8MW Waste Heat Recovery Based Power Project by Sree Rengaraaj Power India Private Limited

Document Prepared By Abi Energy Consultancy Services Private Limited

Project Title	8MW Waste Heat Recovery Based Power Project by Sree Rengaraaj Power India Private Limited
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Sree Rengaraaj power India Private Limited merged with its sister concern Sree Rengaraaj Ispat Industries Private Limited in April 2011. Sree Rengaraaj Ispat Industries Private Limited is operating a Sponge Iron Plant with an annual capacity of 350 Tons/day. Flue gas with high heat content is generated in the Rotary kiln in the Sponge iron plant during Sponge iron conversion from iron ore. The total flue gas generated from this kiln is 84,000 Nm^3/hr and this rotary kiln is directly connected to the WHR Boiler with a steam generation capacity of 36 TPH. The total waste flue gas generated is ducted to the WHR boilers to generate steam at 64 Kg/cm^2 and 485^oC. The generated steam is then fed in to the 8 MW bleed cum condensing Turbo Generator for power generation. The electricity generated by this project activity is used within the industrial facility for captive usage and the remaining surplus power is wheeled to its sister concern through southern regional grid. The project commissioned in the year of 2005. From the date of start, the project is in continuous operation.

Technical Specifications of the Main equipments in this project activity

Waste Heat Recovery Boiler:	
Type	Natural Circulation, Water Tube Boiler
Steam Output	36 Tonnes per Hour
Steam Pressure (abs)	64 Kg/ cm^2
Steam Temperature	485^{o}c
Make	Cethar Vessels Limited

Turbine:	
Capacity	8 MW
Inlet Steam Pressure (abs)	64 Kg/ cm^2
Inlet Steam flow	33.90 Tonnes per Hour
Inlet Steam Temperature	480^{o}c
RPM	7555
Make	ABB Limited

Alternator:	
Make	BHEL
Capacity	8 MW
Generator Voltage	11KV

Frequency	50 Hz
Full Load Current	525 Amps
Phase	3
RPM	1500
Connection	Star

The other accessories installed in this project activity are air-cooled condenser, induced draft fan, air compressor system, de- aerator, de-mineralization plant, Cooling Tower etc.

In the absence of this project activity both Rengaraaj steel and its sister concern will import power from southern regional grid. The total power generation for this monitoring period is 182,972.689 MWh. The heat energy of waste gas is used for electricity generation; therefore the GHG emission from the project is zero.

The total GHG emission reduction generated in this monitoring period (28/12/2009 to 30/11/2015) is 1,56,573 tonnes of Carbon dioxide equivalent.

1.2 Sectoral Scope and Project Type

Sectoral Scope	01 - Energy Industries (renewable/ non -renewable sources) 09 - Metal Production (Iron, steel, aluminium and magnesium industry)
Project Category	ACM0012 “Consolidated baseline methodology for GHG Emission Reduction from waste energy recovery projects”, (Version 3.1)
Whether the project is a grouped project?	No

1.3 Project Proponent

Organization name	Abi Energy Consultancy Services Private Limited
Contact person	*Mr. K.* Vijayarajan
Title	*Director*

Address	22, Suramaniyanagar 2nd Street, Rengarajapuram, Kodambakkam, Chennai-600024,India
Telephone	*+91 9444481041*
Email	vijay@abienergy.com

Organization name	Sree Rengaraaj Ispat Industries Private Limited
Contact person	Mr. S.Shyam Sundar
Title	*Director*
Address	No 99, Sankagiri Main Road, Salem, Tamilnadu - 636 002, India
Telephone	+91 427 2270235
Email	sripl05@yahoo.co.in

1.4 Other Entities Involved in the Project

No other Entities Involved in this project activity.

