and the applied monitoring methodology AMS-III.H version 15 /**11**/. Daily wastewater flow to digester is recorded in log books as per readings in flow meter totalizer (difference of previous days reading and the reporting day) /**06**/. When the mill does not operate the reported value is kept as zero and the emission reduction worksheet represents the same /**02**/. Hence, RINA was able to determine that all data applied in the emission reduction calculation spread sheet /**02/** and monitoring report /**14**/ were correct and from the original data.<br>$COD_{removed,y}$: In line with the methodology and registered PDD, $COD_{removed,y}$ for anaerobic deep lagoon is estimated considering *ex-post* monitored value of $COD_{ww,untreated,y}$ and COD removal efficiency of 85.7% determined *ex-ante* considering COD campaign data and 0.89 uncertainty range and for poorly managed aerobic lagoon considering 19.80% baseline removal efficiency and 0.89 uncertainty range. This is as per registered PDD and applied methodology /**02**/, **/03/, /11/**. $COD_{ww,untreated,y}$ is analyzed daily (closed reflux Tirtrimetric method) in in-house laboratory from sample of wastewater entering digesters and average weekly value is reported in ER sheet. Further, external laboratory analysis was done on monthly basis and conservative value is applied in ER calculation /**02**/. This is in line with the registered PDD. RINA has verified the values in the monitoring report /**14**/ against the Original test reports of the $COD_{ww,untreated,y,}$ /**06**/ which is in line with the requirements of the registered monitoring plan /**03**/ and the applied monitoring methodology AMS-III.H version 15 /**11/.**<br>Methane correction factor for baseline wastewater treatment system i ($MCF_{ww,treatment,BL,i}$) has been fixed ex-ante as 0.8 for anaerobic deep lagoon and 0.3 for aerobic poor managed lagoon/**03**/. Methane producing capacity of the wastewater ($B_{o,ww}$) has been fixed ex-ante as 0.25 kg CH4/kg COD /**03**/. Model correction factor to account for model uncertainties ($UF_{BL}$) is fixed ex-ante to be 0.89 /**03**/. Global Warming Potential for methane ($GWP_{CH4}$) is fixed 25 from 01/01/2013 onwards as per IPCC /**03**/, /**06**/.<br>Therefore, $BE_{ww,treatment,y}$ for the monitoring period is 11,518.96 $tCO_{2e}$.<br><br>Similarly, $BE_{ww,discharge,y}$ is calculated as follows:<br>$B_{ww,discharged,y} = \sum(Q_{ww,i,y} * COD_{ww,discharged,BL,y} * MCF_{ww,BL,discharge,y}) * B_{o,ww} * UF_{BL} *$ |

| | |
|---|---|
| | $GWP_{CH4}$<br>During the monitoring period the monitored data for volume of wastewater discharged ($Q_{ww,discharged,y,(outlet)}$) was not available and therefore in line with appendix 1 of project standard PP has considered this value as zero and hence, $BE_{ww,discharge,y}$ for the monitoring period is reported zero on conservative side.<br>In summary, $BE_{y,ex\ post}$ for the monitoring period is 11,518.96 $tCO_{2e}$.<br>Baseline emissions for the electricity displaced by the project activity ($BE_{power,y}$) are calculated based on AMS-I.D version 16 /**12**/, /03/ as follows:<br>$BE_{power,y} = EG_{BL,y} * EF_{CO2,\ grid,y}$<br>$EG_{BL,y}$ is the net electricity generated from the biogas collected in the anaerobic treatment facility and sent to the grid is monitored using an energy meter under the control of PEA and monthly report is generated by PEA as per readings. The values in the ER sheet is taken against the monthly PEA reports /**06**/ and cross checked against the monthly invoices raised /**06**/ and confirm the values to be correct. The $EG_y$ for the current monitoring period is 1,706 MWh. Grid emission factor ($EF_{CO2}$) is fixed ex-ante to be 0.52 $tCO_2$/MWh as per registered PDD /**03**/. Therefore, $BE_{power,y}$ for the current monitoring period is 887 $tCO_{2e}$ /**02**/.<br>Therefore, total baseline emissions from methane avoidance (COD approach) and power component is 12,406 $tCO_2e$.<br><br>The calculation of $BE_{y,ex\text{-}post}$ and $BE_{power,y}$ is reflected in the monitoring report /01/, and CER spreadsheet /02/. |
| **Findings** | N/A |
| **Conclusion** | RINA confirms that baseline emissions have been appropriately calculated and are consistent with site visit observations, the applied methodology and registered PDD **/01/, /02**/, **/03/, /04/, /05/, /06/.** |

