

“Siam Cement Biomass Project”



By

Document Prepared By: KBS Certification Services Pvt. Ltd.

Project Title	Siam Cement Biomass Project
Version	02
Report ID	VCS.17.VER.011-MP-05

Report Title	Verification Report of “Siam Cement Biomass Project”
Client	South Pole Carbon Asset Management Ltd.
Pages	71
Date of Issue	04-September-2018
Prepared By	KBS Certification Services Pvt. Ltd.
Contact	Registered Office: 414-424, Om Shubham Tower, Neelam-Bata Road, N.I.T., Faridabad-121001, Haryana India. Contact us at: Tel.: +91-129-4034513, 4054513, 403513, Fax: +91-129-4035139. Webpage: www.kbsindia.in.
Approved By	Kaushal Goyal, Managing Director
Work Carried Out By	Team Leader: Chetan Swaroop Sharma (TA 1.1, 13.1) Team Member: Rohit Badaya (TA 1.1, 13.1) Technical Expert: Anil Kumar Pandey (TA 4.1) Local Expert: Siam Phoolcharoen Technical Reviewer: MP Kanal (TA 1.1, 13.1) and Rajpal Singh (4.1) Manager Technical and Certification: Sanjay Kandari

Summary:

KBS Certification Services Pvt. Ltd. has been contracted by, "South Pole Carbon Asset Management Ltd." to undertake independent periodic verification and certification for the greenhouse gas (GHG) emission reductions reported from 'Siam Cement Biomass Project' for the monitoring period 01/01/2014 to 31/03/2016 in the initial monitoring report version 01 date 26/09/2017, with regard to the relevant requirements of VCS Standard Version 3.7 /16/17/.

The project was validated and registered with reference no. 403 under VCS (Verified Carbon Standard) program on 03/11/2009. The project was validated by Bureau Veritas Certification Holding SAS (validation report issued on 03-November-2009) /12/. This is the 5th periodic verification of this project which covers the period from 01/01/2014 to 31/03/2016 (including both the days). The project is verified against the VCS Version 3 /16/17/. The verification is based on the monitoring plan of registered VCS Project Description Document (VCS PD) /11/, requirements of VCS (VCS Standard and VCS Program Guide of VCS Version 3) /16/17/ and CDM Validation and Verification Standard for project activities, version 01 /15/.

The methodology applied for the project to estimate the GHG emission reduction is ACM0003 Version 07.2 – "Emission reduction through partial substitution of fossil fuels with alternative fuels or less carbon intensive fuels in cement manufacture" /14/.

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

Monitoring report (MR) /01/, Emission reduction calculation spread sheet (ER sheet) /02/, Project Description document (VCS PD) /11/ and other supporting documents have also been made available to the verification team.

A risk based approach has been followed to perform the verification of the project activity. In the course of verification, 01 Corrective Action Request (CAR) and 01 Clarification Request (CL) have been raised. All the CARs and CLs have been closed out successfully.

It is our responsibility to express an independent GHG verification opinion on the GHG emissions and on the calculation of GHG emission reductions from the project for the period 01/01/2014 to 31/03/2016 based on the reported emission reductions in the final monitoring report Version 02.1 dated 03/09/2018 for the same period.

Based on an understanding of the risks associated with reporting GHG emissions data and the controls in place to mitigate these, KBS planned and performed our work to obtain the information and explanations that we considered necessary to provide sufficient evidence for us to give reasonable assurance that this reported amount of GHG emission reductions for the period is fairly stated.

As a result of the verification, the verifiers confirm that the GHG emission reduction in the verification period from 01/01/2014 to 31/03/2016, including both the days, is **567,310 tCO₂e** /2/.

KBS confirms the following;**Reporting period:** 01/01/2014 to 31/03/2016

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
2014 (01/01/2014 to 31/12/2014)	346,430	50,978	0	295,452
2015 (01/01/2015 to 31/12/2015)	257,515	47,864	0	209,651
2016 (01/01/2016 to 31/03/2016)	85,870	23,663	0	62,207
Total	689,815	122,505	0	567,310

Table of Contents

1	Introduction	6
1.1	Objective	6
1.2	Scope and Criteria	6
1.3	Level of Assurance.....	7
1.4	Summary Description of the Project	7
2	Verification Process	8
2.1	Method and Criteria.....	8
2.2	Document Review	9
2.3	Interviews	9
2.4	Site Inspections	10
2.5	Resolution of Findings.....	10
2.5.1	Forward Action Requests	12
2.6	Eligibility for Validation Activities	12
3	Validation Findings.....	12
3.1	Participation under Other GHG Programs	12
3.2	Methodology Deviations	12
3.3	Project Description Deviations	18
3.4	Grouped Project	24
4	Verification Findings.....	24
4.1	Project Implementation Status	24
4.2	Accuracy of GHG Emission Reduction and Removal Calculations	52
4.3	Quality of Evidence to Determine GHG Emission Reductions and Removals	54
4.4	Non-Permanence Risk Analysis.....	54

5	safeguards	54
5.1	No Net Harm	54
5.2	Local Stakeholder Consultation	54
6	Verification conclusion	54
APPENDIX X:.....		57

1 INTRODUCTION

1.1 Objective

KBS has been commissioned by 'South Pole Carbon Asset Management Ltd.' to perform verification of its registered VCS project 'Siam Cement Biomass Project', for the reported GHG emission reductions for the given monitoring period 01/01/2014 to 31/03/2016 (both dates included). The VCS projects must undergo an independent third party verification and certification of emission reductions as the basis for issuance of Voluntary Emission Reductions (VERs).

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

- The project activity has been implemented and operated as per the project description (PD) and that all physical features (technology, project equipment, and monitoring and metering equipment) of the project are in place;
- Monitoring report and other supporting documents are complete;
- The data is recorded and stored as per the monitoring methodology and approved monitoring plan.
- To confirm that the monitoring system is implemented and fully functional to generate Voluntary Emission Reductions (VERs/VCUs) without any double counting, and
- To establish that the data reported are accurate, complete, consistent, transparent and free of material error or omission by checking the monitoring records and the emissions reduction calculation.

1.2 Scope and Criteria

The verification scope is defined as an independent and objective review of monitoring report /1/, VCS project description (VCS PD), including the monitored data and other relevant documents made available to verifier and information collected through performing interviews during on-site assessment of the project activity.

The project is assessed against the requirements of VCS Standard version 3.7 /17/ and related rules and guidance. KBS has, based on the recommendations in the latest version of Verified Carbon Standard, and employed a rule-based approach (as criteria) in the verification, focusing on the identification of significant reporting rules and the reliability of project monitoring.

The aspects to be covered under the purview of verification are:

- Ensure that the project activity has been implemented and operated as per the registered VCS PD and that all physical features (technology, project equipment, and monitoring and metering equipment) /7/ of the project are in place as per the documents provided by the client and on-site visit;
- Ensure that the monitoring report /20/ and other supporting documents provided are complete
- Ensure that the practiced monitoring system and procedures comply with the monitoring systems and procedures described in the monitoring plan and the approved CDM methodology;
- Evaluate the data recorded and stored are as per the monitoring methodology.

1.3 Level of Assurance

☒ Reasonable level of assurance

The verification report is based on monitoring report, VCS PD, supporting documents and information collected, which are made available to the verifier through document review, interviews session and during the on-site assessment. The verification opinion is assured to provide the credibility of all above with reasonable level of assurance.

1.4 Summary Description of the Project

The project is a combination of five GHG reduction projects located in five different cement manufacturing units of SCG Cement Co., Ltd., in Thailand. All project activities in this group involve partial replacement of fossil fuels by alternative fuels or less carbon intensive fuels, including biomass, in kiln processing of cement manufacture. The proposed project activities involve the installation of storage and handling system for biomass residue. In order to implement the project activities a complete system for receiving, storing, and feeding alternative fuels and less carbon intensive fuels needs to be introduced.

Hence the purpose of the project activity is to improve waste management system, reduction of the dependence on fossil fuels and reduction of greenhouse gas emission through the decreasing of fossil fuel consumption. The partial substitution of fossil fuels with alternative fuels and less carbon intensive fuels allow reduction of the GHG emission from fossil combustion in kiln processing.

The proposed grouped project has been implemented at The Siam Cement (Ta Luang) Co., Ltd. (Ta Luang Cement Plant and Khao Wong Cement Plant), The Siam Cement (Kaeng Khoi) Co., Ltd., The Siam Cement (Thung Song) Co., Ltd., and The Siam Cement (Lampang) Co., Ltd. SCG Cement Co., Ltd. has 100% shareholding in these five companies. Although there are 5 different sites, the primary site appeared in the VCS project database is 'The Siam Cement (Kaeng Khoi) Co., Ltd.' with unique coordinate at 14°36'33.59"N 100°59'46.88"E.

According to Voluntary Carbon Standard Program Guidelines, clause 5.2 (Group Projects), the central GHG information system and controls associated with the project and its monitoring will response by SCG Cement Co. Ltd. As per VCS program guidelines (18 November 2008), the proposed grouped project is expected to reduce anthropogenic emissions by sources within 5,000 – 1,000,000 tonnes of carbon dioxide equivalent annually.

Verification team has checked the project activity equipments installed as the project site and found in compliance with the registered VCS PD /11/.

The project sites are located in different areas of the Thailand. Three of them are located in Saraburi province: Kaeng Khoi District, Ban Kor District and Phaputtabat District, approximately 120 km north of Bangkok. One project site is situated in Lampang province, approximately 600 km to the north of Bangkok. The remaining project site is located in Nakon Si Thammarat province, approximately 835 km to the south of Bangkok.

The geo-coordinates of the project site are: The Siam Cement (Kaeng Khoi): 14° 36' 33.59"N & 100° 59' 46.88"E, The Siam Cement (Ta Luang): 14° 34' 10.00"N & 100° 45' 56.10"E, The Siam

Cement (Khao Wong): 14° 45' 08.56"N & 100° 47' 15.21"E, The Siam Cement (Lampang): 18° 33' 22.66"N & 99° 34' 23.08"E, The Siam Cement (Thung Song): 8° 6' 1.20"N, 99° 41' 2.50"E.

The project crediting period is from 01/04/2006 to 31/03/2016, Hence the monitoring period selected for 5th periodic verification i.e. 01/01/2014 to 31/03/2016 is within the crediting period.

The total emission reduction for 5th verification period from 01/01/2014 to 31/03/2016 is 5,67,310 tCO₂e. The emission reductions are calculated conservatively as per the applied methodology.

Project entity information is presented below:

Item	Data
Project Entities	The Siam Cement (Kaeng Khoi) Co.,Ltd. 1 Siam Cement Road , Bangsue Bangkok , Thailand 10800
	The Siam Cement (Ta Luang) Co.,Ltd. 1 Siam Cement Road , Bangsue Bangkok , Thailand 10800
	The Siam Cement (Lampang) Co.,Ltd. 1 Siam Cement Road , Bangsue Bangkok , Thailand 10800
	The Siam Cement (Thung Song) Co.,Ltd. 1 Siam Cement Road , Bangsue Bangkok , Thailand 10800
	South Pole Carbon Asset Management Ltd. Technoparkstrasse 1 , Zurich , Switzerland 8005

2 VERIFICATION PROCESS

2.1 Method and Criteria

The verification process was carried out inline with the requirements VCS Version 3. In addition, the verification team followed the guidelines of the CDM Validation and Verification Standard for project activities, version 01.0 /15/. Standard auditing techniques and KBS's CDM Procedures were also applied during the verification. A risk-based approach was followed to carry out verification and access all the factors and concerns that relate to the issuance of emission reductions from a project activity.

They include:

- Identification of all the sources contributing to the baseline emissions, project emissions and emission reductions.
- Authenticity of the provided data is checked.
- A risk based analysis is carried out to ensure a clear and transparent assessment. The risks involved in this process are mainly with the informational flows and data recording.

KBS follows a risk based verification approach, wherein a desk review of the project documentation is undertaken, which is followed by an onsite visit by the members of verification team. The verification protocol is filled by the verification team that is based on standard auditing practices and VCS requirements. The verification protocol provides transparent means to record

the observations by the verification team members and the non-conformities, if any. The verification protocol is an internal document, and available on request.

Duration of Verification:

Verification Contract	21/09/2017
On site verification	02/10/2017 to 04/10/2017
Findings raised	11/10/2017
Draft Verification Report	06/08/2018
Final Verification Report	04/09/2018

2.2 Document Review

A desk review is undertaken, involving but not limited to,

- A review of the data and information presented to verify their completeness;
- A review of the monitoring plan and monitoring methodology, paying particular attention to the frequency of measurements, the quality of metering equipment including calibration requirements, and the quality assurance and quality control procedures;
- An evaluation of data management and the quality assurance and quality control system in the context of their influence on the generation and reporting of emission reductions.

