Jilin Rice Husk Thermal Energy Generation Project

Document Prepared By Wilmar International Limited
Contact Information:
Mr. Joshua Lim
Tel: (65) 6216 0244
Fax: (65) 6233 9493
E-mail: joshualim@wilmar.com.sg

Project Title	Jilin Rice Husk Thermal Energy Generation Project
Version	1
Report ID	Jilin VCS MR #1
Date of Issue	30-December-2013
Project ID	529
Monitoring Period	Monitoring Period 1: 10-December-2009 – 09-December-2010 Monitoring Period 2: 10-December-2010 – 09-December-2011 Monitoring Period 3: 10-December-2011 – 09-December-2012 Monitoring Period 4: 10-December-2012 – 31-December-2012 (first and last days included)
Prepared By	Wilmar International Limited
Contact	56 Neil Road Singapore 088830 Contact: Mr. Joshua Lim Tel: (65) 6216 0244Fax: (65) 6233 9493 E-mail: joshualim@wilmar.com.sg

Table of Contents

1 PROJECT DETAILS

1.1 Summary Description of Project

The project is a green-field rice husk based activity to generate steam needed by Yihai Kerry (Jilin) Oils, Grains and Foodstuffs Industries Co., Ltd for its operations, which is a subsidiary of Wilmar International Ltd, the Project Proponent (PP) of the project activity.

The steam is required for its operations involving rice bran oil extraction and the paddy drying tower. This contributes to the greenhouse gas (GHG) emission reduction by avoiding potential use of a fossil fuel (in this case, coal) for thermal energy production.

The VCS project comprises two boilers with installed capacity of 15 MT/hour each (Boiler 1 "JIL_B01" and Boiler 2 "JIL_B02"), each capable of generating medium pressure (3.82 MPa) superheated steam at 450°C.

The trial operation of the project started on 26 November 2009 while the actual delivery of steam is 10 December 2009. The project is expected to be operational for at least 15 years. The total emission reductions achieved in the monitoring periods are as follows:

- Monitoring Period 1 (10 December 2009 – 09 December 2010) "MP1": 6,020 tCO_2
- Monitoring Period 2 (10 December 2010 – 09 December 2011) "MP2": 8,710 tCO_2
- Monitoring Period 3 (10 December 2011 – 09 December 2012) "MP3": 10,204 tCO_2
- Monitoring Period 4 (10 December 2012 – 31 December 2012) "MP4": 1,444 tCO_2

1.2 Sectoral Scope and Project Type

The project falls in VCS Sectoral Scope 1 - Energy (renewable/non-renewable). It is a stand-alone project and is not grouped with any other project.

1.3 Project Proponent

Wilmar International Limited

Role: VCS Project Developer

Responsibility: Undertake all activities leading to registration of VCS project and monitoring, verification and issuance of VCU.

Contact:
Mr. Joshua Lim
Address: 56 Neil Road, Singapore 088830
Tel: (65) 6216 0244, Fax: (65) 623 9493
E-mail: joshualim@wilmar.com.sg

1.4 Other Entities Involved in the Project

There are no other entities involved in the project.

1.5 Project Start Date

10-December-2009

1.6 Project Crediting Period

10-December-2009 – 09-December-2019 (Fixed crediting period)
The length of project crediting period is 10 years.

1.7 Project Location

The project is located at Jilin, Jilin Province, China. The location GPS coordinates are 44° 4'1.75"N and 126°31'40.36"E. The project site is about 25 km from Jilin City to the north.

1.8 Title and Reference of Methodology

AMS I.C (version 16) "Thermal energy production with or without electricity".

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The VCS project started on 10 December 2009. There were no events or situations that occurred during the monitoring period which may impact the applicability of the methodology or the GHG emission reductions.

The VCS PD was validated by the Designated Operational Entity, Bureau Veritas Certification (BV) and the present monitoring report will also be verified by BV.

The monitoring data was kept according to the monitoring plan as described in Section 3 of the validated PD.

