MONITORING REPORT
Version: 3
Date: 01/09/2011

Natural gas based grid connected power generation project at Valantharavai
VCRS No.: 152
Monitoring Period 1: Period from (1/04/2006 - 31/12/2009)

SECTION A. General description of the project activity

A.1. Brief description of the project activity: >>

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Coromandel Electric Company Limited (CECL) is an associate company of The India Cements Limited (ICL), the leading producer of cement in South India. The Company has well established cement brands- Sankar Super Power, Coromandel Super Power and Raasi Super Power. ICL operates three cement manufacturing units in the state of Tamil Nadu, India (at Salem, Tirunalveli and Trichy). The power requirements of the three units were mainly being sourced from the state owned electricity supply company, Tamil Nadu Electricity Board (TNEB).

Purpose of the project activity:

CECL was established by ICL with the objective of setting up a grid connected power generation plant from which electricity would be "wheeled" through the TNEB grid to ICL's three cement units and thereby substitute import of TNEB grid electricity.

Brief description of the installed technology and equipment:

The project activity involves the usage of natural gas fuelled Internal Combustion (IC) engine technology against other emission intensive economical options available. CECL has set up a 26.19 MW Natural Gas Based power Plant in Ramanathapuram district, Tamil Nadu (project activity) in two phases (Phase I: 17.46 MW + Phase II: 8.73 MW). The project activity is connected to the Tamil Nadu Electricity Board (TNEB) grid, through which it supplies electrical energy to the three factories of ICL. The ownership of the project activity has remained the same since registration of the project activity. There has been no emergency incident occurred during the first monitoring period, hence there is no impact on the Verified Emission Reductions (VERs).

Relevant dates for the project activity:

S.No.	Activity	Year
1	Purchase Order of Indigenous Power Plant Equipment – Phase I	14, January 2004
2	Project Commissioned	26, November 2004
3	Start date of project activity	26, November 2004
4	Purchase Order of Indigenous Power Plant Equipment – Phase II	4, March 2005
5	Phase II commissioned	2, February 2006
6	Registration of the project in the VCS Board	19, November 2009
7	1st Monitoring period	1, April/2006 – 31, December 2009

The plant has been in continuous operation from the time of commissioning, except for maintenance activities (as described in section B.1 of this Monitoring Report.

Total emission reductions achieved in the monitoring period:
The total emission reductions of the project activity in this monitoring period is **2,05,551 tCO_2e**. The monitoring data spreadsheet containing data for all the meter readings and supporting documents have been submitted to the DOE for verification.

A.2. Project Participants

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Name of Party involved (*) ((host)indicates a host party)	Private and/or public entity (ies) Project Participants(*) (as applicable)	Kindly indicate if the party involved wishes to be considered as project participant (Yes/NO)
India (host)	Coromandel Electric Company Limited (CECL)	No

A.3. Location of the project activity:

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Latitude **:** 9°22′05″ N
Longitude **:** 78°57′18″ E
Village **:** Valantharavai
District **:** Ramanathapuram
State **:** Tamil Nadu
Country **:** India

A.4. Technical description of the project

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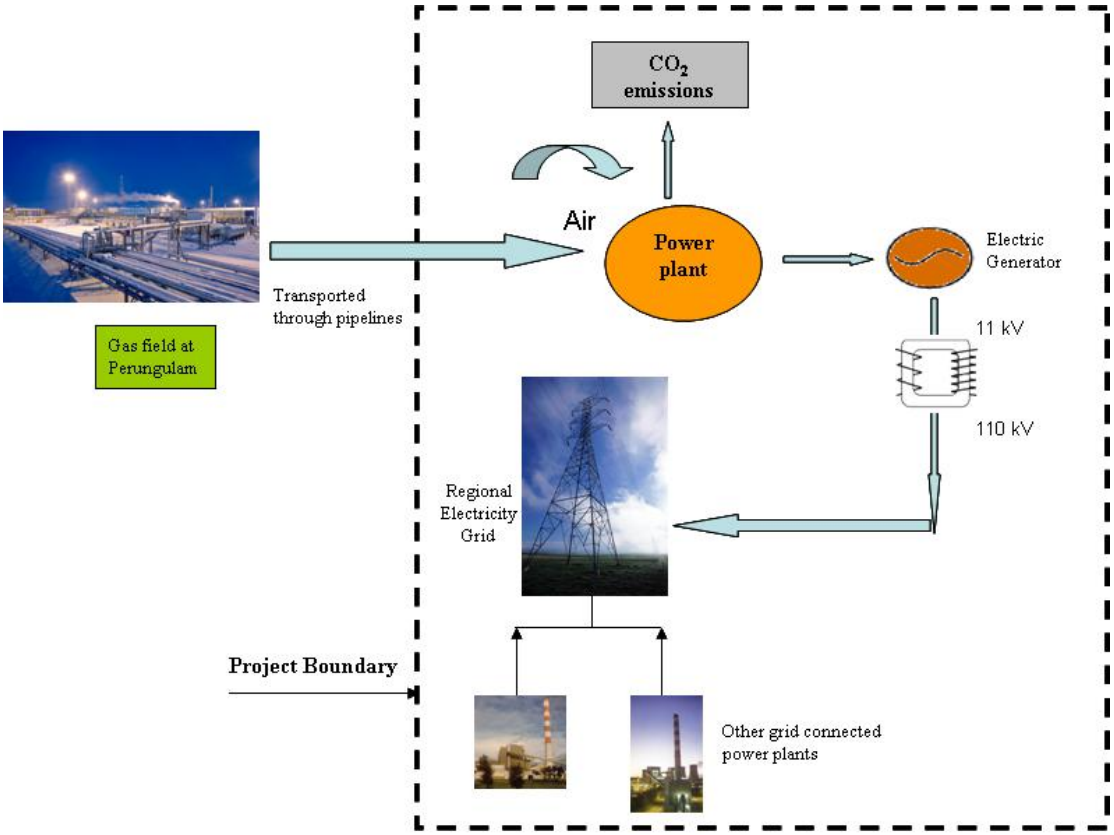
Technology employed
The Internal Combustion (IC) reciprocating engine mechanism has been implemented in this project activity. The incoming fuel, natural gas, produces energy on combustion which drives a piston inside a cylinder causing a reciprocating motion. This is converted to rotary motion which in turn drives a rotor in the alternator where electric energy is generated. The energy generation is at 11kV which is stepped up to 110kV using transformers and transferred to the TNEB grid. It is then imported by ICL's three cement manufacturing units located elsewhere in the State and utilised to meet their power requirements.