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

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|---|---|
| **Means of verification** | Project emissions are calculated as:<br>$PE_y = PE_{power,y} + PE_{ww,treatment,y} + PE_{ww,discharge,y} + PE_{fugitive,y} + PE_{flaring,y}$<br><br>Emissions from electricity or fossil fuel consumption in the year y ($PE_{power,y}$) is calculated as follows:<br>$PE_{power,y}=\Sigma EC_{PJ,y} * FE_{EL,y}$<br>Electricity consumed by biogas system from grid ($EC_{PJ,y}$) is monitored to be 4 MWh during the monitoring period as per daily energy meter readings /**06/**. Electricity consumption from biogas plant is neglected since this is from the project itself and hence do not result to project emissions. Therefore considering $FE_{EL,y}/EF_{CO2}$ 0.52 $tCO_{2e}$/MWh (Fixed *ex-ante*), $PE_{power,y}$ is estimated to be 2 $tCO_{2e}$ for the current monitoring period.<br><br>Emissions in wastewater not equipped with biogas recovery system and are calculated as per AMS-III.H and as follows:<br>$PE_{ww,treatment,y} = \sum Q_{ww,k,y} \times COD_{removed,PJ,ky} \times MCF_{ww,treatment,PJ,k} \times B_{o,ww} \times UF_{PJ} \times GWP_{CH4}$<br><br>Flow of wastewater treated in the year y ($Q_{ww,y}$): The reported value during the monitoring period is 40,651 $m^3$. RINA has verified the values in the monitoring report /**14**/ against the daily recording of volume of the wastewater treated digesters/**06**/, which is in line with the requirements of the registered monitoring plan /**03**/ and the applied monitoring methodology AMS-III.H version 15 /**11**/. Daily wastewater flow to digester is recorded in log books as per readings in flow meter totalizer (difference of previous days reading and the reporting day) /**06**/. When the mill does not operate the reported value is kept as zero and the emission reduction worksheet represents the same /**02**/. Hence, RINA was able to determine that all data applied in the emission reduction calculation spread sheet /**02/** and monitoring report /**01**/ were correct and from the original data. |

$COD_{removed,PJ,k,y}$: In line with the methodology $COD_{removed,PJ,k,y}$ is calculated as difference between $COD_{in}$ and $COD_{out}$. $COD_{in}$ before cooling pond, $COD_{out}$ after cooling pond, $COD_{in}$ after the reactors and before post treatment ponds and $COD_{out}$ after post treatment ponds are analyzed daily (closed reflux Tirtrimetric method) from sample of wastewaters and average weekly value is reported in ER sheet. RINA has verified the values in the monitoring report /**14**/ against the Original test reports /**06**/ which is in line with the requirements of the registered monitoring plan /**03**/ and the applied monitoring methodology AMS-III.H version 15 /**11**/. Global Warming Potential for methane ($GWP_{CH4}$) is fixed as 25 from 01/01/2013 onwards as per IPCC **/03/, /06/**. Methane producing capacity of the wastewater ($B_{o,ww}$) is fixed ex-ante to be 0.25 kg $CH_4$/kg COD as per IPCC **/03/**. Model correction for uncertainties ($UF_{PJ}$) is fixed ex-ante to be 1.12 as per registered PDD **/03/** and applied methodology **/11/**. Methane correction factor for project wastewater treatment system k without biogas recovery ($MCF_{ww,treatment,PJ,k}$) is fixed ex-ante to be 0.3 as per registered PDD /**03**/. $PE_{ww,treatment,y}$ for the monitoring period is 1,411.34 $tCO_{2e.}$

Project emissions on account of inefficiency of the project activity wastewater treatment system and presence of degradable organic carbon in treated wastewater ($PE_{ww,discharge,y}$) is calculated as below:

$$PE_{ww,discharge,y} = \sum(Q_{ww,k,y} * COD_{ww,discharge,PJ} * MCF_{ww,PJ,discharge}) * B_{o,ww} * UF_{PJ} * G$$