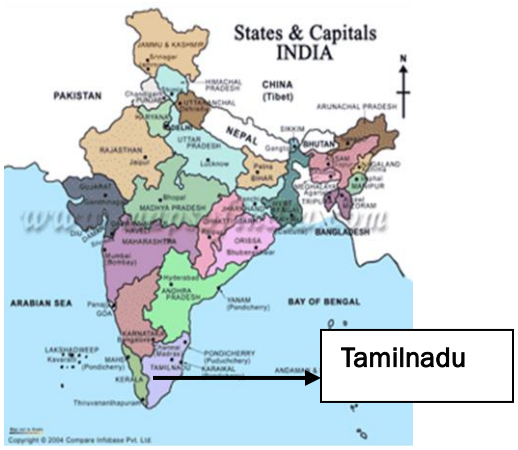
1.5 Project Start Date

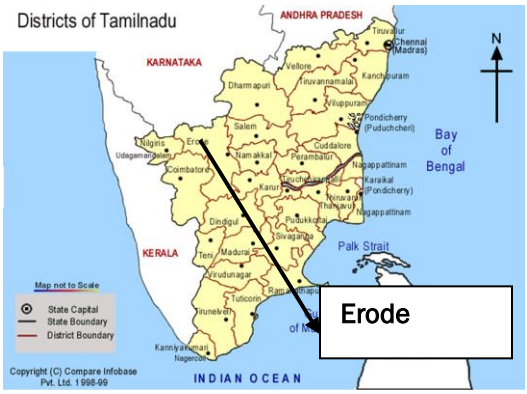
The starting date of the project activity is 21/12/2005 (Grid parallel connection date)

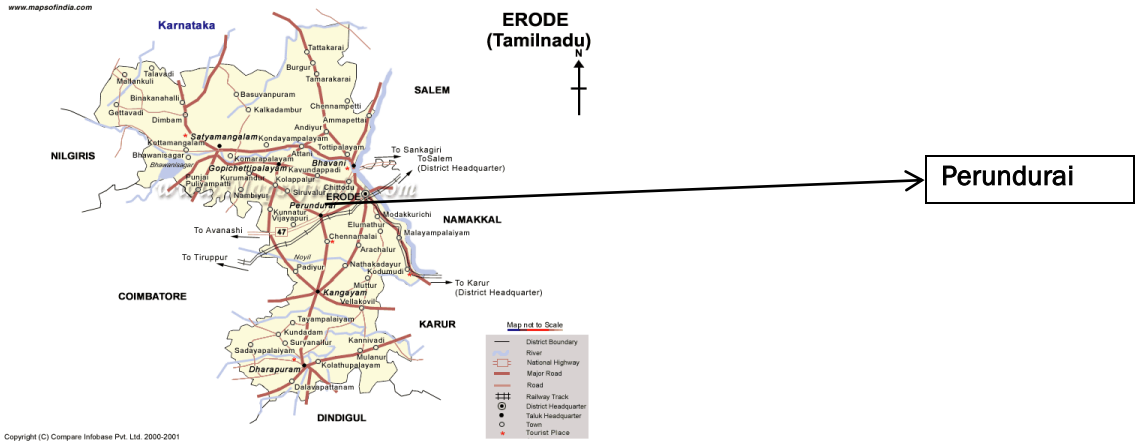
1.6 Project Crediting Period

The chosen crediting period is Fixed Crediting Period of 10 years (28/03/2006 to 27/03/2016).

1.7 Project Location







1.8 Title and Reference of Methodology

The methodology applied for this project activity is

Title: ACM0012 "Consolidated baseline methodology for GHG Emission Reduction from waste energy recovery projects". Version 3.1.

Reference: https://cdm.unfccc.int/EB/044/eb44_repan13.pdf

Title of Tool: "Tool to calculate the emission factor for an electricity system" Version: 1.1

Reference:

https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v1.1.pdf

1.9 Participation under other GHG Programs

The chosen crediting period is Fixed Crediting Period of 10 years (28/03/2006 to 27/03/2016). This project has not registered under any other GHG program.

1.10 Other Forms of Credit

The project has been registered under the VCS Program only, and it has not been registered under any other approved or not approved GHG programs or any other binding limit program or any environmental credit program. A letter of undertaking has been provided to DOE to confirm that this project is not registered with any another GHG program other than VCS.