The list of document reviewed is included in the Appendix 2: 'References'

2.3 Interviews

The site visit for this verification assessment was undertaken by the members of the assessment team. Summary of on-site activities are mentioned below;

Location	Thung Song, Nakon Si Thammarat, Thailand Khao Wong, Saraburi, Thailand Ta Luang, Saraburi, Thailand
Dates	02/10/2017 to 04/10/2017
Key points discussed	Name of persons interviewed, Designation, Organization
• General aspects of the project • Project equipment operation and technical details • Changes since validation • Monitoring and measurement equipment • Remaining issues from previous verification • Calibration procedures • Quality management system • Involved personnel and responsibilities • Training and practice of the operational personnel • Implementation of the monitoring plan • Monitoring data management	Santosh K. Singh, Regional Director, South Pole Carbon Asset Management Ltd. Nattaya Lonawan, Project Manager, South Pole Carbon Asset Management Ltd. Kanitpoom Piboonnurak, Site Engineer, SCG Pipat Kussalerdjarjya, Laboratory section, SCG Oubonrat Kabounsang, Laboratory section, SCG Panuwat Naruebarn, Production section, SCG Sirinut Raya, Project Manager, South Pole Carbon Asset Management Ltd. Yulta Dobrolyubova, Expert, South Pole Carbon Asset Management Ltd. Pollaphat Pornpitakthum, Engineer, SCG Patiphan Kurustien, Engineer, SCG Attaporn Matae, Engineer, SCG

• Data uncertainty and residual risks • GHG calculation • Maintenance	
---	--

2.4 Site Inspections

A site visit is undertaken by members of verification team, involving but not limited to,

- An assessment of the implementation and operation of the project activity as per the registered VCS PD;
- A review of information flows for generating, aggregating and reporting the monitoring parameters;
- Interviews with relevant personnel to confirm that the operational and data collection procedures are implemented in accordance with the approved monitoring plan;
- A cross-check between information provided in the monitoring report and data from other sources such as plant log books, inventories, purchase records or similar data sources;
- A check of the monitoring equipments including calibration performance and observations of monitoring practices against the requirements of the registered VCS PD /11/ and the selected methodology /14/;
- A review of calculations and assumptions made in determining the GHG data and emission reductions;
- An identification of quality control and quality assurance procedures in place to prevent or identify and correct any errors or omissions in the reported monitoring parameters.

2.5 Resolution of Findings

KBS applies the risk based approach aimed at focusing on high risk issues to the verification results whilst not omitting any part of the mandatory processes. A few discrepancies were found during the verification and the verification report was submitted to the project proponent, indicated under the titles corrective action requests (CARs) and clarification requests (CLs). CARs and CLs require the PP to take relevant actions. Criteria for judging items as CAR or CL are as follows:

Corrective action request (CAR):

- the project participants have made mistakes that will influence the ability of the project activity to achieve real, measurable additional emission reductions
- the Verified Carbon Standard's requirements have not been met, or
- there is a risk that emission reductions cannot be monitored or calculated.

Clarification request (CL):

- Information is insufficient or not sufficiently clear to determine whether the applicable VCS requirements have been met.

FARs is to be raised to highlight issues related to project implementation that require review during the first or subsequent verification of the project activity. FARs does not relate to VCS requirements for registration.

CARs and CLs are to be resolved or closed out if the PP modifies the project description, rectifies the Monitoring report or provides adequate additional explanations or evidence that satisfies the concerns. If this is not completed, the project activity cannot be recommended for issuance under VCS registry.

The monitoring report document was revised addressing the CARs & CLs issued by KBS. After reviewing the revised and resubmitted monitoring report /1/; resolving the CARs & CLs raised and outstanding concerns, KBS issues this final verification report and opinion.

01 CAR and 01 CL were found during verification and closed satisfactorily. The list of CARs/CLs raised and the response provided, the means of verification, reasons for their closure and references to correction in the MR are provided in Appendix 4 of this report. The revised MR with changes incorporated as per the issues raised were rechecked with the documentary evidences and found to be inline.

2.5.1 Forward Action Requests

No FAR was raised during this monitoring period but the remaining FAR from the previous verification has been addressed during this current verification.

2.6 Eligibility for Validation Activities

KBS conducts the verification activity; the validation was performed by the other VVB and the separate validation report issued and approved by the VCS association. This report is publicly available on v-c-s.org website at link:

http://www.vcsprojectdatabase.org/#/project_details/403

KBS has a valid UNFCCC accreditation in the sectoral scope from UNFCCC.

3 VALIDATION FINDINGS

Refer above section.

3.1 Participation under Other GHG Programs

PP does not apply for other GHG program as declared in the registered VCS PD.

3.2 Methodology Deviations

As result of this current verification and finding from previous verifications (1st, 2nd, 3rd and 4th verification), it was found that there are two (2) categories of deviations as per following,

- Methodology Deviation – when monitoring practices of some parameters in this monitoring period had been deviated from applied methodology, and
- Related Methodology Deviation - some particular parameters, which approved monitoring in registered PD didn't demand Project Proponent to conduct monitoring actions, but Project Proponent voluntarily to monitor these in order to be in line with applied methodology and related tools, with objective to increase accuracy of quantifications.

Verification team verified the justification from Project Proponent and the description of the deviations and the assessment on conservativeness of the deviation is provided below.

Deviation 01: Pclinker (Production of clinker in year y)

Description of the deviation
The $P_{clinker,y}$ is not monitored by the weight feeder.
Explanation of the deviation
The daily clinker production is calculated from the amount of raw meal and clinker factor. The summary of daily clinker production in a month is adjusted by the stock checking data at the end of month and reported in the Work Journal /5/.

Compliance with the deviation

Since the amount of clinker production cannot be directly measured because of its high temperature. The amount the raw meal which is directly measured by weight feeder and the clinker factor is used for calculating the clinker production.

- The amount of raw meal is continuously monitored by the weight feeder and the data is recorded on daily basis.
- The clinker factor is from the result of LOI (Lost of Ignition), % ash, % dust loss and moisture content from internal laboratory.
- The amount clinker produced in the stock checking report is from the truck scale and the available stock of clinker in the cement factory.
- The calculated amount of clinker produced is cross-checked and adjusted with the stock checking information on monthly basis to ensure the accuracy of the figures presented in the Work Journal.

This approach can improve the accuracy and reliability of monitoring data measured from monitoring devices. It was also applied for previous verifications and does not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario

Assessment by the verification team

The deviation has been transparently described in Section 2.2.2 of the MR.

Due to the fact that hot clinker is not possible to be directly weighted by any weighting machine because of their extremely high temperature, in doing so, verification team had verified the Work Instruction (W-P-W1-001) on how calculation of clinker had been made. It's found that quantity of clinker came from several input parameters such as, (a) Loss on Ignition (LoI), (b) % Ash, (c) % Dust loss and (d) Moisture content in raw material. Based on evidences found during document review and onsite visit, it's found that these parameters had been analyzed by well calibrated equipment (e.g., furnace, oven, 4-digit weighing machines) which are in line with their internal laboratory procedures. In addition, annual total quantity of clinker produced had taken account of amount of raw material consumed, which also continuously measured by well-calibrated weighing feeder. With cross-checking between analyzed data from laboratory and data aggregated in daily log sheet & work journal, verification team didn't find any discrepancy larger than 5% material threshold. Instead of applying default clinker produced, verification team accepted the justification from Project Proponent that using data from well calibrated equipment & qualified laboratory is not negatively affect the conservativeness but also increasing quantification's accuracy. This is also permitted by VCS rules and requirements /16/17/19/.

The verification team is of the opinion that the approach followed by the PP is appropriately described and justified and the project remains in compliance with the VCS rules. In conclusion, verification team accepted this deviation on the basis that using reliable calculation methods from well calibrated and relevant weighing machines are resulting in greater quantification accuracy.

The deviation does not overestimate the emission reduction and hence accepted to the

verification team. Hence the deviation is accepted.

Deviation 02: Quantity of biomass residue type K

Description of the deviation

The quantity of biomass residue type k is the additional monitored parameter in this monitoring period.

Explanation of the deviation

The biomass residue type k is the parameter, which needs to be monitored according to ACM0003 version 07.2 /14/. This parameter is monitored based on public available data for available biomass to apply leakage estimation as per the methodological approach.

Compliance with the deviation

This parameter is applicable if approach L₂ is used to estimate the leakage emissions. It is additional monitored parameter from the registered PD which required to be monitored as per methodology. This additional monitored parameter can increase the precision of emission reduction calculation. This approach was also applied for previous verifications and does not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario.

Assessment by the verification team

The deviation has been transparently described in section 2.2.1 of the MR. As result of previous verifications in the past, it's found that this parameter should be monitored according to applied methodology and related tool. However, this parameter has not been addressed in approved monitoring plan in registered PD. In response to this, Project Proponent voluntarily monitored quantity of biomass residue type K, which is taken from governmental data sources (i.e., Thailand Alternative Energy Situation Report 2014, 2015 and 2016, Department of Alternative Energy Development and Efficiency, DEDE). This data had been used to calculate L₂ to rule out the leakage from biomass competing situation and shown that there are abundant in biomass resources, confirming that there are sufficiently available for project utilization. Verification team had cross-checked DEDE data sources and found that data of biomass is reliable, data is collected by non-bias government officers configured with yearly updating, as well as this DEDE website is publically available on their website. Instead of presuming that there is no leakage without monitoring action, verification team accept this deviation on the basis that this deviation (from registered PD) is resulting in more accuracy in ruling out leakage from emission reduction calculation. It's worthwhile to be noted that the monitoring action of this parameter in this current monitoring period is in line with requirement in ACM0003 version 7.2 and there is no deviation from methodology found.

In conclusion, this deviation (in fact, this is deviated from registered PD, NOT methodology and related tools) is accepted on the basis that monitoring of this parameter is resulting in more accuracy in ruling out leakage from emission reduction calculation.

The verification team is of the opinion that the approach followed by the PP is appropriately

described and justified and the project remains in compliance with the VCS rules. In conclusion, verification team accepted this deviation on the basis that using reliable calculation methods from well calibrated and relevant weighing machines are resulting in greater quantification accuracy.

The deviation does not overestimate the emission reduction and hence accepted to the verification team. Hence the deviation is accepted.

Deviation 03: EC_{PJ,y} (Quantity of electricity consumed by project electricity consumption sources J in year y)

Description of the deviation

The quantity of electricity consumed by project is the additional monitored parameter in this monitoring period.

Explanation of the deviation

The EC_{PJ,y} is the parameter which needs to be monitored according to ACM0003 version 07.2.

Compliance with the deviation

This parameter is used for calculating the CO₂ emissions from on-site electricity consumption by "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" /22/ It is additional monitored parameter from the registered PD which required to be monitored as per methodology. This additional monitored parameter can increase the precision of emission reduction calculation. This approach was also applied for previous verifications and does not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario.

Assessment by the verification team

The deviation has been transparently described in section 2.2.1 of the MR.

Same as deviation 2, this deviation is actually deviated from approved monitoring plan in registered PD, while approved monitoring plan not forcing Project Proponent to monitor this value, but Project Proponent decided to put one more monitoring parameter to their monitoring plan in order to be in line with general guidance in 'Tool to calculate baseline, project and/or leakage emission from electricity consumption (EB39 Annex7)' /22/. It's should be noted that tools did not specifically define any requirements for monitoring of this parameter, but only provided general guidance on how to calculate 'Project Emission, PEEC,y' from electricity consumption (please refer to page 2-3 of the tool) /22/, but Project Proponent took more step ahead to monitor this. Since there is no specific requirement on how to monitor parameter EC_{PJ,y} by the tools, so Project Proponent introduced some key factors such as, specification, record of electricity meter reading in order to quantify project emission from electricity consumption PEEC,y. Verification team had verified their claim by document review and conducted onsite visit, it's found that data presented in specification is in line with real specification of electricity-consumed machined found on site (i.e., biomass handling unit). In addition, data showed in electricity meter reading record is reliable having well agreement with

data used for Project Emission calculation presented in their ER calculation sheet. Verification team accepted this deviation (in fact, deviated from approved monitoring plan and registered PD) on the basis that this doesn't affect conservativeness in negative way, instead it's raising more accuracy in Emission Reduction calculation at the end.

In conclusion, verification team accepted this deviation because this is resulted in more accuracy in quantification of emission reduction.

In conclusion, this deviation is accepted on the basis that monitoring of this parameter is resulting in more accuracy in ruling out leakage from emission reduction calculation.

The verification team is of the opinion that the approach followed by the PP is appropriately described and justified and the project remains in compliance with the VCS rules. In conclusion, verification team accepted this deviation on the basis that using reliable calculation methods from well calibrated and relevant weighing machines are resulting in greater quantification accuracy.

The deviation does not overestimate the emission reduction and hence accepted to the verification team. Hence the deviation is accepted.

Deviation 04: $FC_{i,j,y}$ (Quantity of alternative fuel type K for biomass handling)

Description of the deviation

The quantity of alternative fuel type k for biomass handling, $FC_{i,j,y}$ is the additional monitored parameter in this monitoring period. However, the monitoring method is not in line with the *Tool to calculate project or leakage CO₂ emission from fossil fuel combustion /22/*.