2.2 Deviations from the Monitoring Plan

Though it was stated that steam flow from the boilers are to be recorded on hourly basis as per the monitoring plan in the registered/validated PD (in Section 3.4), a deviation was made with respect to the monitoring plan provided. The deviation comprises calculating energy delivered on a daily basis over the monitoring period instead of on an hourly basis. This was necessitated because steam flow to the steam customers was monitored on a daily basis. The details are provided in Section 4.1 in this Monitoring Report.

2.3 Grouped Project

This is not a grouped project.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data Unit / Parameter:	$\eta_{BL,thermal}$
Data unit:	-
Description:	Average net efficiency of a similar thermal heat generation system in the baseline using coal
Source of data:	An efficiency of 100% as a conservative default value (refer: clause 18(c) in AMS I.C – version 16)
Value applied:	100%
Purpose of the data:	This is used for baseline emissions estimation
Any comment:	-

3.2 Data and Parameters Monitored

Data Unit / Parameter:	$EF_{FF,CO2,y}$
Data unit:	tCO_2e/TJ
Description:	The CO_2 emission factor of the fossil fuel (in this case, coal) that would have been used in the baseline plant
Source of data:	As no accurate and reliable local or national data is available, IPCC default emission factor was used
Description of measurement methods and procedures to be applied:	Not relevant
Frequency of monitoring/recording:	Annually
Value monitored:	94.6
Monitoring equipment:	Not relevant
QA/QC procedures to be applied:	Not relevant
Calculation method:	Not relevant
Any comment:	No revision of the IPCC guidelines was found during MP1, MP2 and MP3.

Data Unit / Parameter:	$Temp_{Steam,B1}$
Data unit:	°C
Description:	Temperature of MP steam produced by the 15 MT/hour Boiler 1
Source of data:	On-line data records obtained from PLC readings using temperature sensors on MP steam delivery line to Header 1
Description of measurement methods and procedures to be applied:	Hourly records maintained at the project site
Frequency of monitoring/recording:	Hourly

Value monitored:	• Monitoring Period 1: 263 • Monitoring Period 2: 289 • Monitoring Period 3: 293 • Monitoring Period 4: (not operating)
Monitoring equipment:	Type: Temperature meter Accuracy class: Class II
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor. Calibration procedures are in accordance to national standards and regulations. Frequency of calibration: Annually Calibration dates for • Monitoring Period 1: Factory calibration, valid at installation • Monitoring Period 2: 17 October 2010 • Monitoring Period 3: 16 October 2011 • Monitoring Period 4: 15 October 2012
Calculation method:	Average of hourly values for each day in the monitoring period has been calculated to provide the daily average temperature of steam
Any comment:	Obtained from PP's "Jilin VCS Monitoring Records 2009-2012" spreadsheet, average of "Temperature (°C) Meter 5" taken from Meter 5, per the Monitoring Plan Diagram in Section 5 (Metering Point #5).

Data Unit / Parameter:	$Temp_{Steam,B2}$
Data unit:	°C
Description:	Temperature of MP steam produced by the 15 MT/hour Boiler 2
Source of data:	On-line data records obtained from PLC readings using temperature sensors on MP steam delivery line to Header 1
Description of measurement methods and procedures to be applied:	Hourly records maintained at the project site
Frequency of monitoring/recording:	Hourly
Value monitored:	• Monitoring Period 1: 293 • Monitoring Period 2: 334 • Monitoring Period 3: 288 • Monitoring Period 4: 350
Monitoring equipment:	Type: Temperature meter Accuracy class: Class II
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor. Calibration procedures are in accordance to national standards and regulations. Frequency of calibration: Annually Calibration dates for

	• Monitoring Period 1: Factory calibration, valid at installation • Monitoring Period 2: 17 October 2010 • Monitoring Period 3: 16 October 2011 • Monitoring Period 4: 15 October 2012
Calculation method:	Average of hourly values for each day in the monitoring period has been calculated to provide the daily average temperature of steam
Any comment:	Obtained from PP's "Jilin VCS Monitoring Records 2009-2012" spreadsheet, average of "Temperature (°C) Meter 6" taken from Meter 6, per the Monitoring Plan Diagram in Section 5 (Metering Point #6).