The power plant includes three IC engines; each of 8.73 MW rated capacity. The total rated capacity of the natural gas based power plant is 26.19 MW (Phase I: 17.46 MW + Phase II: 8.73 MW). The project activity has a design capacity to operate at an average plant load factor of 87.82% and generates approximately 0.196 Million MWh of electricity per annum. The gas engines are expected (design capacity) to consume around 0.23 Standard Cubic Metre (SCM) of natural gas per kWh of electricity generated at a calorific value of 8744 kCal/SCM. The actual generation values have been provided in Sections D.2 "Data and parameters monitored" and E.4 "Emission reductions calculation/table" of this monitoring report. Technical details of the power plant and components are as follows:

- Type: 3 X 20V34SG Gas Engine Generator Sets [GEG's]

- Make: Wartsila, Finland OY
- Capacity each : 8.73 MW
- Heat rate: 2038 kCal/kWh
- Frequency: 47.5 – 51.5 HZ
- Power evacuation: 110 kV Switchyard
- 25MVA, 11/115kV Generator transformer for 2 x 20V34SG GEG's [Phase-I]
- 15MVA, 11/115kV Generator Transformer for 1 x 20V 34SG GEG [Phase – II]

Project boundary (as described in the registered PD)
The detailed diagram describing the project activity is shown below:



A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

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Baseline & monitoring methodology applied:

Title: "AM0029 Methodology for Grid Connected Electricity Generation Plants using Natural Gas" Version 3

Reference: http://cdm.unfccc.int/methodologies/PAmethodologies/approved

A.6. Registration date of the project activity:

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19 November 2009

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

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Type of crediting period: Fixed (10 years)
Start date of crediting period: As per registered PD - 30 March 2006. The PP has opted to start the accounting of emission reductions from 1 April 2006
End date of crediting period: 29 March 2016

A.8. Name of responsible person(s)/entity(ies):

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Mr. D. Sivagurunathan
President, Manufacturing
Coromandel Electric Company Limited
93, "Coromandel Towers"
Santhome High Road, Karpagam Avenue,
MRC Nagar,
Chennai, Tamil Nadu - 600 028
Tel.: +91 044 28413294
Fax No.: +91 044 28521344
E-mail id: sivagurunathan@indiacements.co.in

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

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S.No.	Activity	Year
1	Purchase Order of Indigenous Power Plant Equipment – Phase I	14, January 2004
2	Project Commissioned	26, November 2004
3	Start date of project activity	26, November 2004
4	Purchase Order of Indigenous Power Plant Equipment – Phase II	4, March 2005
5	Phase II commissioned	2, February 2006

Information regarding actual operation of project activity during the monitoring period:
The project was in continuous operation during the verification period i.e., 1, April 2006 to 31, December 2009 (both days included). Please find the shutdown details in the below table:

Period	Forced Outages (Hours)	Scheduled Maintenance (Hours)
April 2006 - March 2007	101.00	672.17
April 2007 - March 2008	36.99	513.84
April 2008 - March 2009	232.78	775.11
April 2009 - Dec 2009	201.7	271.09

Events / situations that occurred during the monitoring period:

There were no events / situations during the monitoring period which would have any impact on the applicability of the methodology.

B.2. Revision of the monitoring plan

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There is no revision in the monitoring plan during this monitoring period.

B.3. Request for deviation applied to this monitoring period

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There is no deviation in the monitoring plan during this monitoring period.

B.4. Notification or request of approval of changes

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There is no notification or request of approval of changes to the project activity during this monitoring period.

SECTION C. Description of the monitoring system

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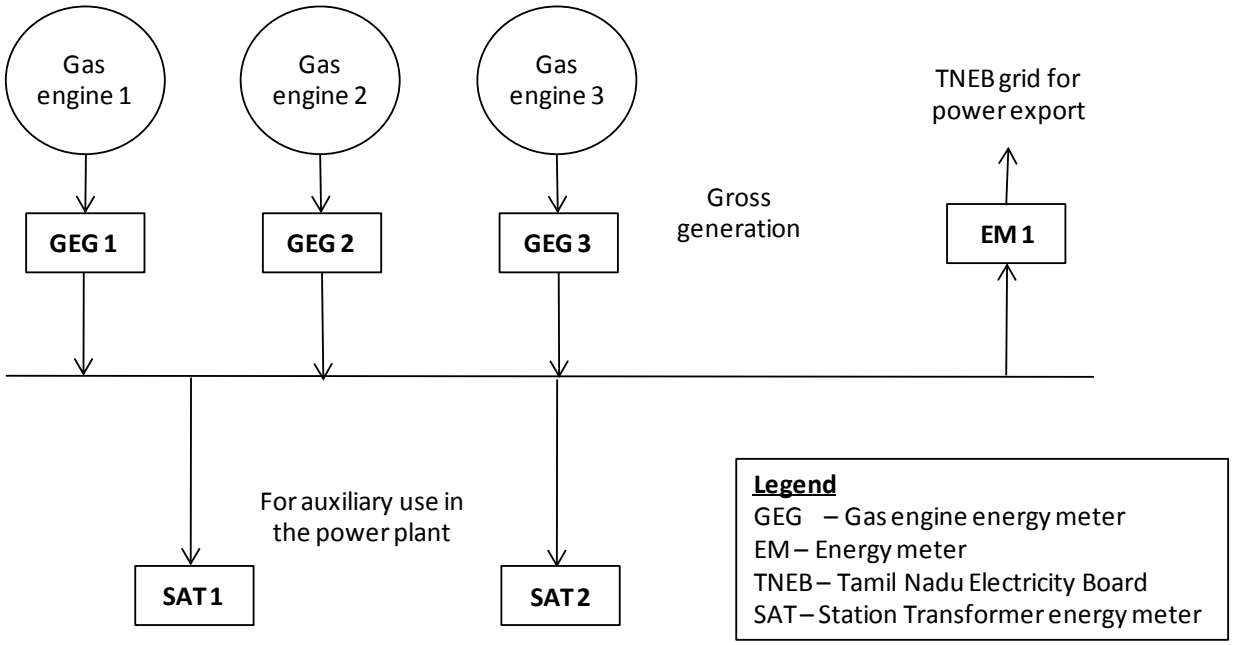
Description of Monitoring Systems and Procedures

Electricity Monitoring Diagram:



Details of Energy meters

There are a total of five energy meters that need to be monitored in the project activity. Three of the energy meters (GEG 1, GEG 2 and GEG 3) monitor the electricity generation from the three gas engines and the remaining two energy meters (SAT 1 and SAT 2) monitor the auxiliary electricity consumption from the grid.

Energy Meters	GEG 1	GEG 2	GEG 3	SAT 1	SAT 2
Location	Control Room	Control Room	Control Room	Control Room	Control Room
Model	EM 3360	EM 3360	EM 3360	EM 3360	EM 3360
Accuracy Class	0.2	0.2	0.2	0.2	0.2
Sl.No.	58956/3-4104	58956/2-4104	77307/22-3105	58956/4-4104	79560/23-3705
PT I/P	110 V AC	110 V AC	110 V AC	110 V AC	110 V AC
CT I/P	5A	5A	5A	5A	5A
Make	ENERCON	ENERCON	CONZERV	ENERCON	CONZERV
Calibration dates (during the monitoring period)	30.09.06	30.09.06	30.09.06	30.09.06	30.09.06
	02.10.07	08.10.07	23.08.07	16.08.07	23.08.07
	23.08.08	16.10.08	15.09.08	30.11.08	27.08.08
	03.10.09	13.08.09	23.07.09	13.10.09	12.07.09

Details of fuel monitoring equipment

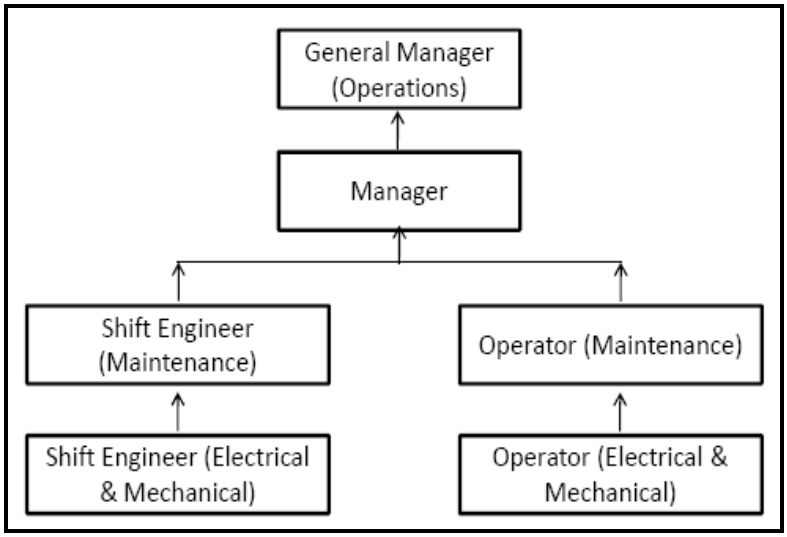
There is one natural gas flow meter (NGFM1) maintained by GAIL that needs to be monitored in the project activity. This flow meter monitors the total natural gas that is consumed by the project plant.