Explanation of the deviation

As per the tool, the diesel oil usage for internal biomass handling must be continuously monitored by using mass or volume meter. Since the internal biomass transfer activity is response by contractor. The project owner cannot directly monitor this parameter. The contractor will report the diesel oil consumption to the project owner, at least on yearly basis. The purchasing invoice can be used for cross-checking the consumption reported by contractor.

Compliance with the deviation

As per FAR 01 from the 3rd verification, the monitoring plan of this parameter is not in line with the tool so this FAR has been opened for the 4th verification. Although the monitoring description is not followed the tool. However, the purchasing invoice can be used for cross-checking as per QA/QC description determined in the tool. Hence, this approach can give the accurate data for emission reduction calculation. In additionally, it does not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario.

Assessment by the verification team

The deviation has been transparently described in section 2.2.1 of the MR.

This deviation 4, in fact, it is result of 2nd verification finding that description of AF_{t,k,y} addressed in approved monitoring plan in registered PD is not in line with “Tool to calculation project or leakage CO₂ emission from fossil fuel combustion” as well as lacking of monitoring practice from Project Proponent to appropriate monitor this parameter – this resulting that verification team raised FAR01 at previous verification. Based on guidance in this tool parameter FC_{i,j,y} shall be monitored by meter on the basis of mass or volume consumed, while this shall be cross-checking with purchased invoice. In response to this, Project Proponent voluntarily added this parameter in their monitoring plan and replacing parameter AF_{t,k,y} which was earlier proposed. In this monitoring period, Project Proponent submitted purchased invoices of diesel oil consumption from contractor at Ta Luang and Khao Wong site. Verification team also verified and crosschecked the submitted purchased invoices against confirmation letter from contractor and found these are consistent and no any discrepancies found. In addition, it was verified that diesel oil consumption was measured on volume basis from oil meter at Oil service station. It's considering that these practices are in line with methodology. These monitoring practices and valued applied in ER calculation are accepted. For Thung Song site, verification team cross-checked that value applied in ER calculation against diesel oil consumption rate. Verification accepted this deviation on the basis that this is giving more conservativeness at the end emission reduction calculation.

In conclusion, verification team accepted this deviation on the reason that this raising more accuracy in quantification of emission reduction and resulting in more conservativeness. In conclusion, this deviation is accepted on the basis that monitoring of this parameter is resulting in more accuracy in ruling out leakage from emission reduction calculation.

The verification team is of the opinion that the approach followed by the PP is appropriately described and justified and the project remains in compliance with the VCS rules. In conclusion, verification team accepted this deviation on the basis that using reliable calculation methods from well calibrated and relevant weighing machines are resulting in greater quantification accuracy.

The deviation does not overestimate the emission reduction and hence accepted to the verification team. Hence the deviation is accepted.

Deviation 05: TL_y (The average truck load of the truck used in during the year y)

Description of the deviation

The average truck load of the trucks used during the year y, TL_y is the not monitored parameter in this monitoring period.

Explanation of the deviation

As per the methodology, this parameter is continuously monitored from transportation data logs. Since this data is not collected at project sites. The maximum truck load allowed by

Transportation regulation of Thailand is used for emission reduction calculation.
<u>Compliance with the deviation</u> Since the 15 tonnes is the maximum allowance so the actual data must be always less than 15 tonnes. It is in line with conservativeness principle since it gives the higher project emissions.
<u>Assessment by the verification team</u> The deviation has been transparently described in section 2.2.2 of the MR. In absence of transportation data log submitted, Project Proponent proposed figure 15 ton/trips and making reference to transportation regulation regarding highest allowance weight for truck travelling in Thailand. Verification team had cross-checked highest allowance weight according to type of truck found during onsite visit and found that the highest weights allowed by transportation regulation (http://www.motorway.go.th/). is fixed at 15 ton/trip same as the claim by Project Proponent The application of this figure is resulting in more conservativeness, which is resulting in more number of trips travelled and more Project Emission, this is due to the fact that truck driver would like to transport more weight load than legally required by the transportation law, in order to reduce number of trips travelled and time saving. Verification team accepted this deviation based on the conservative reason once applied this 15 ton/trips in their ER calculation In conclusion, verification team accepted this deviation on the reason that this raising more accuracy in quantification of emission reduction and resulting in more conservativeness. The verification team is of the opinion that the approach followed by the PP is appropriately described and justified and the project remains in compliance with the VCS rules. In conclusion, verification team accepted this deviation on the basis that using reliable calculation methods from well calibrated and relevant weighing machines are resulting in greater quantification accuracy. The deviation does not overestimate the emission reduction and hence accepted to the verification team. Hence the deviation is accepted.

3.3 Project Description Deviations

Taken account of onsite finding at SCG Lampang and Kaeng Khoi site during 2nd, 3rd and 4th verification period, verification team found that fluidized bed gasifier has been installed in Lampang site since 2009. The implementation of this new system leads to difficulties in consideration of emission reduction from this new system. Moreover, it is found that the solid waste pre-treatment plant has been installed at Kaeng Khoi site by SCI Eco Services Company. The objective of this project is for increasing the amount of solid waste to be fired at cement kiln. Project proponents decided to neglect any amount of emission reduction possibly generated from Lampang site and Kaeng Khoi site during this current verification period. With reference to Validation and Verification Manual version 3.2 /19/, verification team had verified the impact of these deviations to the applicability of the methodology, additionally or the appropriateness of the

baseline scenario consistent with “Guidelines on assessment of different types of changes from the project activity as described in the registered PDD (Annex 67 EB48)” /22/ as shown in table 1 - 3 below.

Table 1: Assessment on impact of deviations to the applicability of the methodology ACM0003 version 7.2

Applicability Criteria	Justification as per the registered VCS PD	DOE's opinion on the impact of deviation on Applicability of Methodology
A significant investment is required to enable the use of the alternative fuels and/or less carbon intensive fossil fuels	A significant investment is required for new machinery installation, including storage, handling and transporting systems to enable the use of alternative fuels and/or the less carbon intensive fossil fuels.	The installation of fluidized bed gasifier and the solid waste pre-treatment plant required significant investment to enable the use of the alternative fuels and/or less carbon intensive fossil fuels.
During the last three years prior before the start of the project activity, no alternative fuels have been used in the project plant.	According to the fuel consumption work journal during the last three year period, before the start of the project activities, no alternative fuels and biomass were consumed. However a small amount of alternative fuels was used in the testing phase of the projects.	Due to fact that the project design changed has occurred after the start of original SCG activities (i.e., utilization of biomass as alternative fuels). Hence, it is not related to the last three year prior to the start of project activity.
The CO2 emission reduction relates to CO2 emission generated from fuel combustion only and is unrelated to the CO2 emissions from decarbonisation of raw materials.	The CO2 emission reductions are only related to the CO2 generated by fuel burning requirement and not by decarbonisation of raw material.	The CO2 emission reductions are only related to the CO2 generated by fuel burning requirement. The installation of fluidized bed gasifier and the solid waste pre-treatment plant has no process on decarbonisation of raw materials
The methodology is applicable only for installed capacity that exists by the time of validation of the project activity.	The installed capacity has not changed at each site during the time of validation and is presented in Table 2 in registered PD.	The installation of fluidized bed gasifier and the solid waste pre-treatment plant had nothing impact the change of installed capacity of project

		activity.
The biomass is not chemically processed (e.g. esterification to produced biodiesel, production of alcohols from biomass, etc) prior to combustion in the project plant but it may be processed mechanically or be dried at the project site. Moreover, any preparation of the biomass, occurring example, methane emissions from anaerobic treatment of waste water or from char coal production.	The biomass residues used in the project plants are not chemically processed prior to combustion in the project plant.	The installation of fluidized bed gasifier and the solid waste pre-treatment plant are not associated with the biomass chemically process but it's related to low grade lignite and solid waste not biomass.
The biomass used by the project facility is stored under aerobic condition.	All biomass residues used in the project plants are stored under aerobic condition and it is stored for not more than one year.	The installation of fluidized bed gasifier and the solid waste pre-treatment plant are not associated with the biomass residue or biomass facility.

Table 2: Assessment on impact of deviations to plausible baseline scenario

Alternative Scenario	Description	Description as per the registered VCS PD	DOE's opinion on the impact of deviation on plausible scenario
F2	Continuation of current practice, i.e., a scenario in which the company continues cement production using the existing technology, materials and fuel mix.	The cement manufacturing industry in Thailand is mainly using coal. In the absence of the project activities the usage of lignite and other carbon intensive fuels in cost effective way would have continued without involving any major capital investments.	The installation of fluidized bed gasifier and the solid waste pretreatment plant did not affect to this scenario, the cement manufacturing in Thailand still use coal, lignite and other carbon intensive fuel as business as usual. The justification in the registered VCS PD is still valid.

F3	The continuation of using only fossil fuels and no alternative fuels; however, with a different fuel mix portfolio, taking into account relative prices of fuels available. The scenario(s) may be based on one fuel or a different mixes of fuels.	The cement manufacturing industry in Thailand is mainly using coal. In this regard, continuing utilization of fossil fuels is most likely to happen in the absence of the project activities. In Thailand formal permission from government is required to start alternative fuel usage in cement manufacturing. This requires a significant amount of effort on part of project proponent. Then in the absence of the project activities the usage of lignite and other carbon intensive fuels in a cost effective way would have continued.	The installation of fluidized bed gasifier and the solid waste pretreatment plants are confirmed the fact that continuation of fossil fuels is still common in cement production in Thailand. The justification in registered PD is still valid.
W1	Incineration of the waste in a waste incinerator without utilizing the energy from the incineration.	In the absence of the project activities, most wastes have gone to the incinerator without utilizing the energy from the incineration.	The installation of fluidized bed gasifier is irrelevant to this scenario. For installation solid waste pretreatment plant, it's confirmed in the previous verification finding that heat value of waste is pretty much low and it's not possible to utilize energy from burning of the solid waste. The justification in registered VCS PD is still valid.

W3	Disposal of the waste at a managed or unmanaged landfill.	Some of the waste has gone to the landfill in the absence of the project activities.	Even though there are installation of fluidized bed gasifier and the solid waste pretreatment plant, it's confirmed in the previous verifications that some of waste originated from fossil fuel from SCG project are managed to be disposal at landfill for use of fertilizer. These two project design deviation did not affect to alternative scenario. The justification in registered PD is still valid.
B3	The biomass residues are burnt in an uncontrolled manner without utilizing them for energy purposes.	Most of the biomass used in project plants is burnt in an uncontrolled manner without utilizing them for energy purposes.	The installation of fluidized bed gasifier and the solid waste pretreatment plant does not affect to alternative scenario. The justification in registered PD is still valid.

As per the justification above, the most plausible baseline scenario is still F2 or F3 all project activities in this grouped project. At the same time, W1 or W3 is still the most plausible baseline scenario for wastes originating from fossil sources (alternative fuels), and B3 is still the most plausible baseline scenario for biomass residues. Thus, it is confirmed that there is no impact to the applicability of the methodology and the appropriateness of the baseline scenario. Both deviations did not effect to the main process of project activities. Meanwhile, the deviations also did not affect to the production capacity of project activity. Hence, there is no change in the scale of project activity

In order to check the impact to additionality, verification team found that according to registered PD, the investment barrier was considered due to the high investment cost of new technology. In other words, the additionality was demonstrated that due to high investment cost in new technology causing the project is not economically attractive and need revenue from carbon credit. Thus, verification team had re-assessed the additionality by considering of newly added investment cost for installation of fluidized bed gasifier and solid waste pretreatment plant as shown in Table 3 below.

Table 3: Approximate investment to implement the use of biomass residue in Lampang and Kaeng Khoi site

Project site	Total Investment as in Registered PD (million Baht)	DOE's opinion on the impact of deviation on the additionality
The Siam Cement (Lampang)	8.2	It is found that project proponent found difficulty to separate the cost of installing fluidized bed gasifier, because it is included in the budget of engineering department which mix with the budget for other project. Taken account of 2nd verification period, it is confirmed by onsite finding that that there is fluidized bed gasifier system completely installed and operated at Lampang site. This also conforms with the documented evidence, file named 'LP_Gasifier.pdf' submitted to verifier during verification. There is picture demonstrated that the equipment had been installed and tested at Lampang site since 2009. In light of above, verification team confirmed authentically existing of this new unit. Therefore, it's confirmed that there is investment cost associated with installation and operation of this new unit.
The Siam Cement (Kaeng Khoi)	89.44	With reference to attached document No.3 of SCG Cement's management committee meeting no. 8/2552 dated 13 August 2009; the investment cost of the new solid waste pre-treatment plant is 152.3 million Baht

Both project deviation activities would make overall SCG investment cost higher than what was earlier expected in register PD, this is also make the project more risky in term of economic return. It could be understandable that these deviations unavoidably make additionality of the project even stronger because of its higher project investment costs.