Data Unit / Parameter:	$P_{Steam,B1}$
Data unit:	MPa
Description:	Pressure of MP steam produced by the 15 MT/hour Boiler 1
Source of data:	On-line data records obtained from PLC readings using pressure sensors on MP steam delivery line to Header 1
Description of measurement methods and procedures to be applied:	Hourly records maintained at the project site
Frequency of monitoring/recording:	Hourly
Value monitored:	• Monitoring Period 1: 1.34 • Monitoring Period 2: 1.53 • Monitoring Period 3: 1.47 • Monitoring Period 4: (not operating)
Monitoring equipment:	Type: Pressure meter Accuracy class: 0.075%
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor. Calibration procedures are in accordance to national standards and regulations. Frequency of calibration: Annually Calibration dates for • Monitoring Period 1: Factory calibration, valid at installation • Monitoring Period 2: 17 October 2010 • Monitoring Period 3: 16 October 2011 • Monitoring Period 4: 15 October 2012
Calculation method:	Average of hourly values for each day in the monitoring period has been calculated to provide the daily average pressure of steam
Any comment:	Obtained from PP's "Jilin VCS Monitoring Records 2009-2012" spreadsheet, average of "Pressure (MPa) Meter 5" taken from Meter 5, per the Monitoring Plan Diagram in Section 5

	(Metering Point #5).

Data Unit / Parameter:	$P_{Steam,B2}$
Data unit:	MPa
Description:	Pressure of MP steam produced by the 15 MT/hour Boiler 2
Source of data:	On-line data records obtained from PLC readings using pressure sensors on MP steam delivery line to Header 1
Description of measurement methods and procedures to be applied:	Hourly records maintained at the project site
Frequency of monitoring/recording:	Hourly
Value monitored:	• Monitoring Period 1: 1.37 • Monitoring Period 2: 1.96 • Monitoring Period 3: 1.57 • Monitoring Period 4: 2.08
Monitoring equipment:	Type: Pressure meter Accuracy class: 0.075%
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor. Calibration procedures are in accordance to national standards and regulations. Frequency of calibration: Annually Calibration dates for • Monitoring Period 1: Factory calibration, valid at installation • Monitoring Period 2: 17 October 2010 • Monitoring Period 3: 16 October 2011 • Monitoring Period 4: 15 October 2012
Calculation method:	Average of hourly values for each day in the monitoring period has been calculated to provide the daily average pressure of steam
Any comment:	Obtained from PP's "Jilin VCS Monitoring Records 2009-2012" spreadsheet, average of "Pressure (MPa) Meter 6" taken from Meter 6, per the Monitoring Plan Diagram in Section 5 (Metering Point #6).

Data Unit / Parameter:	$Temp_{FeedWater}$
Data unit:	^{o}C
Description:	Temperature of feed water (at atmospheric pressure) entering the respective boilers installed in the Project
Source of data:	On-line data records obtained from PLC readings using temperature sensors on feed water delivery line attached to the boiler performance monitoring system

Description of measurement methods and procedures to be applied:	Hourly records maintained at the project site
Frequency of monitoring/recording:	Hourly
Value monitored:	• Monitoring Period 1: 104 • Monitoring Period 2: 104 • Monitoring Period 3: 104 • Monitoring Period 4: 103
Monitoring equipment:	Type: Temperature meter Accuracy class: Class B
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor. Calibration procedures are in accordance to national standards and regulations. Frequency of calibration: Annually Calibration dates for • Monitoring Period 1: Factory calibration, valid at installation • Monitoring Period 2: 17 October 2010 • Monitoring Period 3: 16 October 2011 • Monitoring Period 4: 15 October 2012
Calculation method:	Average of hourly values for each day in the monitoring period has been calculated to provide the daily average temperature of feed water
Any comment:	Obtained from PP's "Jilin VCS Monitoring Records 2009-2012" spreadsheet, average of "Average Temp of Feedwater (°C)" taken from Meter 4 per the Monitoring Plan Diagram (Metering Point #4)