ID	NGFM1
Monitored parameter	Fuel consumed by the project plant
Equipment Name	GAIL Natural Gas flow meter
Location	Gail yard
Serial No.	16329468
Make	Floboss/Fisher
Model No.	FB503
Accuracy class	± 1.0%
Unit	SCM
Previous calibration date	25.02.2006
Calibration dates (during the monitoring period)	24.05.2006, 27.11.2006, 21.02.2007, 21.05.2007, 24.08.2007, 12.10.2007, 19.02.2008, 05.05.2008, 20.08.2008, 15.11.2008, 24.02.2009, 28.05.2009, 18.08.2009, 28.11.2009.

Monitoring Procedures

The "monitoring system and procedures" adopted is in compliance/accordance with the monitoring plan contained in registered PD and monitoring methodology prescribed in AM0029 version 3.0. The monitoring procedures (including data reviewing, reporting, archiving & QA/QC procedure adopted) has been detailed for each monitoring parameter in section D.2 "Data & parameters monitored".

An overview of the organization team to manage the VCS project activity is illustrated below:



Functions of the Team

- Ensure operation of the project activity to comply with the VCS Project Document
- Log periodically the data relevant to project activity
- Ensure accuracy of data by proper maintenance and calibration of monitoring equipment
- Take necessary permission from GM (Projects) before changing any monitoring equipment related to project activity
- Monitor emissions reduction generated by the project activity and maintain records of relevant data for verification of VCUs
- Review performance of the project activity periodically

Calibration

During the monitoring period, all the energy meters and the flow meters were found to be working within the required accuracy class. Copy of calibration reports have been submitted to the DOE.

Data adjustments due to delayed calibration

There was a delay in calibration observed for the energy meters and the GAIL natural gas flow meter. Details are as provided in the tables below:

Calibration delay in energy meters

Energy meter	Previous calibration date	Due date for next calibration	Actual date of calibration	Remarks
GEG 1 : I/C Sl. No.: 58956/3-4104	23.11.05	23.11.06	30.09.06	No delay
	30.09.06	30.09.07	02.10.07	Calibration delay (30.09.07 - 02.10.07)
	02.10.07	02.10.08	23.08.08	No delay
	23.08.08	23.08.09	03.10.09	Calibration delay (23.08.09 - 03.10.09)
GEG 2 : I/C	23.12.05	23.12.06	30.09.06	No delay

Energy meter	Previous calibration date	Due date for next calibration	Actual date of calibration	Remarks
Sl. No.: 58956/2-4104	30.09.06	30.09.07	08.10.07	Calibration delay (30.09.07 - 08.10.07)
	08.10.07	08.10.08	16.10.08	Calibration delay (08.10.08 - 16.10.08)
	16.10.08	16.10.09	13.08.09	No delay
GEG 3 : I/C Sl. No.: 77307/22-3105	10.08.05	10.08.06	30.09.06	Calibration delay (10.08.06 - 30.09.06)
	30.09.06	30.09.07	23.08.07	No delay
	23.08.07	23.08.08	15.09.08	Calibration delay (23.08.08 - 15.09.08)
	15.09.08	15.09.09	23.07.09	No delay
SAT 1 Sl. No.: 58956/4-4104	23.12.05	23.12.06	30.09.06	No delay
	30.09.06	30.09.07	16.08.07	No delay
	16.08.07	16.08.08	30.11.08	Calibration delay (16.08.08 - 30.11.08)
	30.11.08	30.11.09	13.10.09	No delay
SAT 2 Sl. No.: 79560/23-3705	13.09.05	13.09.06	30.09.06	Calibration delay (13.09.06 - 30.09.06)
	30.09.06	30.09.07	23.08.07	No delay
	23.08.07	23.08.08	27.08.08	Calibration delay (23.08.08 - 27.08.08)
	27.08.08	27.08.09	12.07.09	No delay

Calibration delay in GAIL natural gas flow meter (NGFM1)

Previous calibration date	Due date for next calibration	Actual date of calibration	Remarks
25.2.2006	25.5.2006	24.5.2006	No delay
24.5.2006	24.8.2006	27.11.2006	Calibration delay (24.8.06 - 27.11.06)
27.11.2006	27.2.2007	21.2.2007	No delay
21.2.2007	21.5.2007	21.5.2007	No delay
21.5.2007	21.8.2007	24.8.2007	Calibration delay (21.8.07 - 24.8.07)
24.8.2007	24.11.2007	12.10.2007	No delay
12.10.2007	12.2.2008	19.2.2008	No delay
19.2.2008	19.5.2008	5.05.2008	No delay
5.05.2008	5.8.2008	20.8.2008	Calibration delay (5.8.08 - 20.8.08)
20.8.2008	20.11.2008	15.11.2008	No delay
15.11.2008	15.2.2009	24.2.2009	Calibration delay (15.2.09 - 24.2.09)
24.2.2009	24.5.2009	28.5.2009	Calibration delay (24.5.09 - 28.5.09)
28.5.2009	28.8.2009	18.8.2009	No delay
18.8.2009	18.11.2009	28.11.2009	Calibration delay (18.11.09 - 28.11.09)

As per the monitoring plan, the energy meters have to be calibrated annually and the GAIL natural gas flow meter has to be calibrated every quarter. To account for the delay in calibration as detailed in the

tables above, as a conservative measure, emission reductions have been adjusted. The same approach as that specified by UNFCCC for CDM project activities under EB 52 Annex 60: "Guidelines for Assessing Compliance with the Calibration Frequency Requirements" has been adopted. In accordance with paragraph 4a of the guideline, the emission reductions have been adjusted considering the maximum permissible error of the energy meters. The delayed calibration test reports for all the energy meters do not show any error that is more than the maximum possible error of 0.2% and similarly, the delayed calibration test reports for the GAIL natural gas flow meter does not show any error that is more than the maximum possible error of 1%. This can be substantiated with the calibration reports for the meters that have been provided to the DOE. This being the case, the maximum permissible error of the instrument has been applied to the measured values for the months where no calibration was done. The data adjustment has been applied in a conservative manner such that the adjusted measured values shall result in lower baseline emissions and higher project emissions / leakage thus reducing the emission reductions.