1.11 Sustainable Development Contributions

The project activity contributes to climate change and mitigation activities related to SDG 13 as detailed in table below:-

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
Sequential row number	*SDG Target number*	*Number and text of SDG indicator or, if no official SDG indicator is applicable, user-defined indicator*	*Indicate the project's contribution to the SDG Indicator (implemented activities to increase or decrease)*	*Brief description of the quantifiable impact of the project's activities related to the SDG indicator, during the monitoring period.*	*Brief description of the cumulative quantifiable impact of the project's activities related to the SDG indicator, over the project lifetime.*
1)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Project implemented activities to decrease the CO2 released to the atmosphere	By generating electricity from waste heat recovery, the Project has prevented the release of 156573 tonnes of carbon into the atmosphere during the monitoring period	The project prevented the release of 261159 tonnes of carbon into the atmosphere over the project lifetime.

2 SAFEGUARDS

2.1 No Net Harm

The heat energy of waste gas is used for electricity generation, therefore the GHG emission from the project is zero, and hence the project activity has no negative impact on the environment. This project activity has positive environment and socio-economic benefits such as GHG emission reduction by utilizing heat energy of waste gas and job opportunities for the local public.

2.2 Local Stakeholder Consultation

The project proponent has conducted a stakeholder consultation at the time of development of project design and received positive response from local stakeholders. The outcome of the stakeholder's consultation has been described in the VCS PD. The project activity generates power by utilising heat energy of waste gas and thereby resulting in zero GHG emission. Hence the project activity has no negative impact on the environment. The project activity minimises fossil consumption by utilising the thermal energy in the waste flue gas and thereby providing positive environmental benefits in terms of GHG emission reduction. Also the projects provide job opportunities for the local public and thereby it creates socio-economic benefits. The project proponent has not received any negative response from local stakeholders. The PP has established on-going communications with the local stakeholders as per VCS standard requirement, and the project proponent has received only positive feedback from the local stakeholders.

2.3 AFOLU-Specific Safeguards

The project activity generates power by utilizing only the heat from waste hot gas, which is a thermal energy source; hence this section is not applicable.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project commissioned in the year of 2005. From the date of start, the project is in continuous operation. During this monitoring period, the project was operated normally. All the operation status is consistent with the description in the PD. There were not any events or situations that occurred during the monitoring period, which may impact the GHG emission reductions of this Project activity.

3.2 Deviations

3.2.1 Methodology Deviations

There is no deviation from the Methodology.

3.2.2 Project Description Deviations

1. Sree Rengaraaj power India Private Limited merged with its sister concern Sree Rengaraaj Ispat Industries Private Limited in April 20111. The Honourable High Court of Madras issued the Merger Order on 28/04/2011. After the Merger Order the PP informed to all the Government Department for name change. Sree Rengaraaj Ispat Industries Private Limited is operating a Sponge Iron Plant with an annual capacity of 350 Tons/day.
2. The energy meters are not calibrated as per the frequency mentioned in the monitoring plan for this monitoring period. The maximum permissible error for the EGGross monitoring meter is 1%, and for EGAux-fromCPP meter is 0.5%. Hence monitored values are multiplied by (1-(1/100)) for EGGross meter, as it is export meter and for EGAux-fromCPP meter it is multiplied by (1+(0.5/100)) as it is import meter.

Other than above there is no deviation from the Project Description,

3.3 Grouped Projects

This project activity is an individual and not grouped project activity.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	EF_{OM}
Data unit	tCO2eq/MWh
Description	Operating Margin emission factor of the Southern regional grid
Source of data	Central Electricity Authority (CEA) CO2 Baseline Database values have been used for calculation. *Source:* http://www.cea.nic.in/reports/planning/cdm_co2/database_publishing_ver4.zip Version: 4, Dated Oct 2008
Value applied	0.998157296
Justification of choice of data or	Calculated from Central Electricity Authority (CEA) CO2 Baseline Database, Version: 4, Dated Oct 2008

[1] The reason for the merger is as per the management decision of Sree Rengaraaj power India Private Limited

description of measurement methods and procedures applied	
Purpose of Data	To calculate Baseline Emission Factor
Comments	The above value is fixed and it is same for the entire crediting period