Therefore, verification team had confirmed that the installation of fluidized bed gasifier at Lampang site and the solid waste pre-treatment plant at Kaeng Khoi site did not impact the applicability of the methodology, additionality or the appropriateness of the baseline scenario, and the project remains in compliance with the applied methodology.

Further for the two cement factories located at “Ta Luang” and “Khao Wong” sites in the Saraburi province, the rice husk has not been used from year 2015 onwards, however the emission reductions have been claimed for the year 2014. The rice husk availability for the “Ta Luang” and “Khao Wong” sites has been demonstrated for the year 2014. The rice husk has been found surplus based on the data submitted to the DOE and the emission reductions have been conservatively calculated for the year 2014 and found acceptable.

3.4 Grouped Project

Not Applicable

4 VERIFICATION FINDINGS

4.1 Project Implementation Status

The project activity is in operation stage as evidenced by the physical verification of the site.

All the physical components /3/4/10/ and project boundary are in conformity with the description in registered VCS PD /11/. The capacity of project equipments have been cross-checked during the on-site visit and found in-compliance with the registered VCS-PD /11/. On the basis of the on-site visit and the reviewed project documentation, the verification team confirms that the project was implemented and operated as described in the registered VCS PD /11/.

There are five deviations which have been addressed in the Section 3.2 and 3.3 of this report and have been assessed by the verification team.

Ownership and other programs:

The PP declared that the project is not registered any other mechanism apart VCS. Thus emission reductions generated by project will be solely claimed by PP and PP has right of use and hence accepted. Net GHG emission reductions or removals generated by this project will not be used for compliance with an emissions trading program or to meet binding limits on GHG emissions as the host country i.e. Thailand is not a participant in any emission trading programs or nor does it have any binding limits.

PP will not claim the carbon credits under any other GHG emission reduction scheme for the crediting period under VCS and PP has provided declaration on the same during the validation. Hence there is no possibility of double counting. Apart from VCS, it has neither applied nor been rejected under any other GHG program.

Management and operational system:

Verification team was able to verify that authorities and responsibilities for monitoring and reporting of all data related to the emission reductions were clearly defined for the monitoring period from 01/01/2014 to 31/03/2016.

The allocation of the responsibilities is documented in a written form and is followed as described in the registered VCS PD. Routines for the archiving of data are defined and documented. During the site visit all the required plant records were verified and found that the data is consistent with the provided in the final MR /01/ and ER sheets /02/.

The monitoring plan described in section 3.3 of the MR is confirmed to be correct. All the parameters of the monitoring plan are monitored using appropriate metering system.

The verification team has interviewed the plant personnel who are involved in the monitoring of the parameters that are used to determine the emission reductions of the VER project. It is confirmed based on the interviews that the plant's team is competent enough to monitor the parameters as described in the monitoring plan.

As discussed above, the verification team concludes that management and operational system of the project is implemented and operated well. Thus it ensures the quality of data which is required in calculating the emission reductions.

Implementation status of the monitoring plan:

Verification team confirms through on-site verification and from the document review, the actual monitoring system complies with the monitoring plan mentioned in the registered VCS-PD.

During the verification, all relevant monitoring parameters of the registered monitoring plan have been verified with regard to the appropriateness of the verification method; the correctness of the values applied for ER calculation, the accuracy and applied QA/QC measures. All monitoring parameters have been measured / determined without material misstatements and are in line with all applicable standards and relevant requirements. It is confirmed that the monitoring mechanism is effective and reliable /6/. Wherever a parameter was not sufficiently monitored as per the monitoring plan of the VCS PD, a deviation was applied by the PPs and the emission reduction was calculated by a conservative approach.

Therefore, from the document review and onsite verification, it is confirmed that all the parameters were monitored in accordance with the registered monitoring plan during the monitoring period. Following are the details of monitoring in accordance with the monitoring plan of the registered VCS PD:

Monitored Parameter	Assessment/Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	$FC_{PJ,k,y}$ and $FC_{PJ,i,y}$ Quantity of alternative fuel or less carbon intensive fossil fuel type k ($FC_{PJ,k,y}$) and fossil fuel of type i ($FC_{PJ,i,y}$) used in the project plant in year y (ton)
Measuring frequency:	Continuous monitoring with daily recording and adjusting with stock checking report at the end of month. The quantity of solid fossil fuel and biomass fuel is continuously monitored

	by weight scale equipment. The data from all inline measuring equipment is connected to Distributed Control System (DCS) at the control room /5/. The data recording from DCS is carried out by cell operator on daily basis. The fuel oil volume is continuously monitored by flow meter. The cell operators record the totalized flow at the flow meter before and after the operation of fuel oil supply pump. The daily monitored data is checked and adjusted with stock checking report at the end of month. The final figures are summarized in Work Journal (WJ) /5/ by engineer. The parameter is continuously monitored with daily recording and adjusting with stock checking report at the end of month in line with the VCS PD.
Reporting frequency:	The data is recorded on daily basis by the respective operators and then, upload and transfer the same to the electronic storage in line with the VCS PD. The same was also verified during the on-site visit and found OK.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PD .
Type of monitoring equipment:	The monitoring equipment details are provided in the Appendix 6 of the Verification Report. The monitoring equipment details have been checked during the site visit and found consistent.
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	The accuracy class of the weighing scale equipment (for monitoring solid fossil fuel and biomass fuel) and flow meter (for monitoring fuel oil) is in compliance with the registered VCS PD. Hence accepted to the verification team.
Calibration frequency /interval:	The monitoring equipment is calibrated according to the calibration plan /8/ and/or shutdown plan of kiln which is in compliance with the registered VCS PD. Hence accepted to the verification team.
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of	Yes

calibration, does the selected frequency represent good monitoring practice?	
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
If applicable, has the reported data been crosschecked with other available data?	The daily monitored data is checked and adjusted with stock checking report at the end of month.
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet were verified with the Work Journal (WJ) /05/. The summary of values has been provided in the Appendix 5 of the Verification report. The reported values in the MR and ER sheet were found to be consistent with the Work Journal (WJ) information /5/.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The data management procedure is transparent; which ensure correct transfer of data and reporting of emission reductions.

Monitored Parameter	Assessment/Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	$EF_{CO_2,k,y}$ Weighted average CO ₂ emission factor for biomass residue of type k ($EF_{CO_2,k,y}$) and for fossil fuel of type i ($EF_{CO_2,FF,i}$) in year y (tCO ₂ /GJ)
Measuring frequency:	IPCC default values /21/ or value provided by World Business Council for Sustainable Development /21/ are used. IPCC default values at the upper/lower limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories /21/. For alternative fuels, the source of emission factor is from the CO ₂

	Accounting and Reporting Standard for the Cement Industry ¹ , provided by World Business Council for Sustainable Development.
Reporting frequency:	IPCC default values /21/ or value provided by World Business Council for Sustainable Development /21/ are used. The same was also verified during the on-site visit and found OK.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PD .
Type of monitoring equipment:	Not Applicable
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Not Applicable.
Calibration frequency /interval:	Not Applicable
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the	Not Applicable

¹ <http://wbcsdcement.org/index.php/key-issues/climate-protection/co2-accounting-and-reporting>

frequency of calibration, does the selected frequency represent good monitoring practice?	
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not Applicable
If applicable, has the reported data been crosschecked with other available data?	Not Applicable
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet were verified with the IPCC default values or value provided by World Business Council for Sustainable Development /21/. The reported values in the MR and ER sheet were found to be consistent with the source of information. $EF_{CO_2,k,y}$ is zero for the biomass residues referred to page 29/40 ACM0003 version 07.2 /14/.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The data management procedure is transparent; which ensure correct transfer of data and reporting of emission reductions.

Monitored Parameter	Assessment/Observation
Data / Parameter: (as in monitoring	$NCV_{k,y}$ and $NCV_{i,y}$

plan of the VCS PD):	Weighted average net calorific value of the alternative or less carbon intensive fuel type k ($NCV_{k,y}$) and fossil fuel types i ($NCV_{i,y}$) in year y (GJ/ton)
Measuring frequency:	This parameter will be measured daily or every batch / delivery depends on type of fuel. The monthly weighted-average figure from QIS is used in emission reduction calculation.
Reporting frequency:	The fuel sample is analyzed by internal laboratory. The results are saved in QIS (Quality Information System) by lab analyst. The same was also verified during the on-site visit and found OK.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PD.
Type of monitoring equipment:	The NCV /5/ is analysed according to the national or international approved standards and procedures through the internal laboratory.
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	The laboratory equipment is calibrated as per manufacturer's recommendation. The documentation and calibration is controlled and managed in accordance with ISO9001 requirements. Hence this is in compliance with the registered VCS PD and accepted to the verification team.
Calibration frequency /interval:	The laboratory equipment is calibrated /8/ as per manufacturer's recommendation. The documentation and calibration is controlled and managed in accordance with ISO9001 requirements. Hence this is in compliance with the registered VCS PD and accepted to the verification team.
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Yes

Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
If applicable, has the reported data been crosschecked with other available data?	NA
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet were verified with the QIS (Quality Information System). The summary of value has been provided in the Appendix 5 of the Verification report. The reported values in the MR and ER sheet were found to be consistent with the QIS (Quality Information System) information. The NCV of fuel oil applied for all sites is from the annual maximum test results from provided by suppliers. The same maximum value is used for all sites.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The data management procedure is transparent; which ensure correct transfer of data and reporting of emission reductions.

Monitored Parameter	Assessment/Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	AVD _y Average round trip distance (from and to) between the alternative fuel supply sites and the site of the project plant during the year y
Measuring frequency:	Not Applicable. The maximum round trip distance suggested in methodology ACM0003 version 07.2 /14/.
Reporting frequency:	Not Applicable. The maximum round trip distance suggested in methodology ACM0003 version 07.2. The same is found to be acceptable based on the site visit and found OK.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring	The maximum round trip distance suggested in methodology ACM0003 version 07.2.

methodology? (Yes / No)	
Type of monitoring equipment:	Not Applicable. The maximum round trip distance suggested in methodology ACM0003 version 07.2.
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Not Applicable. The maximum round trip distance suggested in methodology ACM0003 version 07.2.
Calibration frequency /interval:	Not Applicable. The maximum round trip distance suggested in methodology ACM0003 version 07.2.
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Not Applicable
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not Applicable
If applicable, has the reported data been crosschecked with other available data?	Not Applicable
How were the values in the monitoring report verified?	The maximum round trip distance suggested in methodology ACM0003 version 07.2 /14/. The distance of 400 km is considered as the maximum round trip distance and is used for the calculations.
Does the data management (from monitoring	The data management procedure is transparent; which ensure correct transfer of data and reporting of emission reductions.

equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	
---	--

Monitored Parameter	Assessment/Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	EF _{km,CO2,y} CO ₂ emission factor for the trucks represented per km of the distance travelled
Measuring frequency:	Once during the verification period. The data is sourced from the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual, Table 1-32 (for US heavy duty diesel vehicles, uncontrolled)" /21/
Reporting frequency:	Once during the verification period. The data is sourced from the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual, Table 1-32 (for US heavy duty diesel vehicles, uncontrolled)"
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	The data is sourced from the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual, Table 1-32 (for US heavy duty diesel vehicles, uncontrolled)"
Type of monitoring equipment:	Not Applicable
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Not Applicable

Calibration frequency /interval:	Not Applicable
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Not Applicable
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not Applicable
If applicable, has the reported data been crosschecked with other available data?	Not Applicable
How were the values in the monitoring report verified?	The values have been sourced based on the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual, Table 1-32 (for US heavy duty diesel vehicles, uncontrolled) has been used as source for the estimation of emission reductions". The value (0.001097 tCO ₂ /km) from IPCC is applied for the most conservative approach.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The data management procedure is transparent; which ensure correct transfer of data and reporting of emission reductions.

Monitored Parameter	Assessment/Observation
Data / Parameter:	AF _{T,k,y}

(as in monitoring plan of the VCS PD):	Quantity of biomass residue type k that has been transported to the project site during the year y
Measuring frequency:	Continuous monitoring with daily recording. Using weight scale to measure and monthly adjusted according to stock change. The parameter is continuously monitored with daily recording in line with the VCS PD.
Reporting frequency:	Using weight scale to measure and monthly adjusted according to stock change. The parameter is continuously monitored with daily recording in line with the VCS PD. The same was also verified during the on-site visit and found OK.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PD.
Type of monitoring equipment:	The data is monitored using weight scale to measure and monthly adjusted according to stock change. The monitoring equipment details are provided in the Appendix 6 of the Report. The monitoring equipment details have been checked during the site visit and found consistent.
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	The accuracy class of the weighing scale equipment is in compliance with the registered VCS PD. Hence accepted to the verification team.
Calibration frequency /interval:	The monitoring equipment is calibrated /8/ according to calibration plan and/or shutdown plan of kiln which is in compliance with the registered VCS PD. The documentation and calibration is controlled and managed in accordance with ISO9001 requirements. Hence accepted to the verification team.
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the	Yes

frequency of calibration, does the selected frequency represent good monitoring practice?	
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
If applicable, has the reported data been crosschecked with other available data?	The data is monthly adjusted according to stock change /5/.
How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet were verified with the Work Journal (WJ) /05/. The summary of values has been provided in the Appendix 5 of the Verification report. The reported values in the MR and ER sheet were found to be consistent with the Work Journal (WJ) information /5/.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The data management procedure is transparent; which ensure correct transfer of data and reporting of emission reductions.