Data Unit / Parameter:	$FL_{steam,OEP}$
Data unit:	MT/day
Description:	Flow rate of MP steam delivered by the 15 MT/hour boilers to the oil extraction plant
Source of data:	On-line data records obtained from PLC readings for MP steam produced by the 15 MT/hour boilers, using flow rate sensors on MP steam delivery lines to the oil extraction plant
Description of measurement methods and procedures to be applied:	Daily records maintained at the project site
Frequency of monitoring/recording:	Daily
Value monitored:	• Monitoring Period 1: 88.12 • Monitoring Period 2: 100.81 • Monitoring Period 3: 100.42 • Monitoring Period 4: 189.95
Monitoring equipment:	Type: Flow meter Accuracy class: 1%
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor. Calibration procedures are in accordance to

	national standards and regulations. Frequency of calibration: annually Calibration dates for • Monitoring Period 1: Factory calibration, valid at installation • Monitoring Period 2: 17 October 2010 • Monitoring Period 3: 16 October 2011 • Monitoring Period 4: 15 October 2012
Calculation method:	Aggregated daily values in the monitoring period has been provided to calculate the Total Daily Steam Flow
Any comment:	Obtained from PP's "Jilin VCS Monitoring Records 2009-2012" spreadsheet, average of "Oil Extraction Plant Steam Flow (MT) - Meter 8" taken from Meter 8 per the Monitoring Plan Diagram (Metering Point #8) in Section 5.

Data Unit / Parameter:	$FL_{steam,DT}$
Data unit:	MT/day
Description:	Flow rate of MP steam delivered by the 15 MT/hour boilers to the drying tower
Source of data:	On-line data records obtained from PLC readings for MP steam produced by the 15 MT/hour boilers, using flow rate sensors on MP steam delivery lines to the drying tower
Description of measurement methods and procedures to be applied:	Daily records maintained at the project site
Frequency of monitoring/recording:	Daily
Value monitored:	• Monitoring Period 1: 45.82 • Monitoring Period 2: 45.43 • Monitoring Period 3: 49.77 • Monitoring Period 4: 65.14
Monitoring equipment:	Type: Flow meter Accuracy class: 1%
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor. Calibration procedures are in accordance to national standards and regulations. Frequency of calibration: annually Calibration dates for • Monitoring Period 1: Factory calibration, valid at installation • Monitoring Period 2: 17 October 2010 • Monitoring Period 3: 16 October 2011 • Monitoring Period 4: 15 October 2012
Calculation method:	Aggregated daily values in the monitoring period has been provided to calculate the Total Daily Steam Flow

Any comment:	Obtained from PP's "Jilin VCS Monitoring Records 2009-2012" spreadsheet, average of "Drying Tower Steam Flow (MT) - Meter 9" taken from Meter 9 per the Monitoring Plan Diagram (Metering Point #9) in Section 5.

Data Unit / Parameter:	HR_{B1}
Data unit:	Hours
Description:	Daily operational hours for one of the 15 MT/hour MP boilers (Boiler 1)
Source of data:	Plant operation records
Description of measurement methods and procedures to be applied:	Plant daily operation records maintained at the project site
Frequency of monitoring/recording:	Daily
Value monitored:	• Monitoring Period 1: 3,680 • Monitoring Period 2: 3,636 • Monitoring Period 3: 3,979 • Monitoring Period 4: (not operating)
Monitoring equipment:	Not relevant
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor
Calculation method:	Aggregated values based on daily monitored records
Any comment:	Obtained from PP's "Jilin VCS Monitoring Records 2009-2012" spreadsheet

Data Unit / Parameter:	HR_{B2}
Data unit:	Hours
Description:	Daily operational hours for one of the 15 MT/hour MP boilers (Boiler 2)
Source of data:	Plant operation records
Description of measurement methods and procedures to be applied:	Plant daily operation records maintained at the project site
Frequency of monitoring/recording:	Daily
Value monitored:	• Monitoring Period 1: 1,834 • Monitoring Period 2: 3,180 • Monitoring Period 3: 3,505 • Monitoring Period 4: 528
Monitoring equipment:	Not relevant
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor
Calculation method:	Aggregated values based on daily monitored records
Any comment:	Obtained from PP's "Jilin VCS Monitoring Records 2009-2012" spreadsheet