Data / Parameter	EF_{BM}
Data unit	tCO2eq/MWh
Description	Build Margin emission factor of the Southern regional grid
Source of data	Central Electricity Authority (CEA) CO2 Baseline Database values have been used for calculation. *Source:* http://www.cea.nic.in/reports/planning/cdm_co2/database_publishing_ver4.zip Version: 4, Dated Oct 2008
Value applied	0.71331778
Justification of choice of data or description of measurement methods and procedures applied	Calculated from Central Electricity Authority (CEA) CO2 Baseline Database, Version: 4, Dated Oct 2008
Purpose of Data	To calculate Baseline Emission Factor
Comments	The above value is fixed and it is same for the entire crediting period

Data / Parameter	EF_y
Data unit	tCO2eq/MWh
Description	Combined Margin emission factor of the Southern regional grid

Source of data	Central Electricity Authority (CEA) CO2 Baseline Database values have been used for calculation. *Source:* http://www.cea.nic.in/reports/planning/cdm_co2/database_publishing_ver4.zip Version: 4, Dated Oct 2008
Value applied	0.85573754
Justification of choice of data or description of measurement methods and procedures applied	Calculated from Central Electricity Authority (CEA) CO2 Baseline Database, Version: 4, Dated Oct 2008
Purpose of Data	To calculate Baseline Emission Factor
Comments	The above value is fixed and it is same for the entire crediting period

4.2 Data and Parameters Monitored

Data / Parameter	EG_{Gross}
Data unit	MWh
Description	Total quantity of electricity generated by the project activity.
Source of data	Monthly Report
Description of measurement methods and procedures to be applied	Monitoring: Trivector meter will be used for monitoring Data Type: Measured Frequency: daily measured Recording: Monthly Report Archiving Policy: Paper & Electronic Responsibility: General Manager would be responsible for regular calibration of the meter. Calibration Frequency: Once in a year.
Frequency of monitoring/recording	Continuously monitored and monthly recorded.
Value monitored	198267.811

Monitoring equipment	
	Serial No: 050332069 Make: SOCOMEC Accuracy class: 1 Calibration frequency: Once in a year Date of last calibration: 22/11/2009
	Serial No: 050332069 Make: SOCOMEC Accuracy class: 1 Calibration frequency: Once in a year Date of last calibration: 02/04/2010
	Serial No: 050332069 Make: SOCOMEC Accuracy class: 1 Calibration frequency: Once in a year Date of last calibration: 01/04/2011
	Serial No: 050332069 Make: SOCOMEC Accuracy class: 1 Calibration frequency: Once in a year Date of last calibration: 03/04/2012
	Serial No: 050332069 Make: SOCOMEC Accuracy class: 1 Calibration frequency: Once in a year Date of last calibration: 03/04/2013
	Serial No: 050332069 Make: SOCOMEC Accuracy class: 1 Calibration frequency: Once in a year Date of last calibration: 02/04/2014
	Serial No: 050332069

	Make: SOCOMEC Accuracy class: 1 Calibration frequency: Once in a year Date of last calibration: 02/04/2015
QA/QC procedures to be applied	The Energy meters are calibrated periodically.
Purpose of the data	To calculate Emission Reduction
Calculation method	No calculation method involved, only monitored value.
Comments	Data will be archived during the whole crediting period + 2 years.

Data / Parameter	$EG_{Aux\text{-}fromCPP}$
Data unit	MWh
Description	Auxiliary consumption of electricity by the project activity from its own generation.
Source of data	Monthly Report
Description of measurement methods and procedures to be applied	Monitoring: Trivector meter will be used for monitoring Data Type: Measured Frequency: daily measured Recording: Monthly Report Archiving Policy: Paper & Electronic Responsibility: General Manager would be responsible for regular calibration of the meter. Calibration Frequency: Once in a year.
Frequency of monitoring/recording	Continuously monitored and monthly recorded.
Value monitored	15216.173
Monitoring equipment	Serial No: 63174/134-5104 Make: ENERCON Accuracy class: 0.5 Calibration frequency: Once in a year Date of last calibration: 22/11/2009