Data adjustment

Meter	Measured values	Accuracy class	Data adjustment
Energy meters (GEG 1, GEG 2 & GEG 3)	Gross electricity generation recorded by GEG 1, GEG 2 & GEG 3	±0.2%	The gross electricity generation recorded by the energy meters GEG 1, GEG 2 & GEG 3 have been decreased by 0.2% for the corresponding months where there has been a delay in calibration
Energy meters (SAT 1 & SAT 2)	Auxiliary electricity consumption recorded by SAT 1 & SAT 2	±0.2%	The auxiliary electricity consumption recorded by the energy meters SAT 1 & SAT 2 have been increased by 0.2% for the corresponding months where there has been a delay in calibration
GAIL natural gas flow meter (NGFM1)	Natural gas consumption recorded by NGFM 1	±1.0%	Since the quantity of natural gas measured is used to calculate the project emissions and leakage, the natural gas consumption recorded by NGFM 1 has been increased by 0.2% for the corresponding months where there has been a delay in calibration

Emergency procedures for the monitoring system

Quality Assurance (QA) and Quality Control (QC) Procedures:

Data	Uncertainty level of data (High/Medium/ Low)	Are QA/QC procedures planned for these data?	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
$FC_{NG,y}$ $NCV_{NG,y}$ $EG_{PJ,y}$ $COEF_{f,y}$	Low	Yes	As these data are critical in calculating emission reductions by project activity, these variables are strictly monitored at the project site by means of accurately calibrated instruments, dedicated for the intended purpose.
$OXID_{NG}$ $EF_{CO2,NG,y}$ $EF_{BL,CO2,y}$	Low	No	These values are adapted from studies / reports generated by reputed bodies. Any change / updation will be taken into consideration.

The QA & QC procedures for the all the critical equipments in the project activity has been described clearly in the Monitoring plan. The project proponent is maintaining records pertaining to calibration and maintenance related activities carried out at their site.

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	**$EF_{NG, upstream, CH4}$**
Data unit:	tCH_4/GJ
Description:	Emission factor for upstream fugitive methane emissions of natural gas from production, transportation and distribution
Source of data used:	IPCC guidelines as indicated in Table 2 of AM0029 version 3
Value(s) :	0.00016
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations
Additional comment:	The default values for USA and Canada have been adopted. The gas production, processing, transmission by ONGCL and distribution facilities of the fuel supplier by GAIL, are of recent vintage and built and operated to international standards.[1]

Data / Parameter:	**$EF_{k, upstream, CH4}$ (coal and lignite)**
Data unit:	tCH_4/kt coal or lignite

[1] http://www.blonnet.com/2005/04/23/stories/2005042301550200.htm
http://www.energymanagertraining.com/eca2005/Award2005CD/AwardBook/Petroleum%20Pipeline.pdf
http://gail.nic.in/gailnewsite/investorzone/investorzone_annualreports.html

Description:	Emission factor for upstream fugitive emissions from production of coal and lignite
Source of data used:	IPCC guidelines as indicated in Table 2 of AM0029 version 3
Value(s) :	0.8
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	To calculate Baseline emissions from the emission factor.
Additional comment:	The default value for surface mining is adopted. This is conservative considering that it is lower than that of underground mining. Since a separate default emission factor is not indicated for lignite in the methodology or in IPCC guidelines, the value of coal has been adopted.

Data / Parameter:	**$EF_{k, upstream, CH4}$ (oil / Diesel / Fuel oil)**
Data unit:	tCH_4/PJ
Description:	Emission factor for upstream fugitive emissions from production of oil
Source of data used:	IPCC guidelines as indicated in Table 2 of AM0029 version 3
Value(s) :	4.1
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emissions calculations
Additional comment:	Since a separate default emission factor is not indicated separately for diesel and other fuel oils in the methodology or in IPCC guidelines, the value of oil has been adopted

D.2. Data and parameters monitored

Data / Parameter:	$FC_{NG,y}$
Data unit:	Mn SCM (Standard[2] Cubic Metre)
Description:	Annual quantity of natural gas consumed in project activity
Measured /Calculated /Default:	Measured
Source of data:	Online Natural gas flow meter readings
Value(s) of monitored parameter:	See table below
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project and leakage emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	See table below

Period	**$FC_{NG,y}$ (Mn SCM)**
April 2006 – December 2006	36.578
January 2007 – December 2007	44.205
January 2008 – December 2008	40.373
January 2009 – December 2009	37.822
Total	**158.978**

Type	GAIL Meter
Accuracy Class	±1%
Sl No	16329468
Frequency	Quarterly
Last calibration date during monitoring period	28.11.2009

[2] 1 bar pressure and 273 degree Kelvin

	Validity: 18.02.2010
Measuring/ Reading/ Recording frequency:	The data would be measured continuously in online flow meters of the gas supplier (Gas Authority of India Limited – GAIL) and recorded electronically on a daily basis. 100% of the data is monitored
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	The gas flow meters are subject to calibration periodically. The consumption will be checked with the readings from the gas supply company [GAIL] invoices. The instruments used for monitoring data are calibrated once every quarter. QA/QC procedures: *Calibration:* All the flow meters are duly calibrated, in case of calibration has been delayed for any energy meters EB 52 annex 60 "Guidelines for assessing compliance with the calibration frequency requirements" would be applied.

Data / Parameter:	$NCV_{NG,y}$
Data unit:	GJ/m^3
Description:	Net calorific value of natural gas
Measured /Calculated /Default:	Recorded
Source of data:	"Customer Fortnight Statement" provided by Fuel supplier (GAIL). The statement contains daily quantity of fuel consumed, NCV and fortnightly weighted average values. Fortnightly weighted average NCV values will be used for calculations. The NCV values are provided in kCal/ SCM which will be converted to GJ/m^3.
Value(s) of monitored parameter:	0.0368
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project and leakage emissions calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The data is measured by GAIL. CECL has recorded and archived data from GAIL documents. 100% of the data is recorded.
Measuring/ Reading/ Recording frequency:	The data is measured by GAIL. CECL records and archives data from GAIL documents on paper. 100% of the data is recorded.
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	Since supplier-provided data is used, no additional QA/QC procedures need to be applied as per AM0029.

Data / Parameter:	$OXID_{NG}$
Data unit:	-
Description:	Oxidation factor for natural gas
Measured /Calculated /Default:	Default value
Source of data:	IPCC current default value
Value(s) of monitored parameter:	1.0

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	NA
Measuring/ Reading/ Recording frequency:	100% of the data is monitored annually
Calculation method (if applicable):	NA
QA/QC procedures applied:	Since IPCC default value is used, no additional QA/QC procedures need to be applied as per AM0029.

Data / Parameter:	$EF_{CO2,NG,y}$
Data unit:	tCO_2/GJ
Description:	Emission factor for natural gas
Measured /Calculated /Default:	Default
Source of data:	IPCC default value is applied since national data is not available Volume 2, Chapter 2 – Stationary Combustion, table 2.2 page 2.17. The default emission factor for natural gas is 56100 $kgCO_2/TJ$. This has been converted to 0.0561 tCO_2/GJ
Value(s) of monitored parameter:	0.0561
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	NA
Measuring/ Reading/ Recording frequency:	Latest IPCC default value would be adopted
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	No additional QA/QC procedures need to be applied as per AM0029.

Data / Parameter:	CO_{EFy}
Data unit:	tCO_2/m^3
Description:	CO_2 emissions coefficient of natural gas
Measured /Calculated /Default:	Calculated
Source of data:	
Value(s) of monitored parameter:	0.002067
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration	The data is calculated as per AM0029 formula and archived electronically. 100% of the data is to be monitored annually

frequency, date of last calibration, validity)	
Measuring/ Reading/ Recording frequency:	
Calculation method (if applicable):	Please refer Baseline emission calculation section
QA/QC procedures applied:	No additional QA/QC procedures need to be applied as per AM0029.