Data Unit / Parameter:	$RH_{Consumed,B1}$

Data unit:	MT
Description:	Annual quantity of rice husk used in one of the 15 MT/hour boiler (Boiler 1)
Source of data:	As per PLC reading for the feeding chambers located before each boiler and recorded in the daily production report
Description of measurement methods and procedures to be applied:	On-line air-lock system based flow meter (continuous basis)
Frequency of monitoring/recording:	Continuously
Value monitored:	• Monitoring Period 1: 7,807 • Monitoring Period 2: 6,257 • Monitoring Period 3: 6,566 • Monitoring Period 4: (not operating)
Monitoring equipment:	Count meter
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor
Calculation method:	Using equipment provider's empirical formula using input data on mass flow
Any comment:	Obtained from PP's "Jilin VCS Monitoring Records 2009-2012" spreadsheet, total of JIL_B01's "Monthly Consumed Rice Husk (MT)" (Metering Point #2)

Data Unit / Parameter:	$RH_{Consumed,B2}$
Data unit:	MT
Description:	Annual quantity of rice husk used in one of the 15 MT/hour boiler (Boiler 2)
Source of data:	As per PLC reading for the feeding chambers located before each boiler and recorded in the daily production report
Description of measurement methods and procedures to be applied:	On-line air-lock system based flow meter (continuous basis)
Frequency of monitoring/recording:	Continuously
Value monitored:	• Monitoring Period 1: 3,627 • Monitoring Period 2: 7,412 • Monitoring Period 3: 6,338 • Monitoring Period 4: 1,510
Monitoring equipment:	Count meter
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor
Calculation method:	Using equipment provider's empirical formula using input data on mass flow
Any comment:	Obtained from PP's "Jilin VCS Monitoring Records 2009-2012" spreadsheet, total of JIL_B02's "Monthly Consumed Rice Husk (MT)" (Metering Point #3)

Data Unit / Parameter:	$RH_{supplied}$ or $RH_{regional}$

Data unit:	MT
Description:	Annual quantity of rice husk obtained from a rice mill located nearby the project which is accounted for as the rice husk procured from the region from a source not affected by any other "competing demand for the same quantity of rice husk"
Source of data:	As per rice mill records
Description of measurement methods and procedures to be applied:	Estimated figure from the rice milling operations based on the rice husk yield of around 18% for every tonne of paddy processed
Frequency of monitoring/recording:	Continuously
Value monitored:	• Monitoring Period 1: Factory calibration, valid at installation • Monitoring Period 2: 17 October 2010 • Monitoring Period 3: 16 October 2011 • Monitoring Period 4: 15 October 2012
Monitoring equipment:	NA
QA/QC procedures to be applied:	Periodic verification by site/shift supervisor
Calculation method:	NA
Any comment:	Obtained from PP's "Jilin VCS Monitoring Records 2009-2012" spreadsheet, "Rice Husks (MT)" (Metering Point #1)

3.3 Description of the Monitoring Plan

The responsibility and reporting of the monitoring parameters follows the procedures set out in the monitoring plan in the validated PD. The PP used these provisions to develop and deploy a 'VCS project software application' to collect, manage and archive all raw field data described in Sections 3.1 and 3.2 above. For the purposes of the GHG emission reduction calculations during any monitoring period, such data is exported from the archives and processed.

The monitoring procedures for raw field data recording are as described in the monitoring plan. The project uses meter sensors that transmit the respective meter readings into the Programmable Logic Controller (PLC) system which electronically monitors the main performance and outputs of the boiler. The readings are then transferred into the PP's internal reporting system. The data for the parameters covered in the monitoring plan are drawn extensively from the PLC system. The data is captured in the 'VCS project software application' mentioned above.