	Serial No: 63174/134-5104 Make: ENERCON Accuracy class: 0.5 Calibration frequency: Once in a year Date of last calibration: 02/04/2010 Serial No: 63174/134-5104 Make: ENERCON Accuracy class: 0.5 Calibration frequency: Once in a year Date of last calibration: 01/04/2011 Serial No: 63174/134-5104 Make: ENERCON Accuracy class: 0.5 Calibration frequency: Once in a year Date of last calibration: 03/04/2012 Serial No: 63174/134-5104 Make: ENERCON Accuracy class: 0.5 Calibration frequency: Once in a year Date of last calibration: 03/04/2013 Serial No: 63174/134-5104 Make: ENERCON Accuracy class: 0.5 Calibration frequency: Once in a year Date of last calibration: 02/04/2014 Serial No: 63174/134-5104 Make: ENERCON Accuracy class: 0.5 Calibration frequency: Once in a year Date of calibration: 02/04/2015
QA/QC procedures to be applied	The Energy meters are calibrated periodically.
Purpose of the data	To calculate Emission Reduction

Calculation method	No calculation method involved, only monitored value.
Comments	Data will be archived during the whole crediting period + 2 years.

Data / Parameter	$EG_{Aux-fromGrid}$
Data unit	MWh
Description	Import of power from TNEB grid
Source of data	Monthly Report
Description of measurement methods and procedures to be applied	Monitoring: Trivector meter will be used for monitoring Data Type: Measured Frequency: daily measured Recording: Monthly Report Archiving Policy: Paper & Electronic Responsibility: General Manager would be responsible for regular calibration of the meter. Calibration Frequency: Once in a year. Calibration Frequency: Once in a year.
Frequency of monitoring/recording	Continuously monitored and monthly recorded.
Value monitored	78.949
Monitoring equipment	Serial No: 03122801 Make: L&T Accuracy class: 0.5 Calibration frequency: Once in a year Date of calibration: 20/04/2009 Serial No: 03122801 Make: L&T Accuracy class: 0.5 Calibration frequency: Once in a year Date of calibration: 12/08/2011 Serial No: 03122801 Make: L&T Accuracy class: 0.5 Calibration frequency: Once in a year Date of calibration: 05/12/2014

QA/QC procedures to be applied	The Energy meters are calibrated periodically by state electricity utility.
Purpose of the data	To calculate Emission Reduction
Calculation method	No calculation method involved, only monitored value.
Comments	Data will be archived during the whole crediting period + 2 years.

Data / Parameter	EG_{Aux}
Data unit	MWh
Description	Auxiliary consumption of electricity from the Project activity and the Grid. Calculated from $EG_{Aux – from CPP}$ and $EG_{Aux – from Grid.}$
Source of data	Monthly Report
Description of measurement methods and procedures to be applied	Data Type: Calculated Frequency: daily recorded Recording: Monthly Report Archiving Policy: Paper & Electronic Responsibility: General Manager would be responsible for regular calibration of the meter. Calibration Frequency: Once in a year.
Frequency of monitoring/recording	Daily and Monthly recorded.
Value monitored	15295.122
Monitoring equipment	No monitoring involved, only calculated value.
QA/QC procedures to be applied	The Energy meters are calibrated periodically.
Purpose of the data	To calculate Emission Reduction
Calculation method	Total sum of Auxiliary consumption of electricity from the Project activity and the Grid. $EG_{Aux} = EG_{Aux – from CPP} + EG_{Aux – from Grid.}$ EG_{aux} = 15216.173 + 78.949 = 15295.122
Comments	Data will be archived during the whole crediting period + 2 years.

Data / Parameter	EG_y
Data unit	MWh
Description	Net quantity of electricity generated by the project activity. Calculated from EG_{gross} and EG_{Aux}
Source of data	Monthly Report
Description of measurement methods and procedures to be applied	Data Type: Calculated Frequency: daily recorded Recording: Monthly Report Archiving Policy: Paper & Electronic Responsibility: General Manager would be responsible for regular calibration of the meter. Calibration Frequency: Once in a year.
Frequency of monitoring/recording	Continuously monitored and monthly recorded.
Value monitored	182972.689
Monitoring equipment	No monitoring involved, only calculated value.
QA/QC procedures to be applied	The Energy meters are calibrated periodically
Purpose of the data	To calculate Emission Reduction
Calculation method	Net quantity of electricity generated is calculated by deducting the auxiliary units consumption from the gross electricity generated. $EG_y = EG_{gross} - EG_{Aux – from CPP} - EG_{Aux – from Grid.}$ $EG_y = 198267.811 – 15216.173 – 78.949 = 182972.689$
Comments	Data will be archived during the whole crediting period + 2 years.