Flow of wastewater treated in the year y ($Q_{ww,y}$) during the monitoring period is 40,651 $m^3$ as explained in above. $COD_{discharge,PJ}$ after post treatment ponds is analyzed daily (closed reflux Tirtrimetric method) from sample of wastewaters and average weekly value is reported in ER sheet. RINA has verified the values in the monitoring report /**14**/ against the Original test reports /**06**/ which is in line with the requirements of the registered monitoring plan /**03**/ and the applied monitoring methodology AMS-III.H version 15 /**11**/. Global Warming Potential for methane ($GWP_{CH4}$) is fixed 25 from 01/01/2013 onwards as per IPCC **/03/, /06/**. Methane producing capacity of the wastewater ($B_{o,ww}$) is fixed ex-ante to be 0.25 kg $CH_4$/kg COD as per IPCC **/03/**. Model correction for uncertainties ($UF_{PJ}$) is fixed ex-ante to be 1.12 as per registered PDD **/03/** and applied methodology **/11/**. Methane correction factor for project wastewater treatment system k without biogas recovery ($MCF_{ww,PJ,discharge}$) is fixed ex-ante to be 0.1 as per registered PDD /**03**/. $PE_{ww,discharge,y}$ for the monitoring period is 47 $tCO_{2e.}$

Methane fugitive emissions on account of inefficiencies in capture systems ($PE_{fugitive,y}$) are determined as per AMS-III.H and as follows:

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

Excess sludge was not found generated during the monitoring period. Hence, $PE_{fugitive,s,y}$ is considered zero in this monitoring period.

Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems in the year y ($PE_{fugitive,ww,y}$) is estimated as follows:

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

Capture efficiency of the biogas recovery equipment in the wastewater treatment ($CFE_{ww}$) is fixed ex-ante to be 0.9 as per registered PDD /**03**/. Global Warming Potential for methane ($GWP_{CH4}$) is fixed 25 from 01/01/2013 onwards as per IPCC /**03/,/06**/.

Methane emission potential of wastewater treatment systems equipped with biogas recovery system in year y ($MEP_{ww,treatment,y}$) is calculated as follows:

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

Flow of wastewater treated in the year y ($Q_{ww,y}$) during the monitoring period is 40,651 $m^3$ as explained in above.

Methane producing capacity of the wastewater ($B_{o,ww}$) is fixed ex-ante to be 0.25 kg $CH_4$/kg COD /**03**/. Model correction factor to account for model uncertainties ($UF_{PJ}$) is fixed ex-ante to be 1.12 /**03**/. Methane correction factor for wastewater treatment system k equipped with biogas recovery ($MCF_{ww,treatment,PJ,k}$) is fixed ex-ante to be 0.8 as per registered PDD /**03**/.

| | |
|---|---|
| | $COD_{removed,PJ,k,y}$ is calculated as the difference between $COD_{ww,untreated,y}$ and $COD_{ww,treated,y}$ **/03/**. $COD_{ww,untreated,y}$ and $COD_{ww,treated,y}$ is analyzed daily (closed reflux Tirtrimetric method) from sample of wastewater entering digesters and leaving the digester and weekly average value is reported in ER sheet /02/. RINA has verified the values in the monitoring report /**14**/ against the Original test reports /**06**/ which is in line with the requirements of the registered monitoring plan /**03**/ and the applied monitoring methodology AMS-III.H version 15 /**11**/. $MEP_{ww,treatment,y}$ for the monitoring period is 479 tonnes and $PE_{fugitive,ww,y}$ for the monitoring period is 1,197 $tCO_{2e}$ /**02**/.<br><br>Project Emissions from flaring in year y ($PE_{flare,y}$) is calculated as per the "Tool to determine project emissions from flaring gases containing methane" version 01 /**13**/ and as follows:<br>$$PE_{flare,y} = \sum TM_{RG,h} \times (1-\eta_{flare,h}) \times GWP_{CH4} / 1000$$<br>Global Warming Potential for methane ($GWP_{CH4}$) is fixed 25 from 01/01/2013 onwards as per IPCC **/03/, /06/.** Flare efficiency in hour 'h' ($\eta_{flare,h}$) as per the registered PDD is 90% default for enclosed flare in line with the 'Tool to determine project emissions from flaring gases containing methane' /**03**/, /**06**/. However, during the monitoring period the monitoring was not recorded as per defined monitoring procedure and hence efficiency is considered 0% for the current monitoring period in line with the tool /**13**/.This is considered conservative approach to estimate project emission from flaring and as per Appendix 1 of project standard version 07 prior approval is not required /**09/.**<br>Mass flow rate of methane in the residual gas in hour 'h' ($TM_{RG,h}$) is calculated as per the 'Tool to determine project emissions from flaring gases containing methane' as follows:<br>$TM_{RG,h} = FV_{RG,h} * fv_{CH4,RG,h} * \rho_{CH4,n,h}$<br>Density of methane at normal condition ($\rho_{CH4,n,h}$) is fixed ex-ante to be 0.716 $kg/m^3$ as per the 'Tool to determine project emissions from flaring gases containing methane' /**06**/.<br>Biogas sent to flare ($FV_{RG,h}$/ $BG_{Flare,y}$) is recorded zero for the monitoring period. Hence, $PE_{flaring,y}$ for the monitoring period is 0 $tCO_{2e}$ **/02/.**<br>Therefore, total project emissions pertaining to the monitoring period is 2,657.419 $tCO_2e$. |
| **Findings** | N/A |
| **Conclusion** | RINA confirms that project emissions have been appropriately calculated and are consistent with site visit observations, the applied methodology and registered PDD **/01/, /02**/, **/03/, /04/, /05/, /06/.** |