Monitored Parameter	Assessment/Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	TL _y Average truck load of the trucks used during the year y
Measuring frequency:	For a conservative calculation, the default value of 15 tons/trip is used, since the on-site data is not available. The same is in line with the Transportation regulation of Thailand and hence acceptable.
Reporting frequency:	For a conservative calculation, the default value 15 tons/trip is used, since the on-site data is not available. The same is in line with the Transportation regulation of Thailand and hence acceptable. The same is found Ok based on the on-site visit.

Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Not Applicable
Type of monitoring equipment:	Not Applicable
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Not Applicable
Calibration frequency /interval:	Not Applicable
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Not Applicable
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not Applicable
If applicable, has the reported data been crosschecked with other available data?	Not Applicable

How were the values in the monitoring report verified?	For a conservative calculation, the default value of 15 tons/trip is used, since the on-site data is not available. The same is in line with the Transportation regulation of Thailand and hence acceptable. The same is found Ok based on the on-site visit.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The data management procedure is transparent; which ensure correct transfer of data and reporting of emission reductions.

Monitored Parameter	Assessment/Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	$FC_{i,j,y}$ Quantity of alternative fuel type k for biomass handling
Measuring frequency:	At least once a year in line with the VCS PD.
Reporting frequency:	At least once a year in line with the VCS PD.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PD.
Type of monitoring equipment:	Not Applicable
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment	Not Applicable

represent good monitoring practice?	
Calibration frequency /interval:	Not Applicable
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Not Applicable
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not Applicable
If applicable, has the reported data been crosschecked with other available data?	Purchasing invoice /5/ is used for the cross-checking purpose.
How were the values in the monitoring report verified?	The values for the “Thung Song” site reported in the monitoring report and ER sheet were verified with the Specific consumption figure which used for ex-ante estimation in the registered PD. The fuel consumption used for internal biomass handling is reported by contractor /05/ and found correct. The summary of value have been provided in the Appendix 5 of the Verification report.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The data management procedure is transparent; which ensure correct transfer of data and reporting of emission reductions.

Monitored Parameter	Assessment/Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	EF _{grid,y} (tCO ₂ /MWh) CO ₂ emission factor for grid electricity during the year y
Measuring frequency:	Once during the verification period. This emission factor in this report is calculated by Methodological Tool (Version 4.0) "Tool to calculate the emission factor for an electricity system". The data has been sourced from Summary report: The study of emission factor for electricity generation of Thailand in year 2014, published by Thailand Greenhouse Gas Management Organization. ²
Reporting frequency:	Once during the verification period. This emission factor in this report is calculated by Methodological Tool (Version 4.0) "Tool to calculate the emission factor for an electricity system" /22/. The data has been sourced from Summary report: The study of emission factor for electricity generation of Thailand in year 2014, published by Thailand Greenhouse Gas Management Organization /21/.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment:	Not Applicable
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Not Applicable
Calibration frequency /interval:	Not Applicable
Is the calibration	Not Applicable

²<http://ghgreduction.tgo.or.th/tver-method/tver-calculation-data.html>

interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not Applicable
If applicable, has the reported data been crosschecked with other available data?	Not Applicable
How were the values in the monitoring report verified?	This emission factor (0.5897) in this report is calculated by Methodological Tool (Version 4.0) "Tool to calculate the emission factor for an electricity system" /22/. The data has been sourced from Summary report: The study of emission factor for electricity generation of Thailand in year 2014, published by Thailand Greenhouse Gas Management Organization /21/.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The data management procedure is transparent; which ensure correct transfer of data and reporting of emission reductions.

Monitored Parameter	Assessment/Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	TDL _{j,y} Average technical transmission and distribution losses for providing electricity to source j.
Measuring	Once during the monitoring period

frequency:	The data has been sourced from the World Bank indicator 'Electric power transmission and distribution loss (%of output)' for Thailand ³
Reporting frequency:	Once during the monitoring period The data has been sourced from the World Bank indicator 'Electric power transmission and distribution loss (%of output)' for Thailand.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PD.
Type of monitoring equipment:	Not Applicable
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Not Applicable
Calibration frequency /interval:	Not Applicable
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Not Applicable
Did calibration confirm proper	Not Applicable

³ <https://data.worldbank.org/indicator/EG.ELC.LOSS.ZS?locations=TH&page=6>

functioning of monitoring equipment? (Yes / No):	
If applicable, has the reported data been crosschecked with other available data?	Not Applicable
How were the values in the monitoring report verified?	The values have been sourced from the World Bank indicator 'Electric power transmission and distribution loss (%of output)' for Thailand ⁴
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The data management procedure is transparent; which ensure correct transfer of data and reporting of emission reductions.

Monitored Parameter	Assessment/Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	$P_{clinker,y}$ Production of clinker in year y
Measuring frequency:	The amount of raw material is continuously monitored. Daily recording and adjusting with stock checking report at the end of month. The quantity of clinker produced is calculated from amount of raw material with clinker factor and adjusting with stock checking report at the end of month. The final figures are summarized in WJ /5/.
Reporting frequency:	The amount of raw material is continuously monitored. Daily recording and adjusting with stock checking report at the end of month. The quantity of clinker produced is calculated from amount of raw material with clinker factor and adjusting with stock checking report at the end of month. The final figures are summarized in WJ /5/.
Is measuring and reporting	Yes. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan

⁴ <https://data.worldbank.org/indicator/EG.ELC.LOSS.ZS?locations=TH&page=6>

frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	of the registered VCS PD.
Type of monitoring equipment:	The monitoring equipment details are provided in the Appendix 6 of the Report. The monitoring equipment details have been checked during the site visit and found consistent.
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	The accuracy class of the measuring equipment is in compliance with the registered VCS PD. Hence accepted to the verification team.
Calibration frequency /interval:	The monitoring equipment is calibrated according to calibration plan /8/ and/or shutdown plan of kiln. The documentation and calibration is controlled and managed in accordance with ISO9001 requirements Hence accepted to the verification team.
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Yes
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
If applicable, has the reported data been crosschecked with other available data?	The amount of raw material is continuously monitored. Daily recording and adjusting with stock checking report at the end of month.

How were the values in the monitoring report verified?	The values mentioned in the monitoring report and ER sheet were verified with the Work Journal (WJ) /05/. The summary of value has been provided in the Appendix 5 of the Verification report. The reported values in the MR and ER sheet were found to be consistent with the Work Journal (WJ) /8/ information.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The data management procedure is transparent; which ensure correct transfer of data and reporting of emission reductions.

Monitored Parameter	Assessment/Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	EF _{CO2,BL,y} Carbon dioxide emissions factor for the fossil fuels displaced by the use of biomass residue in the project plant.
Measuring frequency:	The factor is calculated every monitoring period. The annual weighted average value is calculated as determined in "Procedure for the selection of the most plausible baseline scenario" /22/.
Reporting frequency:	The factor is calculated every monitoring period. The annual weighted average value is calculated as determined in "Procedure for the selection of the most plausible baseline scenario" /22/.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PD.
Type of monitoring equipment:	Not Applicable
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring	Not Applicable

equipment, does the monitoring equipment represent good monitoring practice?	
Calibration frequency /interval:	Not Applicable
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Not Applicable
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not Applicable
If applicable, has the reported data been crosschecked with other available data?	Not Applicable
How were the values in the monitoring report verified?	The annual weighted average value is calculated as determined in "Procedure for the selection of the most plausible baseline scenario" /22/. The formula used in the calculations is as follows: $EF_{BL,CO2,y} = \frac{\sum_i FC_{BL,F3,i,y} * NCV_{i,y} * EF_{CO2,i,y}}{\sum_i FC_{BL,F3,i,y} * NCV_i}$
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in	The data management procedure is transparent; which ensure correct transfer of data and reporting of emission reductions.

place?	
--------	--

Monitored Parameter	Assessment/Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	$FC_{BL,i,y}$ Quantity of fossil fuel type i displaced in the project plant as a result of the project activity in year y.
Measuring frequency:	Once during the monitoring period. The quantities and types of fossil fuels i that are displaced as a result of the project activity ($FC_{BL,i,y}$) has been determined through the calculations.
Reporting frequency:	Once during the monitoring period. The quantities and types of fossil fuels i that are displaced as a result of the project activity ($FC_{BL,i,y}$) has been determined through the calculations.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment:	Not Applicable
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Not Applicable
Calibration frequency /interval:	Not Applicable
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does	Not Applicable

the selected frequency represent good monitoring practice?	
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not Applicable
If applicable, has the reported data been crosschecked with other available data?	Not Applicable
How were the values in the monitoring report verified?	The quantities and types of fossil fuels i that are displaced as a result of the project activity ($FC_{BL,i,y}$) has been determined through the calculations and found correct.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The data management procedure is transparent; which ensure correct transfer of data and reporting of emission reductions.

Monitored Parameter	Assessment/Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	Biomass residue type K Quantity of biomass residue type k that are utilized (eg. for energy generation or as feedstock) in the defined geographical region.
Measuring frequency:	The value is calculated once in the monitoring period. The value is sourced based on the Thailand Alternative Energy Situation Report 2014, 2015 and 2016, from Department of Alternative Energy Development and Efficiency (DEDE) /21/.
Reporting frequency:	The value is calculated once in the verification period. The value is sourced based on the Thailand Alternative Energy Situation Report 2014, 2015 and 2016, from Department of Alternative Energy Development and Efficiency (DEDE) /21/.
Is measuring and reporting	Yes. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan

frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	of the registered VCS PD.
Type of monitoring equipment:	Not Applicable
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practice?	Not Applicable
Calibration frequency /interval:	Not Applicable
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Not Applicable
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Not Applicable
If applicable, has the reported data been crosschecked with other available data?	Not Applicable
How were the values in the	The values mentioned in the monitoring report and ER sheet were verified with Thailand Alternative Energy Situation Report 2014, 2015 and 2016 ,

monitoring report verified?	from Department of Alternative Energy Development and Efficiency (DEDE) /21/.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	The data management procedure is transparent; which ensure correct transfer of data and reporting of emission reductions.

Monitored Parameter	Assessment/Observation
Data / Parameter: (as in monitoring plan of the VCS PD):	$EC_{PJ,y}$ Quantity of electricity consumed by project electricity consumption source j in year (MWh/year)
Measuring frequency:	Continuous monitoring with monthly recording in line with the VCS PD.
Reporting frequency:	Continuous monitoring with monthly recording in line with the VCS PD. The same was also verified during the on-site visit and found OK.
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes. From the document review and onsite verification, it is confirmed that the measuring and reporting frequencies are inline with the monitoring plan of the registered VCS PD.
Type of monitoring equipment:	The monitoring equipment (Multifunction power meters) details are provided in the Appendix 6 of the Report. The monitoring equipment details have been checked during the site visit and found consistent.
Is accuracy of the monitoring equipment as stated in the VCS PD? If the VCS PD does not specify the accuracy of the monitoring equipment, does the monitoring equipment	The accuracy class of the power meters is in compliance with the registered VCS PD. Hence accepted to the verification team.

represent good monitoring practice?	
Calibration frequency /interval:	The calibration frequency is in compliance with the registered VCS PD and hence accepted to the verification team. The maximum error is applied for monitored electricity consumption at KW, as a result of calibration delay.
Is the calibration interval in line with the monitoring plan of the VCS PD? If the VCS PD does not specify the frequency of calibration, does the selected frequency represent good monitoring practice?	Yes
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
If applicable, has the reported data been crosschecked with other available data?	NA
How were the values in the monitoring report verified?	For Ta Luang and Thung Song site, the installed rated capacity of biomass related equipment is used to determine electricity consumption. The energy meter at Khao Wong site is used to measure electricity consumption. The power consumption is calculated from the total kW and the number of operating hours within monitoring period (applicable for Ta Luang and Thung Song site). At Khao Wong site, the power meter continuously monitors the electricity consumption. The record is taken by operator on monthly basis The maximum error is applied for monitored electricity consumption at KW, as a result of calibration delay. The reported values in the MR and ER sheet were found to be consistent with the monitored information and deviation 3 applied with respect to the methodology.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data	The data management procedure is transparent; which ensure correct transfer of data and reporting of emission reductions.

and reporting of emission reductions and are necessary QA/QC processes in place?	
--	--

Remaining Issues from Validation or Previous Verification:

From the review of validation report and the previous (4th) verification report, the verification team has found that there is one remaining FAR from previous verification (4th periodic verification) which have been addressed during this current 5th verification of the project activity.