The PP uses its operational team at the site for the purpose of monitoring information, collection and management. This includes carrying out the monitoring and maintaining records of all the monitored data. The team is also responsible for managing the monitoring equipment calibration and maintenance. In the event of change of monitoring equipment, the PP's operational team documents the date of change as well as the readings before and after the change.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Step 1: Using the average of monitored values of steam temperature ($Temp_{Steam,B1}$ and $Temp_{Steam,B2}$ in '^{o}C'), pressure ($P_{Steam,B1}$ and $P_{Steam,B2}$ in 'MPa'), and feed water temperature ($Temp_{FeedWater}$ in '^{o}C'), the enthalpy (in 'kJ/kg') of delivered steam is determined on a daily basis.

- Daily Enthalpy of Delivered Steam (in 'kJ/kg') = Average Daily Enthalpy of Steam at Metering Points 5 and 6 – Average Daily Enthalpy of Feedwater at Metering Point 4
    - Average Daily Enthalpy of Steam at Metering Points 5 and 6 (in 'kJ/kg') is calculated from the averaged hourly monitored values of steam temperature ($Temp_{Steam,B1}$ and $Temp_{Steam,B2}$ in '^{o}C') and pressure ($P_{Steam,B1}$ and $P_{Steam,B2}$ in 'MPa') for any day; the average enthalpy for any day is calculated based on the hourly Enthalpies of Steam at Metering Point 7; and
    - Enthalpy of Feedwater at Metering Point 4 (in 'kJ/kg') is calculated from hourly monitored values of feedwater temperature ($Temp_{Feedwater}$ in '^{o}C') for the day; the average enthalpy for any day is calculated based on the hourly Enthalpies of Steam at Metering Point 4.
- Relevant steam data for dates where i) there is no steam generated for the extraction plant/drying tower, ii) there is a faulty meter, based on QA/QC checks, or iii) when meters are sent for calibration, are excluded from the computation
    - MP1 – Boiler 1
        - 1 May 2010, 17 June 2010, 14 July 2010, 17 July 2010, 5 August 2010, 8 August 2010: No steam generated.
        - 6 May 2010, 23 to 31 May 2010, 15 July 2010, 14 to 31 October 2010: Steam generated on those days were used for heating/deaerator instead of being sent to extraction plant/drying tower.
    - MP2 – Boiler 1
        - 3 April 2011, 7 to 10 April 2011: Steam generated on those days were used for heating/deaerator instead of being sent to extraction plant/drying tower.
    - MP2 – Boiler 2
        - 22 to 23 January 2011, 28 January 2011 to 10 February 2011, 15 to 16 February 2011, 24 April 2011, 5 to 6 August 2011, 8 to 14 August 2011, 16 August 2011, 18 to 19 August 2011, 13 October 2011: Steam generated on those days were used for heating/deaerator instead of being sent to extraction plant/drying tower.
        - 22 August 2011 (21:00) to 23 August 2011 (06:00), 13 November 2011 (22:00) to 14 November (02:00): faulty meter
        - 16 October 2011: meters sent for calibration
    - MP3 – Boiler 1

- 18 September 2012: No steam generated.

- MP3 – Boiler 2
  - 1 March 2012, 13 March 2012, 9 to 10 April 2012, 11 to 12 August 2012: Steam generated on those days were used for heating/deaerator instead of being sent to extraction plant/drying tower.
  - 24 April 2012 (17:00 to 21:00), 13 September 2012 (08:00 to 13:00): faulty meter
  - 15 October 2012: meters sent for calibration

Step 2: The Total Daily Steam Flow ($FL_{Steam,OEP}$ and $FL_{Steam,DT}$ in 'MT/day') delivered are multiplied by the Average Daily Enthalpy of Delivered Steam (in 'kJ/kg') to obtain the daily value of thermal energy delivered ($EG_{thermal}$ in 'kJ/day').

a) Total Daily Steam Flow (in 'MT/day') = Daily Steam Flow at Metering Point 8 ($FL_{Steam,OEP}$) + Daily Steam Flow at Metering Point 9 ($FL_{Steam,DT}$)

- Daily Steam Flows at Metering Points 8 and 9 are respectively, aggregates of hourly steam flows for any day;

b) For both the boilers, Daily Value of Thermal Energy Delivered ($EG_{thermal}$ in 'kJ/day') = Total Daily Steam Flow (from Step 2a) * Average Daily Enthalpy of Delivered Steam (from Step 1).