### E.8.3. Calculation of leakage GHG emissions

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|---|---|
| **Means of verification** | N/A |
| **Findings** | N/A |
| **Conclusion** | N/A |

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

| | |
|---|---|
| **Means of verification** | The emission reduction (ER) is the sum of the ER from type I component ($BE_{power,y}$) and the ER achieved from the type III component of the project activity ($ER_{y,ex\ post}$). ER from the type I component ($BE_{power,y}$) for this monitoring period is 887 $tCO_{2e}$.<br>As per the applied methodologies AMS-III.H version 15 /**11**/, the emission reductions achieved from type III component ($ER_{y,ex\ post}$) in any year are the lowest value of the following:<br><br>$ER_{y,ex\ post} = \min((BE_{y,ex\ post} - PE_{y,ex\ post} - LE_{y,ex\ post}), (MD_y - PE_{power,y} - LE_{y,ex\ post}))$<br>For the current monitoring period the achieved $BE_{y,ex\ post}$ is 11,518 $tCO_{2e}$, achieved $PE_{y,ex\text{-}post}$ is 2,657.42 $tCO_{2e}$ and $LE_{y,ex\text{-}post}$ is zero as explained in above.<br>As per equation 16 of AMS-III.H, version 15, in case of flaring/combustion MDy will be measured using the conditions of the flaring process: |

| | |
|---|---|
| | $MD_y = BG_{burnt,y} * w_{CH4,y} * D_{CH4} * FE * GWP_{CH4}$<br>The $BG_{burnt,y}$ is the sum of total biogas fired in generator ($FV_{electricity,y}$) and biogas flared ($FV_{RG,h}$). RINA has verified the values in the monitoring report /**14**/ against the daily recording of the amount of biogas flared ($FV_{RG,h}$) and biogas fired in generator ($FV_{electricity,y}$) /**06**/, which is in line with the requirements of the registered monitoring plan /**03**/ and the applied monitoring methodology AMS-III.H version 15 /**11/**. Density of methane at normal condition ($D_{CH4}$) is fixed ex-ante to be 0.716 kg/$m^3$ as per the 'Tool to determine project emissions from flaring gases containing methane' /**06**/. Global Warming Potential for methane ($GWP_{CH4}$) is fixed 25 from 01/01/2013 onwards as per IPCC **/03/, /06/.** Flare efficiency in hour 'h' ($\eta_{flare,h}$) as per the registered PDD is 90% default for enclosed flare in line with the 'Tool to determine project emissions from flaring gases containing methane' /**03**/, /06/. However, during the monitoring period the monitoring was not recorded as per defined monitoring procedure and hence efficiency is considered 0% for the current monitoring period in line with the tool /**06**/.This is considered conservative approach. Methane fraction ($W_{CH4}$) is as per continuous measurement and daily records /**06**/. Methane fraction is measured near the biogas flow meter (generator inlet) and hence complies the methodology requirements. The reported value ensure lower value in 90/10 confidence level for conservative estimation.<br>Therefore, $BG_{burnt}$ for the monitoring period from 06/05/2014 to 31/07/2014 amounts to 1528,897 $Nm^3$/**02**/. Accordingly, MDy achieved during this monitoring period is 15,162.61 $tCO_2e$.<br>Therefore,<br>$ER_{y,ex\ post} = min((BE_{y,ex\ post} – PE_{y,ex\ post} – LE_{y,ex\ post}), (MD_y – PE_{power,y} – LE_{y,ex\ post}))$<br>= min (11,518 + 887- 2,657.42 - 0), (15,162.61 + 887 – 2- 0)<br>= min (9,746), (16,047) $tCO_2e$<br>= 9,746 $tCO_2e$.<br>Therefore, $ER_{y,ex\ post}$ has been calculated considering minimum of the two as emission reduction for the monitoring period /**02/**.<br>Accordingly, emission reduction achieved during the monitoring period is 9,746 $tCO_{2e.}$ |
| **Findings** | N/A |
| **Conclusion** | The data presented in the monitoring report /**01**/ and emission reduction worksheet /02/ were assessed by reviewing in detail project documentation, collection of monitored data, observation of established monitoring and reporting practices and assessment of the reliability of monitoring equipment. Sufficient evidences were presented and verified by RINA for the reported emission reductions as listed above. |