Data / Parameter:	$EF_{BL,CO2,y}$
Data unit:	tCO_2/MWh
Description:	Baseline emission factor of the Southern Regional Grid of India
Measured /Calculated /Default:	Calculated
Source of data:	CEA (Central Electricity Authority) CO2 Baseline Database for the Indian Power Sector, version 5
Value(s) of monitored parameter:	0.8179
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	The data is calculated as per AM0029 formula and archived electronically.
Measuring/ Reading/ Recording frequency:	Annual
Calculation method (if applicable):	Calculated as the Build Margin (BM) emission factor for the Southern Regional Grid as per the CEA CO_2 Baseline Database for the Indian Power Sector, version 5. Formulae and guidelines provided in the methodology ACM0002 and the "Tool to calculate the emission factor for an electricity system" have been used.
QA/QC procedures applied:	No additional QA/QC procedures need to be applied as per AM0029.

Data / Parameter:	$EG_{PJ, y}$
Data unit:	MWh
Description:	Net electricity generated in the project activity
Measured /Calculated /Default:	Calculated
Source of data:	Energy meters of CECL
Value(s) of monitored parameter:	
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline and leakage emissions calculations

Period	**$EG_{PJ,y}$ (MWh)**
April 2006 – December 2006	1,55,968.14
January 2007 – December 2007	1,86,298.23
January 2008 – December 2008	1,67,983.51
January 2009 – December 2009	1,56,889.44
Total	**6,67,139.32**

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	

Type	GEG Meter 1	GEG Meter 2	GEG Meter 3	Aux Meter 1	Aux Meter 2
Accuracy Class	0.2s	0.2s	0.2s	0.2s	0.2s
Sl No	58956/3-4104	58956/2-4104	77307/22-3105	58956/4-4104	79560/23-3705
Frequency	Annual	Annual	Annual	Annual	Annual
Calibration date during the monitoring period	3.10.2009	13.08.09	23.07.09	13.10.09	12.07.09
Validity	3.10.2010	13.08.10	23.07.10	13.10.10	12.07.09

Measuring/ Reading/ Recording frequency:	Annual
Calculation method (if applicable):	Net electricity generation is calculated as follows: Net electricity generation = Gross electricity generation – Auxiliary consumption Accuracy class of energy meters: Class 0.2s or better
QA/QC procedures applied:	Since this data is based on monitored Gross generation and auxiliary consumption data, separate QA/QC procedures are not necessary.

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

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Baseline emissions are calculated by multiplying the electricity generated in the project plant ($EG_{PJ,y}$) with a baseline CO_2 emissions factor ($EF_{BL,CO2,y}$), as follows:

$BE_y = EG_{PJ,y}$ **x** $EF_{BL,CO2,y}$

Baseline Emission Factor ($EF_{BL,CO2,y}$)

AM0029 prescribes that the lowest emission factor among the following three options should be used as the baseline emission factor for the project activity:

Option 1 The build margin, calculated according to ACM0002; and

Option 2 The combined margin, calculated according to ACM0002, using a 50/50 OM/BM weight.

Option 3 The emission factor of the technology (and fuel) identified as the most likely baseline scenario under "Identification of the baseline scenario" above.

Option 1 & 2 – To calculate the build margin & the combined margin

According to ACM0002, the"Tool to calculate the emission factor for an electricity system" should be used to determine the build margin and the combined margin. As per the tool, project participants shall apply the following six steps:

STEP 1. Identify the relevant electricity systems

STEP 2. Choose whether to include off-grid power plants in the project electricity system (optional)

STEP 3. Select a method to determine the operating margin (OM)

STEP 4. Calculate the operating margin emission factor according to the selected method

STEP 5. Identify the group of power units to be included in the build margin (BM)

STEP 6. Calculate the build margin emission factor

STEP 7. Calculate the combined margin (CM) emissions factor

Step 1: Identify the relevant electricity systems

For determining the electricity emission factors, a project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the power plant location) and that can be dispatched without significant transmission constraints.

Similarly, a connected electricity system, e.g. national or international, is defined as an electricity system that is connected by transmission lines to the project electricity system. Power plants within the connected electricity system can be dispatched without significant transmission constraints but transmission to the project electricity system has significant transmission constraint.

The Central Electricity Authority has divided the electricity system of India into two regional grids namely, Southern Grid and North, East, West and North Eastern (NEWNE) Grids[3]. Based on this database, the Tamil Nadu state (project activity location) falls under the Southern region, therefore the relevant electric power system for this project activity will be the Southern Grid.

Step 2: Choose whether to include off-grid power plants in the project electricity system (optional)

Project participants may choose between the following two options to calculate the operating margin and build margin emission factor:

Option I: Only grid power plants are included in the calculation.

Option II: Both grid power plants and off-grid power plants are included in the calculation.

As indicated above, this project activity would use Option I, only grid power plants are included in the calculation.

[3] Source : http://www.cea.nic.in/planning/c%20and%20e/user_guide_ver5.pdf

Step 3: Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor (*EFgrid,OM,y*) is based on one of the following methods:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or
(d) Average OM.

The calculation is based on option (a), since the low-cost/must-run resources constitute less than 50% of total grid generation.

Share of Must-Run (Hydro/Nuclear) (% of Net Generation)					
	2004-05	2005-06	2006-07	2007-08	2008-09
NEWNE	16.83%	18.0%	18.5%	19.0%	17.3%
South	21.6%	27.0%	28.3%	27.1%	22.8%
India	18.0%	20.1%	20.9%	21.0%	18.6%

Step 4: Calculate the operating margin emission factor according to the selected method.

The Simple Operating Margin emission factor $EF_{grid,OM,y}$ is defined as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2e/MWh) of all generating power plants serving the system, not including low-cost/must-run power plants/units (which typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation), using a 3-year generation-weighted average, based on the most recent data available. As per the 'Tool to calculate emission factor for an electricity system', Version 2, Option B (based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system) is chosen, which includes electricity imports[4] to the grid. The assumptions used by CEA while calculating the CO_2 emissions are detailed in Appendix B of the "CO_2 baseline database for the Indian Power Sector – User Guide[5]"

Under Option B, the simple OM emission factor is calculated based on the net electricity supplied to the grid by all power plants serving the system, namely the Southern Grid of India, not including low-cost/must-run power plants/units, and based on the fuel type(s) and total fuel consumption of the project electricity system, as follows:

$$EF_{grid,OM,y} = \frac{\sum_{i,m} FC_{i,m,y} \; X \; NCV_{i,y} \; X \; EF_{CO2,i,y}}{EG_{m,y}}$$

Where,

$EF_{grid,OM,y}$ = Simple operating margin CO_2 emission factor in year y (tCO_2/MWh)

[4] As described earlier, electricity import from the NEWNE grid (a connected electricity system) is considered.

[5] Reference: http://cea.nic.in/planning/c%20and%20e/user_guide_ver5.pdf

$FC_{i,m,y}$ = Amount of fossil fuel type *i* consumed by power unit *m* in the project electricity system in year y (mass or volume unit)

$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ / mass or volume unit)

$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)

m = All power plants/units delivering electricity to the grid in year *y* except low-cost / must-run power plants/units

i = All fossil fuel types combusted in power unit *m* in year *y*

y = The three most recent years for which data is available at the time of submission of the Monitoring Report to the DOE for Verification (ex post option), i.e. the years 2006-2007, 2007-2008, 2008-2009

The operating margin emission factors for the recent most three years (2006-07, 2007-08 & 2008-09) is considered in this project activity.