4.2 Accuracy of GHG Emission Reduction and Removal Calculations

The verification team has reviewed the emission reduction (ER) spread sheet and checked all the formulae and found they are correct and inline with the monitoring plan of the registered VCS PD and the applied monitoring methodology.

All the monitored parameters are described above in section 4.1. All the ex-ante parameters which are used in the calculation of emission reduction are presented in section 3.1 of the MR transparently. It is confirmed that all the ex-ante parameters have been correctly used in the emission reduction calculations.

Baseline emissions:

It is noted that the formula and calculation used for baseline emission calculations in the monitoring report and ER sheet is in compliance with the registered VCS PD. The default values and data used in the monitoring report /01/ is in-line with the registered PD/25/. Hence it is accepted.

Project Emissions:

It is noted that the formula and calculation used for project emission calculations in the monitoring report and ER sheet is in compliance with the registered VCS PD. The default values and data used in the monitoring report /02/ is in-line with the registered PD /11/. Hence, it is accepted.

Leakage:

The used technology is not equipment transferred from another activity, therefore according to the ACM0003 Version 07.2 /14/, there is no leakage to be considered. All the equipment used in the project activity for power and heat generation is either already existing or brought for purpose of project activity and there is no shifting of old equipment takes place. Therefore, there is no leakage as per ACM0003 Version 07.2 /14/.

The following are the ex-ante parameters used in the ER calculation which are in compliance with registered VCS PD:

Parameter	Description	Value	Unit
$FC_{i,x}$, $FC_{i,x-1}$, and $FC_{i,x-2}$	Quantity of fossil fuel of type i used in the project plant in year x, x-1 and x-2 where x is the year prior to the start of the project activity and i are the fossil fuel types used in the project plant in the three years prior to the start of the project activity.	As per the Appendix 5 of Report	ton
$FC_{BL,F3,i,y}$	Quantity of fossil fuel type i that would in the absence of the project activity be used in the project plant according to the selected baseline scenario F3 in year y	As per the Appendix 5 of Report	ton
$P_{clinker,x}$, $P_{clinker,x-1}$, and $P_{clinker,x-2}$	Production of clinker in year x, x-1 and x-2 where x is the year prior to the start of the project activity	As per the Appendix 5 of Report	ton
NCV_i	Net calorific value of fossil fuel types i where i is the fossil types used in the project plant in the three years prior to the start of the project activity.	As per the Appendix 5 of Report	GJ/ton
$EF_{CO_2,FF,i}$	Weighted average CO ₂ emission factor for fossil fuel type i where i are the fossil types used in the project plant in the last three years prior to the start of the project activity	As per the Appendix 5 of Report	tCO ₂ /GJ

According to the applied methodology, the conservativeness of the achieved emission reductions was checked and the calculations have been transparently provided in the ER sheet. The emission reductions are calculated as specified by the applied methodology, ACM0003 Version 07.2 /14/. The total emission reduction for the monitoring period calculated as stated below.

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
2014 (01/01/2014 to 31/12/2014)	346,430	50,978	0	295,452
2015 (01/01/2015 to 31/12/2015)	257,515	47,864	0	209,651
2016 (01/01/2016 to 31/03/2016)	85,870	23,663	0	62,207

Total	689,815	122,505	0	567,310
--------------	---------	---------	---	---------

The detailed emission reduction calculation is presented in the ER spread sheet /02/. All the formulae and the calculation procedure were checked by the verification team. It was observed that the emission reduction was determined in a conservative manner.

4.3 Quality of Evidence to Determine GHG Emission Reductions and Removals

During the verification site visit, all relevant documents were checked to assess the correctness and quality of data submitted by the project participants, which are used to determine emission reductions.

All records needed for monitoring are archived in line with the requirements of the registered monitoring plan and the deviation as described under Section 3.2 and 3.3 of the Verification report. No significant, lack of evidence and missing data were detected during onsite verification. Hence, the verification team confirms that the monitoring system ensures required quality of the monitoring system to ensure the quality of the monitored data. All internal data are subjected to QA/QC measures.

It was verified through onsite interviews that the plant's team involved in the monitoring of project activity is well experienced. Hence, the verification team concludes that competent staff is employed by the project proponent to carry out the relevant tasks with sufficient accuracy.

4.4 Non-Permanence Risk Analysis

Not Applicable to the project activity

5 SAFEGUARDS

5.1 No Net Harm

The project activity has no potential negative environment and social-economic impacts. Assessment team confirms it based on its on-site visit, document review and local & sectoral expertise.

5.2 Local Stakeholder Consultation

The stakeholder meeting process is described in the Section 6 of the registered VCS PD in detail and the process was validated during the registration of project activity under VCS. VCS validation report verified to confirm the same. Stakeholder groups were identified and informed through oral and written means. Further the verification team has interviewed the local stakeholders during the on-site visit for this verification and could not found any negative impact out of the project activity.

6 VERIFICATION CONCLUSION

KBS Certification Services Pvt. Ltd. has been contracted by 'South Pole Carbon Asset Management Ltd.' to undertake independent 5th periodic verification and certification for the greenhouse gas (GHG) emission reductions reported from "Siam Cement Biomass Project", for the monitoring period 01/01/2014 to 31/03/2016 (including both the days).

The verification is based on the monitoring report and registered VCS PD for this project activity. Our verification approach was based on the requirements as defined under the VCS Standard Version 3.7 /16/17/, Kyoto Protocol, Marrakech accord, as well as those defined by the CDM Executive Board of UNFCCC.

The management of the “The Siam Cement Co., Ltd.” and “South Pole Carbon Asset Management Ltd.” is responsible for the preparation of the GHG emissions data and the reported GHG emissions reductions on the basis set out within the project final Monitoring Report Version 02.1, dated 03/09/2018 /1/. The calculation and determination of GHG emission reductions from the project is the responsibility of the management of ‘The Siam Cement Co., Ltd.’ and “South Pole Carbon Asset Management Ltd.”. The development and maintenance of records and reporting procedures are in accordance with the Monitoring Report Version 02.1, dated 03/09/2018 /1/.

It is our responsibility to express an independent GHG verification opinion on the GHG emissions and on the calculation of GHG emission reductions from the project for the period 01/01/2014 to 31/03/2016 based on the reported emission reductions in the final Monitoring Report Version 02.1 and dated 03/09/2018 /1/ for the same period.

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

- All operations of the project are implemented and installed as planned and described in the project description.
- The monitoring system is in place and functional.
- The installed equipment essential for generating emission reductions runs reliably.
- The GHG emission reductions are calculated without material misstatements in a conservative and appropriate manner.

Based on an understanding of the risks associated with reporting GHG emissions data and the controls in place to mitigate these, KBS planned and performed our work to obtain the information and explanations that we considered necessary to provide sufficient evidence for us to give reasonable assurance that this reported amount of GHG emission reductions for the period is fairly stated.

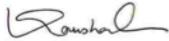
Verification period: From [01-01-2014] to [31-03-2016]

Verified GHG emission reductions and removals in the above verification period:

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
2014 (01/01/2014 to 31/12/2014)	346,430	50,978	0	295,452
2015 (01/01/2015 to 31/12/2015)	257,515	47,864	0	209,651
2016 (01/01/2016 to 31/12/2016)	85,870	23,663	0	62,207

31/03/2016)				
Total	689,815	122,505	0	567,310

Location: Faridabad
Date: 04/09/2018



Authorized Signatory: Kaushal Goyal
Designation: Managing Director
KBS Certification Services Pvt. Ltd.

APPENDIX 1: ABBREVIATIONS

Abbreviations	Full texts
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CDM EB	CDM Executive Board
CL	Clarification request
CO ₂	Carbon dioxide
CO ₂ e	Carbon dioxide equivalent
DCS	Distributed Control System
DEDE	Department of Alternative Energy Development and Efficiency
DOE	Designated Operational Entity
EB	Executive Board
ER	Emission Reduction
FAR	Forward Action Request
GHG	Greenhouse Gas(es)
IPCC	Intergovernmental Panel on Climate Change
MP	Monitoring Plan
MR	Monitoring Report
NCV	Net Calorific Value
PD	Power Density
PP	Project Participant
QA/QC	Quality Assurance / Quality Control
SCG	Siam Cement Group

TGMO	Thailand Greenhouse Gas Management Organization
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Verified Carbon Standard
VCSA	VCS Association
VCS PD	VCS Project Design document
VCU	Verified Carbon Unit
VVS	Validation And Verification Standard for project activities
WJ	Work Journal

APPENDIX 2: REFERENCES

S. No.	Name of document	date
/1/	Draft Monitoring Report Final Monitoring Report	Version 01, dated 26/09/2017 Version 02.1, dated 03/09/2018
/2/	Draft ER sheet Final ER sheet	Version 01, dated 26/09/2017 Version 02, dated 26/06/2018
/3/	Extract of manual of all the major equipments and all meters/measuring instruments/devices clearly indicating their specifications/ technical details corresponding to the project activity. List of auxiliary drives along with their rated capacity	-
/4/	Operating License for the Plant All the Government approvals e.g. from local section and ministry of industry, Thailand. Operational permit.	-
/5/	Daily Reports & Work Journal (WJ) for the monitoring parameters. Stock change data for the monitoring parameters Clinker and Cement Production details along with the sales record. Purchasing invoice	-
/6/	Extract of operation and maintenance record Competency certificates of operators. Records of outage	-
/7/	Single line diagram corresponding to the project activity	-

	describing the monitoring points Flow Chart for the Biomass Transport Operation Manual of the Cement Kiln Plant Biomass preparation flow diagram Process flow details for the wood chipper, biomass transportation, biomass dryers, biomass conveyers, kilns, biomass feeder, Work instruction for the Kilns operation	
/8/	Calibration certificates for the instruments (including power meters, bomb calorimeters, truck scale, rice husk weigh feeder, Kiln feed feeder) used in the project activity covering this monitoring Period	-
/9/	Study on Energy potential of utilized solid biomass during the monitoring period	-
/10/	Snap shots of the following Equipments: Covering the equipment and corresponding nameplates under project boundary (all major equipments). All the meters and measuring & testing equipment (including their specifications/nameplates).	-
/11/	Registered VCS PD for the project "Siam Cement Biomass Project"	Version 3.1, dated 06/11/2009
/12/	Bureau Veritas Certification Holding SAS: Validation report for the project "Siam Cement Biomass Project"	Dated 03/11/2009
/13/	Bureau Veritas Certification Holding SAS: Verification report of the project "Siam Cement Biomass Project" for the 4 th verification, Report ID BVC/VCS-VER/THAILAND-VR/07/2014	Dated 23/09/2014
/14/	CDM methodology: ACM0003 Version 07.2 – "Emission reduction through partial substitution of fossil fuels with alternative fuels or less carbon intensive fuels in cement or quicklime manufacture	-
/15/	CDM-EB: Clean Development Mechanism Validation and	Version 01.0

	Verification Standard for project activities	
/16/	VCS Verified Carbon Standard: VCS Program Guide, VCS Version 03, v3.7	21 June 2017
/17/	VCS Verified Carbon Standard: VCS Standard, VCS Version 03, v3.7	21 June 2017
/18/	VCS Verified Carbon Standard: VCS Verification Report Template Version 3.4	19 October 2016
/19/	VCS Verified Carbon Standard: VCS Guidance, Validation and Verification Manual, Version 3.2	19 October 2016
/20/	VCS Verified Carbon Standard: VCS Monitoring Report Template Version 3.4	19 October 2016
/21/	"Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual, Table 1-32 (for US heavy duty diesel vehicles, uncontrolled) IPCC: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, available at weblink http://www.ipcc-nggip.iges.or.jp/public/2006gl/ World Business Council for Sustainable Development at http://wbcsdcement.org/index.php/key-issues/climate-protection/co2-accounting-and-reporting Summary report: The study of emission factor for electricity generation of Thailand in year 2014, published by Thailand Greenhouse Gas Management Organization Thailand Alternative Energy Situation Report 2014, 2015 and 2016 , from Department of Alternative Energy Development and Efficiency (DEDE).	-
/22/	CDM-EB: Tool to calculate the emission factor for an electricity system, version 01 CDM-EB: Tool to calculate baseline, project and/or leakage emissions from electricity consumption, version 01 CDM-EB: Tool to calculate project or leakage CO₂ emission from fossil fuel combustion, version 02	-

“Guidelines on assessment of different types of changes from the project activity as described in the registered PDD (Annex 67 EB48)” “Procedure for the selection of the most plausible baseline scenario”.	
--	--

APPENDIX 3: COMPETENCE OF TEAM MEMBERS AND TECHNICAL REVIEWERS

Personnel Name:		Chetan Swaroop Sharma	
Qualified to work as:			
Team Leader	☒	Technical Expert	☒
Validator/Verifier	☒	Financial Expert	☒
Technical Reviewer	☒	Local Expert (India)	☒
Area(s) of Technical Expertise			
Sectoral Scope	Technical Area		
Energy industries (renewable/non-renewable sources)	TA 1.1: Thermal energy generation from fossil fuels and biomass including thermal electricity from solar		
	TA 1.2: Energy generation from renewable energy sources		
Energy Demand	TA 3.1. Energy demand		
Waste handling and disposal	TA 13.1. Solid waste and wastewater TA 13.2. Manure		
Approved by (Manager C & T)	Sanjay Kandari		
Approval date:	01/05/2017		