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

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| **Means of verification** | The emission reductions from the project for the monitoring period as reported in the monitoring report revision 2.0 of 22/12/2017 /**01**/ is equivalent to 9,746 $tCO_{2e}$. The reported emission reductions are 127% higher than the estimated emission reduction of 4,291 $tCO_{2e}$ for the period as per the registered PDD /**03**/. |
| **Findings** | CAR 01 was raised as wrong value for $MCF_{ww,\ treatment,\ PJ,\ anaerobic\ treatment\ in\ the\ post\ treament\ (pond\ 1\ \&\ 2)}$ was considered to which PP has corrected the same in revised ER sheet. The factor is now as per registered PDD and hence, accepted by the verification team. |
| **Conclusion** | The emission reduction calculations provided in the spreadsheet /**02**/ have been verified to be correct and in line with the registered PDD /**03/.** |

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

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|---|---|
| **Means of verification** | Review of calculation and monitoring records. |
| **Findings** | N/A |
| **Conclusion** | The higher emission reduction achieved is due to the fact that very short monitoring period is considered. Although, for longer duration 18/10/2011 to 31/07/2014 the certified emission reductions are 55,477 $tCO_{2e}$ against the estimated emission reductions of 52,506 $tCO_{2e}$ which is 5.66% higher. The variation is very minor and |

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| | emission reductions are already certified under UNFCCC CDM. Hence, accepted by the verification team. |

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

| | |
|---|---|
| **Means of verification** | <table><tr><td>GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012</td><td>GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards</td></tr><tr><td>NA</td><td>9,746 $tCO_2e$.</td></tr></table><br>Year-wise break-up of emission reductions:<br><table><tr><td>Year</td><td>Emission Reductions ($tCO_2e$)</td></tr><tr><td>06/05/2014 to 31/07/2014</td><td>9,746 $tCO_2e$</td></tr></table> |
| **Findings** | N/A |
| **Conclusion** | The emission reduction calculations provided in the spreadsheet /**02**/ have been verified to be correct and in line with the registered PDD /**03**/, also the values are consistently reported in the MR for this monitoring period |