Simple Operating Margin (tCO_2/MWh) (including imports)				
South	2005-2006	**2006-2007**	**2007-2008**	**2008-09**
	1.01	**0.9991**	**0.9906**	**0.9704**

Source: Central Electricity Authority CO_2 Baseline Database.
Version: 5.0, dated November, 2009
Link: http://cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

The Operating Margin Emission Factor is calculated as follows:

Parameter	**Row A** **Net Generation in Operating Margin + Electricity Transfers (inter-grid and cross-border) (GWh)**	**Row B** **Simple Operating Margin (including Imports) (tCO_2/MWh)**
2006-07 Data	109116 + 0 = 109116	0.9991
2007-08 Data	114702 + 0 = 114702	0.9906
2008-09 Data	121471 + 6325.9 = 127796.9	0.9704
Operating Margin (OM) - 3 Year generation-weighted average	$= \frac{\sum_{3years}(RowA \times RowB \times 1000)}{(\sum_{3years} RowA) \times 1000}$	**= 0.98683 tCO_2/MWh**

Step 5: Identify the cohort of power units to be included in the build margin (BM).

The sample group of power units *m* used to calculate the build margin consists of either:

(a) The set of five power units that have been built most recently, or

(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently

In terms of vintage of data, project participants can choose between one of the following two options:

Option 1. For the first crediting period, calculate the build margin emission factor *ex-ante* based on the most recent information available on units already built for sample group *m* at the time of PD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

Based on the guidance provided in the tool, as stated above, Option 1 has been chosen to arrive at the sample *m*. The CEA database which publishes common emission factors for the respective electricity systems (region specific), has taken into account all the guidelines specified under this tool. Hence, the emission factor for the Southern grid has been adopted from the CEA database.

Step 6: Calculate the build margin emission factor.

The BM values for calculation of combined margin are adopted from the latest Central Electricity Authority's (CEA) CO_2 database, version 5.0 (which uses ACM0002/version 7.0 and "Tool to Calculate the Emission Factor for an Electricity System", version 2).

The build margin is calculated as the generation-weighted average emission factor (tCO_2/MWh) of all power units *m* during the most recent year *y* for which power generation data is available, calculated as follows:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}} \quad (5)$$

Where,

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (tCO_2/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)

$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)

m = Power units included in the build margin

y = Most recent historical year for which power generation data is available

The build margin emission factor for the most recent year (2008-2009) is considered in this project activity and is as per Version 5.0 of the CO_2 Baseline Database of the Central Electricity Authority of India.

Build Margin (tCO_2/MWh) (not adjusted for imports)				
South	2005-2006	2006-2007	2007-2008	**2008-09**
	0.71	0.7012	0.7133	**0.8179**

Source: Central Electricity Authority CO_2 Baseline Database.
Version: 5.0, dated November, 2009
Link: http://cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

Step 7: Calculate the combined margin (CM) emissions factor.

The combined margin (CM) consisting of operating margin (OM) and build margin (BM) will be computed according to the tool to calculate the emission factor for an electricity system for this project activity. The OM and BM values for calculation of combined margin have been referred from the latest Central Electricity Authority's (CEA) CO_2 database, version 5.0 (which uses ACM0002/version 7.0 and "Tool to Calculate the Emission Factor for an Electricity System", version 2). An account of all grid connected energy generation (a single point source in the country for grid operation and management data) and access to the data from these generating stations is maintained by the CEA. Generation from each unit and net inter-state purchases and other details are published by CEA annually. The baseline emission factor for the regional grids, taking into account all required data from the respective grid, is also calculated by the CEA.

The combined margin/baseline emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

Where,

$EF_{grid,CM,y}$: Combined margin emissions factor for the project electricity system in year y (tCO_2e/kWh)

$EF_{grid,OM,y}$: Operating margin emission factor (tCO_2e/kWh) calculated as per Methodological Tool (version 02); Tool to calculate the emission factor for an electricity system

w_{OM} : Weight of operating margin emissions factor (0.5 as per Methodological Tool (version 02); Tool to calculate the emission factor for an electricity system)

$EF_{grid,BM,y}$: Build margin emission factor (tCO_2e/kWh) calculated as per Methodological Tool (version 01); Tool to calculate the emission factor for an electricity system

w_{BM} : Weight of build margin emissions factor (0.5 as per Methodological Tool (version 02); Tool to calculate the emission factor for an electricity system)

Thus,

$$EF_{grid,CM,y} = (0.9868 \times 0.5) + (0.8179 \times 0.5)$$

$$EF_{grid,CM,y} = 0.90238 \text{ } tCO_2/MWh$$

The emission factors as per CEA database is shown below:

$EF_{OM,y}$ = 0.9868 tCO_2/MWh

$EF_{BM,y}$ = 0.8179 tCO_2/MWh

$EF_{CM,y}$ = 0.90235 tCO_2/MWh

Option 1: Build Margin, calculated according to ACM0002

As described above, build margin calculated according to ACM0002 V7 is 0.8179 tCO_2/MWh.

Option 2: Combined Margin, calculated according to ACM0002

As described above, combined margin calculated according to ACM0002 V7 is 0.90235 tCO_2/MWh.

Option 3: Emission factor of technology identified as the most likely baseline scenario

In this case, the most likely baseline scenario identified is a coal based power plant, the emission factor of which is calculated using the below formula prescribed by AM0029:

$$EF_{BL,CO2} = \frac{COEF_{BL}}{\eta_{BL}} * 3.6$$

where,

$COEF_{BL}$ = the fuel emission coefficient (tCO_2/GJ), based on national average fuel data. In this case, the value is adopted from India's CEA CO2 database as 0.0958[6] tCO_2/GJ.

η_{BL} = the energy efficiency of the coal power plant. As per the heat rate (2500 kCal/kWh), it is 34.4%. (Efficiency = output/input = 860[7] / 2500 = 0.344)

Applying values in the above formula;

Emission factor of coal power plant = (0.0958/0.344)*3.6 = 1.00 tCO_2/MWh

The build margin emission factor is the lowest of the three options and therefore the same will be adopted as the baseline emission factor.

$EF_{BL,CO2,y}$ = 0.8179 tCO_2/MWh

As per AM0029, the build margin has been estimated ex post.

As per the methodology, the emission factor to be fixed *ex post* will be computed as

This determination will be made once at the validation stage based on an ex ante assessment, once again at the start of each subsequent crediting period (if applicable). If either option 1 (BM) or option 2 (CM) are selected, they will be estimated ex post, as described in "Tool to calculate emission factor for an electricity system".

The Tool to calculate emission factor of an electricity system, version 2 states that

[6] Refer "Assumptions" sheet of CEA CO2 database version 04

[7] 1kWh = 860 kCal

Option 2: For the first crediting period, the build margin emission factor shall be updated annually, *ex post*, including those units built up to the year of registration of the project activity or, if information up to the year of registration is not yet available, including those units built up to the latest year for which information is available. For the second crediting period, the build margin emissions factor shall be calculated *ex ante*, as described in Option 1 above. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used.

Therefore, the latest build emission factor value including units built up to the latest year (CEA version 5) has been considered and the same value (Build Margin for the year 2009 – including built units till date) has been used to compute baseline emission. Please refer the emission calculation sheet for details.