Data / Parameter	D
Data unit	Days/year
Description	*No of operating days per year*
Source of data	*Production Records*
Description of measurement methods and procedures to be applied	B*ased on production records*

Frequency of monitoring/recording	yearly
Value monitored	2009-4 days 2010-311 days 2011-321 days 2012-346 days 2013-335 days 2014-262 days 2015- 261 days
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	To calculate Emission Reduction
Calculation method	-
Comments	Data will be archived during the whole crediting period + 2 years

Data / Parameter	$Q_{BL,Product}$
Data unit	Tons/year
Description	*Production associated with the relevant waste energy generation*
Source of data	*Production Records*
Description of measurement methods and procedures to be applied	B*ased on production records*
Frequency of monitoring/recording	Yearly
Value monitored	2009-377 tons 2010-52811 tons 2011-59386 tons 2012- 65120 tons 2013- 70651 tons

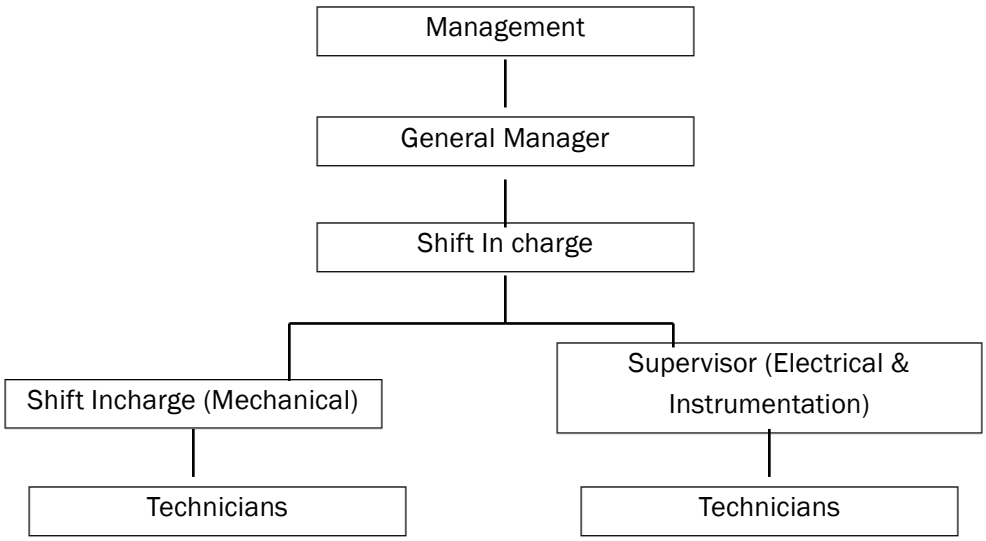
	2014- 68834 tons 2015-61864 tons
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	To calculate Emission Reduction
Calculation method	-
Comments	Data will be archived during the whole crediting period + 2 years

Data / Parameter	$q_{wcm,Product}$
Data unit	Nm3/ton
Description	*Specific waste energy production per unit of product*
Source of data	*Manufacturer's Specification*
Description of measurement methods and procedures to be applied	F*rom Manufacturer's Specification*
Frequency of monitoring/recording	-
Value monitored	5143
Monitoring equipment	-
QA/QC procedures to be applied	-
Purpose of the data	To calculate Emission Reduction
Calculation method	-
Comments	Data will be archived during the whole crediting period + 2 years

4.3 Monitoring Plan

To address all O&M issues, the management signed a contract with the O&M service providers. The O&M service provider for this project activity is OEG. The service provider has formed a team of Technicians, Supervisors headed by the site engineer to effectively control and monitor the complete process in the plant area. The electricity generated by this project activity is

used within the industrial facility for captive usage and the remaining surplus power is wheeled to its sister concern through southern regional grid. The Monitoring data of the equipments are recorded by the labours/ supervisors and the data are submitted to the shift incharges. The shift incharges report daily to the general manager of the OEG. The general manager submits a monthly report to the management, which will be documented and stored in the project office. The monitored parameters have low level of uncertainty. Therefore the possible monitoring data adjustments are not envisaged for the project.