### E.8.8. Assessment of the sustainability parameters

| | |
|---|---|
| **Means of verification** | <table><tr><th>Data variable</th><th>Source of Data</th><th>Reported value for the project period</th></tr><tr><td>Water Quality</td><td>Laboratory analysis reports /16/</td><td>0.0046 ton/m3</td></tr><tr><td colspan="3">Assessment</td></tr><tr><td colspan="3">COD of wastewater entering the digester and after digester is analysed daily and results are recorded. Results show that COD leaving the digester is lower than the initial value /16/. Hence, compared to baseline scenario, where higher COD in wastewater would have resulted higher water pollution the project activity reduces the same utilizing the wastewater in digester. Hence, desired results are achieved.</td></tr></table><br><table><tr><th>Data variable</th><th>Source of Data</th><th>Reported value for the project period</th></tr><tr><td>Quantitative employment and Income generation</td><td>List of employee and payment details /17/.</td><td>As per the employee list, 8 persons have been employed PP.</td></tr><tr><td colspan="3">Assessment</td></tr><tr><td colspan="3">List of employees and payment details were checked /17/. It is confirmed that 8 employment has been generated for the project activity and average monthly salary found to be around 21,025 TBH which is higher than baseline scenario (6,098 THB/month). Hence, the desired results are achieved for the monitoring period.</td></tr></table><br><table><tr><th>Data variable</th><th>Source of Data</th><th>Reported value for the project period</th></tr><tr><td>Technology transfer and self-reliance</td><td>Training records /18/.</td><td>Trainings provided to employees.</td></tr><tr><td colspan="3">Assessment</td></tr><tr><td colspan="3">Trainings related to health and safety, energy management, operation and maintenance of biogas plants, safety at work place etc, are provided to project employees which results in quality of employment and knowledge in technology transfer /18/. Training records are verified. Hence, the desired results are achieved for the monitoring period.</td></tr></table> |
| **Findings** | CAR 02 was raised to provide monitoring results of sustainable development parameters in the monitoring report to which PP has provided the same in revised MR. Hence, response is accepted and CAR is closed. |

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| **Conclusion** | RINA confirms that monitoring of all the sustainable development monitoring parameters during this monitoring period is in line with registered GS passport and are consistent with site visit observations **/01/, /04/, /05/.** |

## SECTION F. Internal quality control

The draft final verification report before being submitted to the client is subjected to an independent technical review to confirm that all validation activities has been completed according to the pertinent RINA's procedures. The technical review is performed by a technical reviewer(s) qualified in accordance with the RINA's qualification procedure.

## SECTION G. Verification opinion

RINA Services Spa (RINA) has performed verification of the emission reductions reported for the project activity 'UPOIC Wastewater Treatment for Energy Generation, Krabi', GS Registration Reference No. 659 for the period 06/05/2014 to 31/07/2014, with regard to the relevant GS requirements and principles. The project participants are responsible for the preparation for the collection of data in accordance with the monitoring plan and the reporting emission reductions from the project. It is RINA's responsibility to express an independent verification opinion on the reported emission reductions from the project and does not express any opinion on the selected baseline scenario or on the validated and registered PDD. Based on documented evidences and corroborated by an on-site assessment RINA can confirm that: (i) the project has been implemented and operated as per the registered PDD; (ii) the monitoring report and other supporting documents provided are complete and verifiable and in accordance with the applicable GS requirements and principles; (iii) the monitoring is in place as per the applied baseline and monitoring methodology; (iv) the monitoring complies with the registered monitoring plan; (v) the monitoring plan in the registered PDD is as per the applied baseline and monitoring methodology.

## SECTION H. Certification statement

It is RINA's opinion that the GHG emission reductions stated in the monitoring report version 2.0 of 22/12/2017 for the project activity 'UPOIC Wastewater Treatment for Energy Generation, Krabi' in Thailand, for the period 06/05/2014 to 31/07/2014 are fairly stated. The GHG emission reductions were calculated correctly on the basis of the approved monitoring methodology AMS-I.D, version 16, 'Grid connected renewable electricity generation' of 11/06/2010 and AMS-III.H, version 15, 'Methane recovery in wastewater treatment' of 30/07/2010. Hence RINA is able to certify that the emission reductions from the project during the monitoring period 06/05/2014 to 31/07/2014 amount to 9,746 $tCO_2e$.

# 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) |
| $CH_4$ | Methane |
| CR | Clarification Request |
| $CO_2$ | Carbon dioxide |
| $CO_2e$ | Carbon dioxide equivalent |
| DNA | Designated National Authority |
| DOE | Designated Operational Entity |
| EB | Executive Board |
| ER | Emission Reductions |
| FAR | Forward Action Request |
| GHG(s) | Greenhouse gas(es) |
| GS | Gold Standard |
| 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 |
| PP(s) | Project Participant(s) |
| Ref. | Document Reference |
| RINA | RINA Services S.p.A: |
| SS(s) | Sectoral Scope(s) |
| 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 SERVICES

classification, certification, inspection & testing

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

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

è qualificato come: / *is qualified as:* **TEC, VAL, VER, TL, ITRP**

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

| AREE TECNICHE *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 |

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

Responsabile di schema
*Scheme Leader*
Rita Valoroso

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

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

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

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

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classification, certification, inspection & testing