Personnel Name:		Rohit Badaya	
Qualified to work as:			
Team Leader	☒	Technical Expert	☒
Validator/Verifier	☒	Financial Expert	☒
Technical Reviewer	☒	Local Expert (India)	☒
Area(s) of Technical Expertise			
Sectoral Scope	Technical Area		
Energy industries (renewable/non-renewable sources)	TA 1.1: Thermal energy generation from fossil fuels and biomass including thermal electricity from solar		
	TA 1.2: Energy generation from renewable energy sources		
Energy demand	TA 3.1. Energy Demand		
Waste Handling and Disposal	TA 13.1 Solid waste and wastewater		

	TA 13.2 Manure
Approval date:	16/10/2017

Personnel Name:		Sanjay Kandari	
Qualified to work as:			
Team Leader	☒	Technical Expert	☒
Validator/Verifier	☒	Financial Expert	☒
Technical Reviewer	☒	Local Expert (India)	☒
Area(s) of Technical Expertise			
Sectoral Scope		Technical Area	
Energy Industries (renewable/non-renewable sources)	TA 1.1: Thermal energy generation from fossil fuels and biomass including thermal electricity from solar		
Energy industries (renewable/non-renewable sources)	TA 1.2: Energy generation from renewable energy sources		
Energy demand	TA 3.1. Energy Demand		
Waste Handling and Disposal	TA 13.1 Waste Handling and Disposal TA 13.2 Manure		
Approved by (Manager C & T)	Akhilesh Joshi		
Approval date:	11/12/2015		

APPENDIX 4: CLARIFICATION REQUESTS, CORRECTIVE ACTION REQUESTS AND FORWARD ACTION REQUESTS

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

FAR ID	01	Section no.	-	Date: 11/10/2017
Description of FAR /13/				
FAR raised during 4th periodic verification:				
Due to difficulties in this verification, this is request SouthPole, as consultant to this project, to assist SCG staff in term of training, explanation, and data declaration that would result in smooth and effective verification process in the next monitoring period.				
Project participant response				Date: 26/06/2018
The data collecting is response by Energy Engineer, who is based at SCG Central Office in Bangkok. The training and knowledge transfer about the monitoring system is provided to Energy Engineer by consultant. The Energy Engineer will coordinate with the engineers at each project sites to get the accurate data with internal quality checking and approval before submitting to consultant. This process is set up and agreed by both parties, to ensure the effective monitoring system at each sites.				
Documentation provided by project participant				
-				
DOE assessment				Date: 03/07/2018
Any supportive document. The issue is open.				

Project participant response	Date: 18/07/2018
The information is explained in section 3.3 – Monitoring plan of MR , <i>The Cell operators are responsible for recording the data from DCS (Distributed Control System) into daily log sheet and input in daily report file. The daily report file is checked by the Cell Head and engineer respectively. At the end of month, the engineer will prepare the Work Journal (WJ) by using the data from daily report and adjusting by the data from stock checking report.</i> <i>Data in electronic format from each site will be centralised at SCG's Engineering Department and then submitted to consultant for emission calculations.</i>	
Documentation provided by project participant	
-	
DOE assessment	Date: 20/07/2018
During the site visit, it was found that the Cell operators are responsible for recording the data from DCS (Distributed Control System) into daily log sheet and input in daily report file. The daily report file is checked by the Cell Head and engineer respectively. At the end of month, the engineer prepares the Work Journal (WJ) by using the data from daily report and adjusting by the data from stock checking report. Data in electronic format from each site will be centralised at SCG's Engineering Department and then submitted to consultant for emission calculations. The effective monitoring system at the site was confirmed during the site visit and hence the issue was closed.	

Table 2. CL from this verification

CL ID	01	Section no.	-	Date: 11/10/2017
Description of CL				
Verification team has found that the biomass availability under the monitoring parameter "Biomass residue type K" in the MR has been justified for the year 2014 and 2015 however there is no justification for the years 2016 as the monitoring period is from 01-January-2014 to 31-March-2016.				
Project participant response				Date: 26/06/2018
Since the annual report by DEDE for 2016 was not available at the time of first submission of MR. The biomass leakage analysis for 2016 is added in the revised MR.				
Documentation provided by project participant				
Monitoring Report rev02				
DOE assessment				Date: 03/07/2018
The assessment has been done however the basis, why only "rice husk availability data of Ta Luang and Khao Wong sites in 2014" and only Saw dust and coconut availability data of Thung Song site during 2014 – 2016. The issue is open.				
Project participant response				Date: 18/07/2018
Since the rice husk is the maximum biomass usage at Ta Luang and Khao Wong sites. While saw dust and coconut are the highest biomass consumptions at Thung Song site. The approach to do the availability assessment is to demonstrate that there is an abundant surplus of the biomass in the region. Therefore, if the surplus of the main types of biomass is more than 25%. This approach is consistence with the previous verifications.				
Documentation provided by project participant				
-				
DOE assessment				Date: 20/07/2018
The PP has demonstrated the surplus biomass availability based on the biomass which has been utilized as maximum at the particular sites of the project activity. The rice husk is the maximum biomass usage at Ta Luang and Khao Wong sites, while the saw dust and coconut are the highest biomass consumptions at Thung Song site. Hence the biomass availability assessment is demonstrated based on the abundant surplus of the biomass in the particular region. Hence the issue is closed.				

Table 3. CAR from this verification

CAR ID	01	Section no.	-	Date: 11/10/2017
Description of CAR				
PP need to submit the Monitoring equipment details corresponding to all the monitoring parameters along with the calibration details.				
Project participant response				Date: 26/06/2018
The information of monitoring equipment with calibration record is submitted , the summary information of the same is also provided in the ER sheet and MR.				
Documentation provided by project participant				
Monitoring Report ver02 ER calculation sheet ver02				
DOE assessment				Date: 03/07/2018
What is the calibration frequency. In case delay, how the emission reduction calculated. The issue is open.				
Project participant response				Date: 18/07/2018
The calibration frequency of monitoring equipment is as per the annual shutdown plan of kilns , which is once a year depended on the sales plan. However, some project sites, they will do the calibration every times when kiln is stopped. The error that may occurred by the monitoring equipment will be adjusted with the stock balance (remaining stock at the end of month and purchasing invoices) in the preparation of Work Journal , on monthly basis. The WJ is the official performance report which balance the amount of raw materials and energy consumption with the amount of final products. This approach is consistence with the previous verifications. The same approach is used for 'Cement Sustainability Initiative' , CSI report (http://www.cement-co2-protocol.org/en/) and 'Getting the Numbers Right' , GNR database (http://www.wbcsdcement.org/index.php/key-issues/climate-protection/gnr-database) , under the World Business Council of Sustainable Development (WBSCD).				
Documentation provided by project participant				
-				
DOE assessment				Date: 20/07/2018
The correction factor (error) of 1% has been applied for the calculations of emission reductions due to calibration delay of the electricity meters. For the calibration of Truck Scale installed for the site "Ta Luang" and "Khao Wong", the calibration details are not available for the complete monitoring period from year 2014 to 2016. However the emission reductions are only claimed for the year 2014, hence the existing available calibration is sufficient for the year 2014 for the calculation of emission reductions. Hence the issue is closed.				

Table 4. FAR from this verification

No FAR raised during this verification.

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

APPENDIX 5: MONITORED & HISTORICAL DATA

Monitored data of Ta Luang site

TL	2014		
	Amount	LHV	Heat
Type of fuel	ton-AF	GJ/ton	GJ
<i>Clinker</i>	<i>2,683,465</i>		
<i>Running Hrs.</i>	<i>7,910</i>		
HFO+used oil	1,671	40.40	67,505
CKB			
Lignite-Maeteep	34,202	17.19	587,925
Hical 40	1,480	11.94	17,661
Petcoke			
Lignite-MT	39,054	19.02	742,612
Coal-High Heat	103,090	26.10	2,690,234
Bituminous dust	136,190	24.27	3,305,308
Coal-Low Heat	52,870	24.67	1,304,507
Coal-Spot Lot	4,587	20.94	96,049
Coal Noble			
Total	373,144	23.62	8,811,800
Husk	47,576	13.16	626,251
Total	47,576	13.16	626,251

Monitored data of Thung Song site

TS	2014			2015			2016		
	Amount	LHV	Heat	Amount	LHV	Heat	Amount	LHV	Heat
Type of fuel	ton-AF	GJ/ton	GJ	ton-AF	GJ/ton	GJ	ton-AF	GJ/ton	GJ
Clinker	4,420,508			4,647,840			1,361,360		
Running Hrs.	6,794			6,922			2,099		
HFO+used oil	3,654	40.40	147,641	2,830	40.40	114,343	212	40.40	8,568
Coal	138,230	24.93	3,445,481	197	25.40	5,004			
Coal HH	176,999	24.94	4,414,285	174,546	25.82	4,506,849	51,911	25.66	1,332,230
Coal MH	122,455	24.77	3,032,731	270,305	25.86	6,990,798	75,164	26.00	1,954,202
Bituminous dust	7,071	24.73	174,820	2,745	25.56	70,150			
Coal Low Grade				2,326	23.84	55,457	1,400	23.84	33,383
Total	448,409	25.01	11,214,959	452,949	25.92	11,742,600	128,687	25.86	3,328,383
Rubber tire	10,431	28.25	294,618	14,760	28.83	425,471	5,251	29.99	157,476
Used oil	82	40.40	3,321						
RDF	176	5.31	935	165	27.95	4,604	203	19.97	4,050
RDF ECO							2,908	26.61	77,391
Total	10,689	27.96	298,874	14,925	28.82	430,075	8,362	28.57	238,917
Palm shell	5,368	14.34	76,957	110	15.87	1,739			
50-wood cip							5,487	12.44	68,264
Saw dust	53,520	14.79	791,349	70,703	13.41	948,440	31,610	11.02	348,474
73-wood chip							14,549	9.92	144,302
Wood chip	35,700	10.99	392,306	25,126	11.09	278,559			
Rice husk	16,731	13.15	219,947	3,815	13.03	49,717	13	9.56	123
Coconut dust	34,670	19.63	680,517	41,130	15.75	647,858	11,604	15.00	174,078
Charcoal	49	13.15	640	826	19.81	16,357	29	13.15	383
Bark	40,817	13.29	542,605	35,945	11.54	414,971	7,494	10.94	81,982
Dust wood							532	13.35	7,104
Crushed bark				57,705	12.15	701,051	13,269	11.13	147,632
Stump	1	11.00	16						
Recycle wood chip	41,400	13.47	557,747	12,963	13.69	177,505			
Total	228,255	14.29	3,262,084	248,322	13.03	3,236,197	84,588	11.50	972,343

Monitored data of Khao Wong site

KW	2014		
	Amount	LHV	Heat
Type of fuel	ton-AF	GJ/ton	GJ
Clinker	3,360,554		
Running Hrs.	-		
Coal	311,909	24.25	7,563,214
Coal + Anthracite			
(ultra)HFO CKB	2,499	39.63	99,044
Shale Hi-Cal	7,830	11.39	89,203
Lignite	86,477	19.20	1,660,130
Other FC based	1,202	21.90	26,328
Total	409,917	23.02	9,437,920
RDF + R40B	1,319	14.02	18,486
Mixed waste	3,004	18.63	55,967
waste oil			
Total	4,323	17.22	74,454
Agricultural waste			
Saw dust	40,785	16.56	675,413
Rice husk	43,864	14.56	638,514
Total	84,649	15.52	1,313,928