5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

The emission reduction is calculated by baseline emissions minus the project emissions and leakage. The following formula is adopted for calculating emission reductions generated by the project activity:

Emission reduction by this project is

$ER_Y = BE_Y - PE_Y$

PE_Y = Emissions from the project activity during the year *y* in tons of CO2

In project activity there is no consumption of auxiliary fuel to supplement waste gas/ heat. In line with requirement of methodology project emissions are not applicable for the project activity. Hence there is no emission from this project activity.

$PE_Y = 0$

So, Emission reduction $ER_Y = BE_Y$

The baseline emissions for the year *y* shall be determined as follows:

$BE_y = BE_{En\,y} + BE_{flst\,y}$

BEy = The total baseline emissions during the year *y* in tons of CO2

$BE_{En,y}$ = The baseline emissions from energy generated by project activity during the year *y* in tons of CO2

$BE_{flst,y}$ = Baseline emissions from steam generation, if any, using fossil fuel that would have been used for flaring the waste gas in absence of the project activity (tCO2e per year), calculated as per equation 1c. This is relevant for those project activities where in the baseline steam is used to flare the waste gas

This project activity is generating electricity from waste flue gas generated from sponge iron plant. In the absence of this project activity the captive power will be import from southern grid. There is no fossil fuel consumption in this project activity. The power will be generated from waste flue gas from sponge iron plant. **Hence $BE_{flst,y}$ is not applicable for this project activity.**

$BE_{flst,y} = 0$

The above equation will be simplified in to

$BE_y = BE_{En\,y}$

As per the methodology **$BE_{En\,y}$** e the baseline emissions from both thermal energy and electrical energy generated by project activity during the year *y* in tons of CO2

$BE_{Eny} = BE_{Elec\,y} + BE_{Ther\,y}$

$BE_{Elec,y}$ = Baseline emissions from electricity during the year *y* in tons of CO2

$BE_{Ther,y}$ = Baseline emissions from thermal energy (due to heat generation by element process) during the year *y* in tons of CO2

This project activity is generating electricity from waste flue gas from sponge iron plant. Other than that there is no thermal energy application in this project activity. **Hence baseline emission from thermal energy ($BE_{Ther,y}$) is not applicable for this project activity**.

$BE_{Ther,y} = 0$

Hence , BE_{Eny} = $BE_{Elec\ y}$

Baseline emissions from electricity ($BE_{electricity,y}$) Type-1 activities:

Case 1: Waste energy is used to generate electricity

$BE_{Elec\ y}$ = $f\ cap * f\ wcm * \sum_j \sum_l (EG_{i,j,y} * EF_{i,j,y})$

$BE_{elec,y}$ = Baseline emissions due to displacement of electricity during the year *y* in tons of CO_2

$EG_{i,j,y}$ = The quantity of electricity supplied to the recipient *j* by generator, that in the Absence of the project activity would have been sourced from i th source (i can be either grid or identified source) during the year *y* in MWh,

f_{wcm} = Fraction of total electricity generated by the project activity using waste energy.

(This fraction is 1 if the electricity generation is purely from use of waste energy)

f_{cap} = Energy that would have been produced in project year *y* using waste energy generated in base year expressed as a fraction of total energy produced using waste source in year *y*. The ratio is 1 if the waste energy generated in project year *y* is same or less than that generated in base year.