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

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

**Champok Buragohain**

è qualificato come:
*is qualified as:*

**TEC, VAL, VER, TL, ITR, Local Expert**

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

| AREE TECNICHE<br>*TECHNICAL AREAS* | DESCRIZIONE DELL'AREA TECNICA<br>*TECHNICAL AREA DESCRIPTION* | SCOPO SETTORIALE<br>*SECTORAL SCOPE* |
|---|---|---|
| 1.2 | Renewables | 1 |
| 2.1 | Electricity distribution | 2 |
| 13.1 | Solid waste and wastewater | 13 |
| 13.2 | Manure | 13 |

| REVISIONE<br>*REVISION* | DATA<br>*DATE* | MOTIVAZIONI PER LA REVISIONE<br>*REASON FOR THE REVISION* |
|---|---|---|
| 0 | 19/07/2016 | First issue with new template (this certificate is linked to CDM qualification) |
| 1 | 11/07/2017 | Qualification update |

Responsabile di schema
*Scheme Leader*
Laura SEVERINO

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

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

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

RINA SERVICES

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

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

**Hui Feng Liu**

è qualificato come:
*is qualified as:*

**TEC, VAL, VER, TL, ITRP**

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

| AREE TECNICHE<br>*TECHNICAL AREAS* | DESCRIZIONE DELL'AREA TECNICA<br>*TECHNICAL AREA DESCRIPTION* | SCOPO SETTORIALE<br>*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 |

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

Responsabile di schema
*Scheme Leader*
Rita Valoroso

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

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

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

# Appendix 3. Documents reviewed or referenced

| No. | Author | Title | References to the document | Provider |
|---|---|---|---|---|
| 1 | South Pole Carbon Asset Management Ltd. | Monitoring report for project activity "UPOIC Wastewater Treatment for Energy Generation, Krabi'" in Thailand | Version 1.0 of 14/11/2017 and version 02 of 22/12/2017 | PP |
| 2 | South Pole Carbon Asset Management Ltd. | Emission reduction calculation spreadsheet (UPOIC_ER-Calculation_1stMR_v04_12102015_GS.xlsx)<br>UPOIC_ER-Calculation_1stMR_v04_12102015_R2_GS.xlsx | Submitted on 14/11/2017 and submitted on 22/12/2017 | PP |
| 3 | United Palm Oil Industry PCL | Registered CDM PDD for project activity "UPOIC Wastewater Treatment for Energy Generation, Krabi'" in Thailand<br>Registered GS PDD | Version 11 of 11/10/2011<br><br>Version 13 of 07/07/2016 | PP |
| 4 | South Pole Carbon Asset Management Ltd. | GS passport for the project 'UPOIC Wastewater Treatment for Energy Generation, Krabi'" in Thailand | Version 05 of 07/07/2016 | PP |
| 5 | RINA | GS validation report (for the project activity 'UPOIC Wastewater Treatment for Energy Generation, Krabi' in Thailand | Revision 2.0 Aa of 12/07/2016 | DOE |
| 6 | RINA | CDM Verification report for the project 'UPOIC Wastewater Treatment for Energy Generation, Krabi' in Thailand covering monitoring report 18/10/2011 to 31/07/2014 | Revision 2.0 Aa of 21/10/2015 | Publicly available |
| 7 | The Gold Standard | Gold Standard Requirements | version 2.2 of 01/06/2012 | Publicly available |
| 8 | The Gold Standard | Gold Standard Toolkit | version 2.2 of 01/06/2012 | Publicly available |
| 9 | CDM Executive Board | Clean Development Mechanism Project Standard | Version 01.0 of 03/03/2017 | Publicly available |
| 10 | CDM Executive Board | Clean Development Mechanism validation and verification standard | Version 01.0 of 03/03/2017 | Publicly available |
| 11 | CDM Executive Board | Baseline and monitoring methodology "AMS-III.H", "Methane recovery in wastewater treatment", | Version 15 of 30/07/2010 | Publicly available |
| 12 | CDM Executive Board | Baseline and monitoring methodology "AMS-I.D", "Grid connected renewable electricity generation", | version 16 of 28/05/2010 | Publicly available |
| 13 | GS foundation | Final GS registration review | GS feedback round II dated 05/08/2016 | PP |
| 14 | South Pole Carbon Asset Management Ltd. | CDM monitoring report for the project 'UPOIC Wastewater Treatment for Energy Generation, Krabi' in Thailand covering monitoring report 18/10/2011 to 31/07/2014 | Version 05 of 06/10/2015 | Publicly available |
| 15 | UNFCCC | Standard for sampling and surveys for CDM project activities and | Version 05.0 of 16/10/2015 | Publicly available |