E.2. Project emissions calculation

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Project Emissions

The CO_2 emissions from electricity generation (PE_y) are to be calculated applying the below equation as per AM0029:

$$PE_y = \sum_f FC_{f,y} * COEF_{f,y}$$

In this case, since natural gas is the only fuel used and start-up / auxiliary fuels are not required, the equation may be as follows:

$$PE_y = FC_{NG,y} * COEF_{NG,y}$$

Where:

$FC_{NG, y}$: is the total volume of natural gas combusted in the project plant (in standard m^3 - SCM) in year 'y'

$COEF_{NG, y}$: is the CO_2 emission coefficient (tCO_2/SCM) in year y for natural gas and is obtained as:

$$COEF_{NG,y} = \sum NCV_y * EF_{CO2\,NG,y} * OXID_{NG}$$

Where:

NCV_y : is the net calorific value per volume unit of natural gas in year 'y' (GJ/SCM) as determined from the fuel supplier.

$EF_{CO2,NG,y}$: is the CO_2 emission factor per unit of energy of natural gas in year 'y' (tCO_2/GJ) as determined from the fuel supplier, wherever possible, otherwise from local or national data. Since in this case local or national data is not available, IPCC default value would be applied.

$OXID_{NG}$: is the oxidation factor of natural gas

E.3. Leakage calculation

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Leakage

The leakage emission sources considered are the fugitive CH_4 emissions associated with fuel extraction, processing, liquefaction, transportation, regasification and distribution of natural gas used in the project plant and fossil fuels used in the grid in the absence of the project activity. Since LNG is not used in the project activity, emissions associated with it need not be considered in the leakage calculations.

AM0029 prescribes the following formula:

$LE_y = LE_{CH4,y} + LE_{LNG,CO2,y}$

Since LNG component is not applicable[8],

$LE_y = LE_{CH4,y}$

Where,

LE_y : Leakage emissions during the year y in tCO_2e

LE_{CH4} : Leakage emissions due to fugitive upstream CH_4 emissions in year y in tCO_2e, calculated using the below formula as prescribed by AM0029.

$$LE_{CH4} = [\ FC_y * NCV_y * EF_{NG,upstream,CH4} - EG_{PJ,y} * EF_{BL,upstream,CH4}] * GWP_{CH4}$$

Where,

FC_y : Quantity of natural gas combusted in the project plant during year y in SCM

NCV_y : Average net calorific value of natural gas combusted during year y in GJ/SCM

$EF_{NG,upstream,CH4}$: Emission factor for upstream fugitive methane emissions of natural gas from production, transportation and distribution in tCH_4/GJ

$EG_{PJ,y}$: Electricity generation in the project plant during year y in MWh

$EF_{BL,upstream,CH4}$: Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in tCH_4/MWh

GWP_{CH4} : Global warming potential of methane valid for the relevant commitment period

As per AM0029, the emission factor for upstream fugitive CH_4 emissions are calculated consistent with the baseline emission factor (in this case Option 1: Build Margin) used as shown below:

$$EF_{BL,upstream,CH4} = \frac{\sum_j FF_{j,k}\ x\ EF_{k,upstream,CH4}}{\sum_j EG_j}$$

[8] As per the natural gas allocation letter from the Ministry of Petroleum and Natural Gas, gas would be directly supplied from the Kuttalam gas field located at a distance of 6 kms from the project activity. No LNG component is involved.

Where,

j : Plants included in the build margin

$FF_{j,k}$: Quantity of fuel type k (coal or oil type) combusted in power plant j included in the build margin

$EF_{k,upstream,CH4}$: Emission factor for upstream fugitive emissions from production of fuel type k in tCH_4 per MJ fuel produced

EG_j : Electricity generation in the plants j included in the build margin in MWh per year

For $EF_{NG,upstream,CH4}$ and $EF_{k,upstream,CH4}$ the IPCC default values as provided in Table 2 of AM0029 are used since reliable and accurate data on fugitive methane emissions associated with the production, transportation and distribution of fuels (natural gas, coal or gas) is not available.

E.4. Emission reductions calculation / table

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<Please refer the next page>

BASELINE EMISSIONS FROM NET ELECTRICITY GENERATION BY THE PROJECT ACTIVITY

Date	Net Electricity Generation	Baseline Emission Factor	Baseline Emissions
	MWh	$EF_{BL,CO2,y}$, tCO_2/MWh	tCO_2e
April-06	17026.583	0.8179	13926.44
May-06	17804.656	0.8179	14562.84
June-06	17315.019	0.8179	14162.36
July-06	17178.019	0.8179	14050.30
August-06	18184.3672	0.8179	14873.42
September-06	17710.07417	0.8179	14485.48
October-06	17079.63	0.8179	13969.83
November-06	17258.715	0.8179	14116.30
December-06	16411.077	0.8179	13423.00
Sub-Total	**155968.140**		**127569**
January-07	18746.678	0.8179	15333.34
February-07	16322.669	0.8179	13350.69
March-07	18316.752	0.8179	14981.70
April-07	16799.703	0.8179	13740.87
May-07	15660.166	0.8179	12808.81
June-07	15410.351	0.8179	12604.48
July-07	15393.015	0.8179	12590.30
August-07	17470.995	0.8179	14289.93
September-07	13474.116	0.8179	11020.79
October-07	12715.028	0.8179	10399.92
November-07	13053.102	0.8179	10676.44
December-07	12935.656	0.8179	10580.37
Sub-Total	**186298.231**		**152377**
January-08	12810.868	0.8179	10478.31
February-08	13596.144	0.8179	11120.60
March-08	15909.506	0.8179	13012.75
April-08	14624.116	0.8179	11961.40
May-08	11508.933	0.8179	9413.42
June-08	11425.574	0.8179	9345.24
July-08	13752.148	0.8179	11248.20
August-08	16819.06943	0.8179	13756.71
September-08	13515.2746	0.8179	11054.46
October-08	15853.2519	0.8179	12966.74
November-08	13364.25672	0.8179	10930.94
December-08	14804.362	0.8179	12108.83
Sub-Total	**167983.504**		**137397**
January-09	14804.221	0.8179	12108.72
February-09	11121.666	0.8179	9096.67
March-09	12686.202	0.8179	10376.34
April-09	12926.552	0.8179	10572.93
May-09	13765.228	0.8179	11258.90
June-09	12475.098	0.8179	10203.67
July-09	11932.793	0.8179	9760.11
August-09	14095.4786	0.8179	11529.02
September-09	12465.9742	0.8179	10196.21
October-09	13252.0852	0.8179	10839.19
November-09	13965.936	0.8179	11423.06
December-09	13398.206	0.8179	10958.70
Sub-Total	**156889.440**		**128323**
TOTAL	**667139.315**		**545666**