As per the FAR the QWCM,y and number of operating days will be verified with the help of external expert to assess the appropriateness during the verification. Technical assessment on capping of baseline emissions prepared by ARK Engineering and Power Consultants Pvt Ltd is submitted to the DOE. In this report the energy balance conducted on the basis of the data collected from plant indicate that the 6.67MW power that is generated at the steam turbine unit reflects the amount of steam generated at the WHRB which in turn reflects the kiln waste gas flow rate at the rotary kiln. The f*cap* calculated on the basis of energy balance is equal to 1

$BE_{Elec\ y}$ = $1 * 1 * EG_{i,j,y} * EF_{i,j,y}$

$BE_{Elec\ y} = EG_{i,j,y} * EF_{i,j,y}$

$EG_y = EG_{gross} - EG_{Aux.}$

EG_{gross} = Gross Generation in kWh

EG_{gross} = 198267812 kWh

$EG_{Aux.}$ = Total Auxiliary Consumption in kWh

$EG_{Aux.}$ = $EG_{Aux – from CPP}$ - $EG_{Aux – from Grid}$

$EG_{Aux – from CPP}$ = Auxiliary Consumption from CPP in kWh

$EG_{Aux – from Grid}$ = Auxiliary Consumption from Grid in kWh

$EG_{Aux – from CPP}$ = 15216173 kWh

$EG_{Aux – from Grid}$ = 78949 kWh

$EG_{Aux.}$ = 15216173+78949 kWh

= 15295123 kWh

$EG_y = EG_{gross} - EG_{Aux}$

= 198267812 - 15295123 kWh

= 182972689 kWh

EG_y = 182972.689 MWh $\boldsymbol{BE_y = EG_y * EF_y}$

$EF_{y=}$ Combined Margin emission factor of the Southern regional grid.

EF_y = 0.85573754 ton of CO_2 /MWh

$\boldsymbol{BE_y = EG_y * EF_y}$

=182972.689* 0.85573754

=156,573 ton of CO_2 (Rounded Down Value)

Detailed calculation given in the Emission Reduction sheet.

The error is applied for the delay period as per the accuracy class of the meters inline with the VVS requirement, for conservative estimate of ERs.

In this project activity Project Emission and Leakage Emission is considered to be Zero

Emission Reduction due to the project activity = **156,573 ton of CO_2**

5.2 Project Emissions

In project activity there is no consumption of auxiliary fuel to supplement waste gas/ heat. In line with requirement of methodology, project emissions are not applicable for the project activity. Hence there is no emission from this project activity.

$PE_Y = 0$

5.3 Leakage

This project activity engages neither transferring the energy generating equipment from another activity, nor is the existing equipment transferred to another activity. So the leakage emissions are not applicable and hence not considered.

LEy = 0 tCO_2/year

5.4 Net GHG Emission Reductions and Removals

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
2009 (28th Dec to 31st Dec)	573	0	0	573
2010	25476	0	0	25476
2011	26856	0	0	26856
2012	30745	0	0	30745
2013	28570	0	0	28570
2014	23476	0	0	23476
2015 (upto 30th Nov)	20877	0	0	20877
Total	156,573	0	0	156,573

Total Emission Reductions (2009-2015) Rounded Down for conservative approach	**156,573**

The actual emission reduction for this monitoring period (28/12/2009 to 30/11/2015) is 1,56,573 tCO2.The actual number of days of operation of this project activity for the monitoring period starting from 28/12/2009 to 30/11/2015 is 1810 (Excluding shut down days), by calculating the ex-ante emission reduction for the exact number of days of operation is coming around 2,60,513 tCO2. While comparing the actual emission reduction with ex-ante emission reduction, the actual emission reduction is 39.89% lesser than ex-ante emission reduction calculated for this monitoring period (28/12/2009 to 30/11/2015).

Estimated Ex-ante Emission Reductions(tCO2) for this monitoring period (28/12/2009 to 30/11/2015)	Actual Emission Reductions (tCO2) for this monitoring period (28/12/2009 to 30/11/2015)
260,513	156,573
	39.89 % less than ex-ante

The explanation for lesser emission reduction during this monitoring period is as follows;

The waste heat from sponge iron kiln is the source for power generation in this project activity. The quantity and quality of steam generated from the WHRB is not constant over the year. Thus the power generated from this project activity was reduced. The power generation depends upon the parameters such as temperature and volume of hot flue gases. The low temperature of hot flue gases affects the temperature of steam generated at the Superheater coil resulting in power generation getting reduced.

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