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|---|---|---|---|---|
| | | programme of activities | | |
| 16 | United Palm Oil Industry PCL | Log book records (as per laboratory test report) for daily COD in wastewater before entering in digester, after leaving the digesters and at discharge for the project activity for the period from 18/10/2011 to 31/07/2014 | Laboratory reports | PP |
| 17 | United Palm Oil Industry PCL | List of employees in the project activity with payment records from the year 2011 to 2014 | Employment records | PP |
| 18 | United Palm Oil Industry PCL | Training records provided to project employees during the period year 2011 to year 2014 | Training records | PP |

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

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

No FAR to be addressed.

**Table 2. CR from this verification**

No CR raised.

**Table 3. CAR from this verification**

| **CAR ID** | 01 | **Section no.** | E.6.2/ E.8.5 | **Date:** 30/11/2017 |
|---|---|---|---|---|
| **Description of CAR** | | | | |
| $MCF_{ww,\ treatment,\ PJ,\ anaerobic\ treatment\ in\ the\ post\ treament\ (pond\ 1\ \&\ 2)}$ is considered 1.8 in the calculation. Please clarify. Also clarify how the ex-ante estimation has been arrived for the applicable GS monitoring period. | | | | |
| **Project participant response** | | | | **Date:** 22/12/2017 |
| • The applied value of MCFww, treatment, PJ, anaerobic treatment in the post treament (pond 1 & 2) shall be 0.8. The ex-post ER calucation has been revised accordinly.<br>• The ex-ante estimation is calculated based on the annual CER of PDD value during the GS MR period from 06/05/2014 to 31/07/2014. The ex-ante estimation of GS MR period in 2014 is considered as 2 month and 26 days. The ex-ante estimation has been revised in ex-post ER calculation sheet. | | | | |
| **Documentation provided by project participant** | | | | |
| *Revised ER sheet and MR* | | | | |
| **DOE assessment** | | | | **Date:** 03/01/2018 |
| PP has corrected the MCF factor in revised ER sheet. The factor is now as per registered PDD and hence, accepted by the verification team. The ex-ante estimation applicable for the monitoring period is also corrected and found to be correct. Hence, response is accepted and CAR is closed. | | | | |

| **CAR ID** | 01 | **Section no.** | E.8.8 | **Date:** 30/11/2017 |
|---|---|---|---|---|
| **Description of CAR** | | | | |
| a) Please specify whether future target for parameter (COD of the wastewater at the outlet of digester system) has been achieved providing the baseline COD value.<br>b) The monitoring report does not specify whether the project activity results to better income to its employees compared to baseline scenario. No data has been provided in MR.<br>c) The monitoring report does not specify the training details against the parameter Technology transfer and self-reliance | | | | |
| **Project participant response** | | | | **Date:** 22/12/2017 |

| |
|---|
| a) Referring to the monitored data of COD in the project, COD entering open lagoon in the project (CODww,treated,PJ,y) is lower than COD entering the open lagoon in the baseline scenario (CODww,untreated,y). The monitored of those parameters are reported in the revised monitoring report. Hence, the future target for COD of the wastewater at the outlet of digester system) has been achieved providing the baseline COD value during this monitoring period.<br>b) The average monthly income generated by this project is 21,025 THB/person. The monitored value is higher than baseline scenario of 6,098 THB/capacity in 2009. The result of comparison between actual income generation and baseline scenario is provided in the monitoring report. The monitored data of quantitative employments and income generation are included in the monitoring report.<br>*c)* The training topics, which are relevant to technology transfer indicator, have been summarized to monitoring report. |
| **Documentation provided by project participant** |
| *Revised ER sheet and MR sheet* |
| **DOE assessment** **Date:** 03/01/2018 |
| The relevant details as included in the MR is consistent with records and site visit observations applicable for the monitoring period. Hence, response is accepted by the verification team and CAR is closed. |

**Table 4. FAR from this verification**

No FAR raised.