Step 3: The Total Thermal Energy ($EG_{thermal,y}$ in 'TJ') delivered is calculated as the summation of each Daily Value of Thermal Energy Delivered ($EG_{thermal}$ in 'kJ/day' converted to 'TJ/day') over the corresponding monitoring period.

- Total Thermal Energy ($EG_{thermal,y}$ in 'TJ') Delivered = $\sum EG_{thermal,y}$ in the monitoring period

Step 4: Baseline emissions ($BE_{thermal,CO2,y}$ in 'tCO_2e') avoided during the monitoring period ('y') by virtue of steam delivered is calculated as per the following formula:

$$BE_{thermal,CO2,y} = (EG_{thermal,y} / \eta_{BL,thermal}) * EF_{FF,CO2}$$

Where,

$BE_{thermal,CO2,y}$	the baseline emissions from heat displaced by the project during the year 'y'; in tCO_2
$EG_{thermal,y}$	the net quantity of heat supplied by the project during the year 'y'; in TJ
$\eta_{BL,thermal}$	the efficiency of the coal/diesel based baseline plant that would have been used in the absence of the project
$EF_{FF,CO2}$	the CO_2 emission factor of the fossil fuel (in this case, coal) that would have been used in the baseline plant; this is taken from IPCC (in tCO_2/TJ)

Monitoring Period 1:

$EG_{thermal,1}$ = 63.64 TJ

$BE_{thermal,CO2,1}$
= ($EG_{thermal,1}$ / $\eta_{BL,thermal}$) * $EF_{coal,CO2}$
= 63.64 TJ / 100% * 94.6 tCO_2/TJ
= 6,020 tCO_2

Monitoring Period 2:

$EG_{thermal,2}$ = 92.07 TJ

$BE_{thermal,CO2,2}$
= ($EG_{thermal,2}$ / $\eta_{BL,thermal}$) * $EF_{coal,CO2}$
= 92.07 TJ / 100% * 94.6 tCO_2/TJ
= 8,710 tCO_2

Monitoring Period 3:

$EG_{thermal,3}$ = 107.87 TJ

$BE_{thermal,CO2,3}$
= ($EG_{thermal,3}$ / $\eta_{BL,thermal}$) * $EF_{coal,CO2}$
= 107.87 TJ / 100% * 94.6 tCO_2/TJ
= 10,204 tCO_2

Monitoring Period 4:

$EG_{thermal,4}$ = 15.26 TJ

$BE_{thermal,CO2,4}$
= ($EG_{thermal,4}$ / $\eta_{BL,thermal}$) * $EF_{coal,CO2}$
= 15.26 TJ / 100% * 94.6 tCO_2/TJ
= 1,444 tCO_2

4.2 Project Emissions

There are no project emissions in the VCS project (refer to Section 2.3 of the validated PD).

4.3 Leakage

There are no leakage emissions from use of rice husk, and its collection, processing and transportation because the procurement of rice husk was from a rice mill located adjacent to the project location (refer Section 4.4 of the validated PD).

4.4 Summary of GHG Emission Reductions and Removals

The emission reductions are calculated as per the following.

$ER_y = BE_y - PE_y - LE_y$

Monitoring Period 1:
Total baseline emissions: 6,020 tCO_2
Total project emissions: 0
Total leakage: 0
Total emission reductions: 6,020tCO_2

Monitoring Period 2:
Total baseline emissions: 8,710 tCO_2
Total project emissions: 0
Total leakage: 0
Total emission reductions: 8,710 tCO_2

Monitoring Period 3:
Total baseline emissions: 10,204 tCO_2
Total project emissions: 0
Total leakage: 0
Total emission reductions: 10,204 tCO_2

Monitoring Period 4:
Total baseline emissions: 1,444 tCO_2
Total project emissions: 0
Total leakage: 0
Total emission reductions: 1,444 tCO_2

5 ADDITIONAL INFORMATION