Historical data of Ta Laung , Khao Wong and Kaeng Khoi sites

Fuel Type		TL				KW				KK			
Fossil		2000	2001	2002	Total	2000	2001	2002	Total	2000	2001	2002	Total
Fuel Oil	ton-dry	885	825	4,866	6,576	3,705	4,188	2,261	10,154	3,877	3,320	5,678	12,875
Coal	ton-dry	16,923	5,944	31,708	54,575	27,218	3,166	19,574	49,958	137,006	1,948	43,007	181,961
Lignite	ton-dry	46,845	92,730	251,340	390,915	189,534	140,995	270,215	600,744	468,388	647,769	533,107	1,649,264
Pet-Coke	ton-dry	4,643	1,771	59,457	65,871	129,514	143,749	106,027	379,290	56,917	104,250	157,989	319,156
Anthracite	ton-dry	-	-	-	-	2,835	48,758	8,477	60,070	-	14,077	4,545	18,622
Heating Value		2000	2001	2002	Average	2000	2001	2002	Average	2000	2001	2002	Average
Fuel Oil	GJ/ton	40.39	40.39	40.39	40.39	40.39	40.39	40.39	40.39	40.39	40.39	40.39	40.39
Coal	GJ/ton	24.30	25.41	25.09	24.88	24.95	26.70	28.47	26.44	25.74	25.74	25.74	25.74
Lignite	GJ/ton	18.21	18.12	17.16	17.51	21.42	20.79	20.26	20.75	17.99	17.99	17.99	17.99
Pet-Coke	GJ/ton	30.13	30.46	32.63	32.40	32.96	32.25	33.76	32.91	32.46	32.44	32.44	32.44
Anthracite	GJ/ton	0.00	0.00	0.00	0.00	29.25	27.80	27.86	27.88	0.00	27.21	27.21	27.21
HG = FC x NCV	GJ	2000	2001	2002	Total	2000	2001	2002	Average	2000	2001	2002	Average
Fuel Oil	GJ	35,758	33,326	196,562		149,663	169,174	91,314		156,611	134,111	229,362	
Coal	GJ	411,229	151,037	795,550		679,164	84,540	557,242		3,527,069	50,149	1,107,168	
Lignite	GJ	852,967	1,680,437	4,312,638		4,060,567	2,930,958	5,474,624		8,425,008	11,651,578	9,589,125	
Pet-Coke	GJ	139,876	53,941	1,940,124		4,268,854	4,635,753	3,579,497		1,847,457	3,382,026	5,125,400	
Anthracite	GJ	-	-	-		82,929	1,355,435	236,153		-	383,021	123,665	
Pclinker	ton	410,188	557,145	2,126,642	1,031,325	3,041,073	3,017,068	3,254,406	3,104,182	4,527,703	4,912,623	5,045,459	4,828,595
HG/Pclinker	GJ/ton	3.51	3.44	3.41		3.04	3.04	3.05		3.08	3.18	3.21	
FC x NCV x EF		2000	2001	2002	Total	2000	2001	2002	Total	2000	2001	2002	Total
Fuel Oil	GJ	2,700	2,516	14,840		11,300	12,773	6,894		11,824	10,125	17,317	
Coal	GJ	38,162	14,016	73,827		63,026	7,845	51,712		327,312	4,654	102,745	
Lignite	GJ	77,535	152,752	392,019		369,106	266,424	497,643		765,833	1,059,128	871,651	
Pet-Coke	GJ	11,596	4,472	160,836		353,888	384,304	296,740		153,154	280,370	424,896	
Anthracite	GJ	-	-	-		7,845	128,224	22,340		-	36,234	11,699	
EFBLCO ₂ y	tCO ₂ /GJ	0.0903	0.0906	0.0885	0.0891	0.0871	0.0871	0.0881	0.0875	0.0901	0.0891	0.0883	0.0891

Historical data of Thung Song and Lampang site

Fuel Type		TS				LP			
Fossil		2000	2001	2002	Total	2000	2001	2002	Total
Fuel Oil	ton-dry	4,126	3,291	2,486	9,903	519	477	682	1,678
Coal	ton-dry	188,136	166,152	143,493	497,781	-	-	-	-
Lignite	ton-dry	50,424	208,229	225,796	484,449	105,615	105,743	191,910	403,268
Pet-Coke	ton-dry	143,272	101,586	105,029	349,888	-	-	-	-
Anthracite	ton-dry	-	-	16,879	16,879	-	-	-	-
Heating Value		2000	2001	2002	Average	2000	2001	2002	Average
Fuel Oil	GJ/ton	40.39	40.39	40.39	40.39	40.39	40.39	40.39	40.39
Coal	GJ/ton	25.12	25.83	25.39	25.44	0.00	0.00	0.00	0.00
Lignite	GJ/ton	18.85	20.48	19.32	19.77	18.10	17.94	17.82	17.92
Pet-Coke	GJ/ton	33.98	32.81	32.22	33.11	0.00	0.00	0.00	0.00
Anthracite	GJ/ton			26.46	26.46	0.00	0.00	0.00	0.00
HG = FC x NCV	GJ	2000	2001	2002	Average	2000	2001	2002	Average
Fuel Oil	GJ	166,665	132,951	100,415		20,965	19,268	27,563	
Coal	GJ	4,726,725	4,292,170	3,643,295		-	-	-	
Lignite	GJ	950,726	4,263,615	4,363,495		1,912,101	1,897,156	3,418,995	
Pet-Coke	GJ	4,868,550	3,332,781	3,383,884		-	-	-	
Anthracite	GJ	-	-	446,680		-	-	-	
Pclinker	ton	3,381,254	3,797,506	3,825,211	3,667,990	642,816	603,902	1,063,054	769,924
HG/Pclinker	GJ/ton	3.17	3.17	3.12		3.01	3.17	3.24	
FC x NCV x EF		2000	2001	2002	Total	2000	2001	2002	Total
Fuel Oil	GJ	12,583	10,038	7,581		1,583	1,455	2,081	
Coal	GJ	438,640	398,313	338,098		-	-	-	
Lignite	GJ	86,421	387,563	396,642		173,810	172,451	310,787	
Pet-Coke	GJ	403,603	276,288	280,524		-	-	-	
Anthracite	GJ	-	-	42,256		-	-	-	
EFBLCO ₂ y	tCO ₂ /GJ	0.0879	0.0892	0.0892	0.0888	0.0907	0.0907	0.0908	0.0908

APPENDIX 6: MONITORED EQUIPMENT DETAILS

Monitoring equipment at Ta Luang site

Project Site	Meter Name	Type	Tag No.	Accuracy	Calibration History		
					2013	2014	2015
TL6	WF-Biomass	Schenck-Multidas	W1U64F1	0.50%	21-Sep-13	17-Oct-14	6-Nov-15
TL5	WF-Biomass	Schenck-Multidas	W2U64F1	0.50%	24-Apr-13	15-Nov-14	17-Sep-15
TL5	Kiln Feed		W2A03F1	1%	27-Apr-13	21-Nov-14	17-Sep-15
TL6	Kiln Feed		W1A01F1 > W1A03F1	1%	26-Sep-13	17-Oct-14	4-Nov-15
TL6	WF-Solid fuel	Coriolis	K6A10	1%	14-May-13	16-Oct-14	13-Oct-15
TL6	WF-Solid fuel	Pfister	L7F15	0.50%	14-May-13	17-Oct-14	13-Nov-15
TL5	WF-Solid fuel	Pfister	L5F35	0.50%	23-Apr-13	25-Nov-14	20-Sep-15
TL5	WF-Solid fuel (stop)	Pfister	K1A02	0.50%	23-Apr-13	Stop	
TL5	WF-Solid fuel (stop)	Pfister	K1A03	0.50%	23-Apr-13	Stop	
TL5	WF-Solid fuel (New)	Coriolis	K1A10	0.50%		26-Nov-14	20-Sep-15
TL	Truck scale	Kubota KL-D1000S	8XBSU6009	-	27-Nov-12	5-Jun-14	
TL	Truck scale	Kubota KL-D1000S	8XBSU60015	-	27-Nov-12	5-Jun-14	
TL	Truck scale	Mettler Todelco IND.310	0038720-6CK	-	3-Jul-13		11-Feb-15
TL	Bomb Calorimeter	Isoperibol	0.15%	-	5-Nov-13	25-Apr-14 16-Oct-14	3-Apr-15

Monitoring equipment at Thung Song site

Project Site	Meter Name	Type	Tag No.	Accuracy	Calibration History				
					2013	2014	2015	2016	2017
TS	WF-Biomass		228_92		23-Oct-13	19-Apr-14 10-Aug-14	2-Aug-15	4-May-16	22-Jul-17
TS	WF-Biomass		228_95		23-Oct-13	19-Apr-14 10-Aug-14	2-Aug-15	4-May-16	22-Jul-17 27-Jul-17
TS	WF-Biomass		6796-03		19-Sep-13	19-Mar-14 4-Sep-14	10-Feb-15 20-Oct-15	18-Jun-16	18-Sep-17 21-Sep-17
TS	WF-Biomass		6796-06		19-Sep-13	19-Mar-14 4-Sep-14	10-Feb-15 20-Oct-15	18-Jun-16	18-Sep-17 21-Sep-17
TS	WF-Biomass		K4J32		20-Jun-13	Kiln 4 stop			
TS	WF-Solid fuel	Coriolis	791-10	1%	23-Oct-13	29-Jul-14	24-Jul-15	25-Jul-16	22-Jul-17
TS	WF-Solid fuel	Pfister	792-10	1%	23-Oct-13	29-Jul-14	24-Jul-15	22-Jul-16	22-Jul-17
TS	WF-Solid fuel	Pfister	793-10	1%	23-Oct-13	29-Jul-14	24-Jul-15	22-Jul-16	22-Jul-17
TS	WF-Solid fuel	Coriolis	6791-10	1%	10-Dec-13	29-Jul-14	24-Jul-15	25-Jul-16	22-Jul-17
TS	WF-Solid fuel	Coriolis	6792-10	1%	10-Dec-13	29-Jul-14	24-Jul-15	25-Jul-16	22-Jul-17
TS	WF-Solid fuel	Coriolis	6793-10	1%	10-Dec-13	29-Jul-14	24-Jul-15	25-Jul-16	22-Jul-17
TS	WF-Solid fuel	Coriolis	K4J20	1%	21-Jun-13	29-Jul-14	24-Jul-15	25-Jul-16	22-Jul-17
TS	WF-Solid fuel	Coriolis	K5J20	1%	21-Jun-13	29-Jul-14	24-Jul-15	25-Jul-16	22-Jul-17
TS	Truck scale	Mettler Toledo Model IND 310	BIX03 00461186FL	40 kg	13-Mar-13	11-Mar-14		24-Mar-16	
TS	Truck scale	Mettler Toledo Model IND 780	BIX04 B312160815	40 kg	27-May-13	11-Mar-14		24-Mar-16	27-Feb-17
TS	Truck scale	Mettler Toledo Model IND 560	XIX05 B211772421	40 kg	3-Apr-13	14-Jan-14		24-Mar-16	
TS	Truck scale	Mettler Toledo Model IND 780	XIX06 B308063872	40 kg	3-Apr-13	15-Jan-14		24-Mar-16	
TS	Bomb calorimeter	LECO AC-350	C-26		10-Feb-13 10-Aug-13	10-Aug-14 23-Dec-14	10-Feb-15 10-Aug-15	10-Feb-16 10-Aug-16	10-Feb-17 10-Aug-17
TS	Bomb calorimeter	LECO AC-500	C-25		10-Jan-13 10-Jul-13	10-Jan-14 10-Jul-14	10-Jan-15 10-Jul-15	10-Jan-16 10-Jul-16	10-Jan-17

Monitoring equipment at Khao Wong site

Project Site	Meter Name	Type	Tag No.	Accuracy	Calibration History		
					2013	2014	2015
KW	Raw Meal	Schenck	0802F101	3%		31-Jan-14	29-Jan-15
KW	Raw Meal	Schenck	0802F201	3%		31-Jan-14	29-Jan-15
KW	Feeder Lignite	Pfister	1566-1	-	22-Dec-13	1-Apr-14 28-Apr-14 23-May-14 19-Jun-14 8-Jul-14 31-Jul-14 5-Sep-14 4-Nov-14	22-Jan-15
KW	Feeder Lignite	Pfister	1566-2	-	22-Dec-13	1-Apr-14 22-Apr-14 28-Apr-14 23-May-14 13-Jun-14 5-Sep-14 4-Nov-14	7-May-15
KW	Feeder Lignite	Pfister	1566-3	-	21-Sep-13	1-Apr-14 28-Apr-14 23-May-14 16-Jun-14 7-Jul-14 31-Jul-14 25-Aug-14 5-Sep-14 4-Nov-14	22-Apr-15
KW	Biomass Belt Weigher	Belt Weight	904H-1	3%	13-Dec-13	24-Jan-14	7-Jan-15
KW	Biomass Belt Weigher	Belt Weight	904H-2	3%	11-Dec-13	22-Jan-14	6-Jan-15
KW	Truck Scale	Mettler Toledo Model IND.780	5691932-5HN	2%	23-May-12	24-Mar-14	
KW	Truck Scale	Mettler Toledo Model 8530	4286655-4NT	2%	24-Oct-13		
KW	Truck Scale	Mettler Toledo Model IND.310	0040351-6EH	2%	25-Sep-12	24-Mar-14	
KW	Truck Scale	Mettler Toledo Model IND.780	B308063871	2%	17-May-13	24-Mar-14	
KW	Truck Scale	Mettler Toledo Model IND.780	B309072021	2%	31-Jul-13		
KW	Power Meter - MCC+N1 incoming : 34)	SOCOMECDIRISAp	034611058	0.5%		28-Oct-14	2-Sep-15
KW	Power Meter (SWC-35)	E-POWER ECM 700	1008031258427	1.0%		28-Oct-14	2-Sep-15
KW	Bomb calorimeter	Isoperibol	6200110823296	0.15%	5-Nov-13	25-Apr-14 16-Oct-14	3-Apr-15