PROJECT EMISSIONS FROM COMBUSTION OF NATURAL GAS

Month	Total volume of NG combusted per year		Net Calorific Value of NG		CO_2 Emission factor of NG	Oxidation factor	CO_2 Emission Coefficient of NG	Total Project Emissions
	First Fortnight gas consumption	Second Fortnight gas consumption	First Fortnight weighted Average NCV	Second Fortnight weighted Average NCV				
	$FC_{NG,y}$		NCVy		$EF_{CO2,NG,y}$	$OXID_{NG}$	$COEF_{f,y}$	$PE_{NG,y}$
	m^3	m^3	GJ/m^3	GJ/m^3	tCO_2/GJ		tCO_2/m^3	tCO_2e
April-06	2005680	1985981	0.0367	0.0367	0.0561	1	0.002060	8223.80
May-06	2021474	2128782	0.0367	0.0367	0.0561	1	0.002060	8550.99
June-06	2061766	1975727	0.0367	0.0368	0.0561	1	0.002062	8325.59
July-06	2061259	1934448	0.0367	0.0369	0.0561	1	0.002065	8248.63
August-06	2084824	2168369	0.0369	0.0368	0.0561	1	0.002068	8795.36
September-06	2096852	2101359	0.0368	0.0368	0.0561	1	0.002066	8672.63
October-06	2137436	1902671	0.0368	0.0368	0.0561	1	0.002065	8341.66
November-06	2083231	2007821	0.0367	0.0368	0.0561	1	0.002062	8435.69
December-06	1782690	2037375	0.0368	0.0368	0.0561	1	0.002063	7881.89
Sub-Total	**18335212**	**18242532**	**Average NCV**	**0.0368**				**75477**
January-07	2119157	2235064	0.0370	0.0369	0.0561	1	0.002074	9031.07
February-07	1955875	1833968	0.0370	0.0371	0.0561	1	0.002079	7878.15
March-07	2110678	2163349	0.0373	0.0371	0.0561	1	0.002086	8915.79
April-07	2105098	1871013	0.0371	0.0372	0.0561	1	0.002082	8278.22
May-07	1878682	1925091	0.0369	0.0369	0.0561	1	0.002072	7881.26
June-07	1800721	1886847	0.0371	0.0368	0.0561	1	0.002074	7646.98
July-07	1808633	1946305	0.0370	0.0369	0.0561	1	0.002072	7780.14
August-07	2059733	2105829	0.0369	0.0367	0.0561	1	0.002066	8607.56
September-07	1830756	1426510	0.0367	0.0367	0.0561	1	0.002057	6701.16
October-07	1435466	1586849	0.0369	0.0368	0.0561	1	0.002068	6250.07
November-07	1458166	1609563	0.0368	0.0367	0.0561	1	0.002063	6327.23
December-07	1381403	1670521	0.0367	0.0370	0.0561	1	0.002068	6312.83
Sub-Total	**21944368**	**22260909**	**Average NCV**	**0.0369**				**91611**
January-08	1486094	1541112	0.0373	0.0373	0.0561	1	0.002091	6330.78
February-08	1646580	1598093	0.0370	0.0373	0.0561	1	0.002085	6765.78
March-08	1845930	1945768	0.0371	0.0371	0.0561	1	0.002080	7885.17

April-08	1770250	1741747	0.0373	0.0369	0.0561	1	0.002081	7309.59
May-08	1477908	1374726	0.0366	0.0362	0.0561	1	0.002043	5828.03
June-08	1385998	1361458	0.0366	0.0369	0.0561	1	0.002060	5659.61
July-08	1197386	2091686	0.0367	0.0368	0.0561	1	0.002062	6783.90
August-08	1965090	2061698	0.0368	0.0369	0.0561	1	0.002069	8332.37
September-08	1795460	1439732	0.0367	0.0367	0.0561	1	0.002061	6667.13
October-08	1853279	1963136	0.0368	0.0367	0.0561	1	0.002063	7874.23
November-08	1706479	1530239	0.0367	0.0367	0.0561	1	0.002059	6663.91
December-08	1652342	1940624	0.0366	0.0368	0.0561	1	0.002058	7395.12
Sub-Total	**19782796**	**20590019**	**Average NCV**	**0.0369**				**83496**
January-09	1900278	1625394	0.0367	0.0367	0.0561	1	0.002059	7260.93
February-09	1406499	1249791	0.0366	0.0367	0.0561	1	0.002056	5459.89
March-09	1451610	1567444	0.0367	0.0368	0.0561	1	0.002062	6225.10
April-09	1700224	1456665	0.0368	0.0368	0.0561	1	0.002065	6517.45
May-09	1439468	1861723	0.0369	0.0369	0.0561	1	0.002069	6828.03
June-09	1549844	1491436	0.0368	0.0368	0.0561	1	0.002064	6276.27
July-09	1443397	1435388	0.0368	0.0370	0.0561	1	0.002070	5958.49
August-09	1409897	1978024	0.0368	0.0367	0.0561	1	0.002063	6986.83
September-09	1513829	1529321	0.0369	0.0369	0.0561	1	0.002071	6301.55
October-09	1585334	1619779	0.0366	0.0368	0.0561	1	0.002057	6593.75
November-09	1739219	1635833	0.0367	0.0370	0.0561	1	0.002068	6978.92
December-09	1504648	1726646	0.0367	0.0365	0.0561	1	0.002052	6631.28
Sub-Total	**18644247**	**19177444**	**Average NCV**	**0.0368**				**78019**
Total	**78706623**	**80270904**	**Average NCV**	**0.0368**				**328603**

LEAKAGE EMISSIONS FROM FUGITIVE METHANE EMISSIONS FROM NATURAL GAS

Leakage in the project activity arises from fugitive methane emissions from natural gas. For the purpose of estimating fugitive CH_4 emissions, the quantity of natural gas consumed by the project in year y with an emission factor for fugitive CH_4 emissions from natural gas consumption is multiplied and subtracted from the emissions occurring from fossil fuels used in the absence of the project activity. Therefore,

Net Fugitive emissions increase due to project activity = Fugitive emissions in the project scenario – Fugitive emissions in the baseline scenario

Fugitive Methane Emissions in the Project Scenario:

Month	Total volume of NG combusted per year		Net Calorific Value of NG		Emission factor for upstream fugitive emissions	Fugitive Emissions in the project scenario
	First Fortnight gas consumption	Second Fortnight gas consumption	First Fortnight weighted Average NCV	Second Fortnight weighted Average NCV		
	FCNG,y		NCVy		$EF_{NG,upstream,CH4}$	
	m3	m3	GJ/m^3	GJ/m^3	tCH_4/GJ	tCH_4
April-06	2005680	1985981	0.0367	0.0367	0.00016	23.45
May-06	2021474	2128782	0.0367	0.0367	0.00016	24.39
June-06	2061766	1975727	0.0367	0.0368	0.00016	23.75
July-06	2061259	1934448	0.0367	0.0369	0.00016	23.53
August-06	2084824	2168369	0.0369	0.0368	0.00016	25.08
September-06	2096852	2101359	0.0368	0.0368	0.00016	24.73
October-06	2137436	1902671	0.0368	0.0368	0.00016	23.79
November-06	2083231	2007821	0.0367	0.0368	0.00016	24.06
December-06	1782690	2037375	0.0368	0.0368	0.00016	22.48
Sub-Total	**18335212**	**18242532**				**215.26**
January-07	2119157	2235064	0.0370	0.0369	0.00016	25.76
February-07	1955875	1833968	0.0370	0.0371	0.00016	22.47
March-07	2110678	2163349	0.0373	0.0371	0.00016	25.43
April-07	2105098	1871013	0.0371	0.0372	0.00016	23.61
May-07	1878682	1925091	0.0369	0.0369	0.00016	22.48

June-07	1800721	1886847	0.0371	0.0368	0.00016	21.81
July-07	1808633	1946305	0.0370	0.0369	0.00016	22.19
August-07	2059733	2105829	0.0369	0.0367	0.00016	24.55
September-07	1830756	1426510	0.0367	0.0367	0.00016	19.11
October-07	1435466	1586849	0.0369	0.0368	0.00016	17.83
November-07	1458166	1609563	0.0368	0.0367	0.00016	18.05
December-07	1381403	1670521	0.0367	0.0370	0.00016	18.00
Sub-Total	**21944368**	**22260909**				**261.28**
January-08	1486094	1541112	0.0373	0.0373	0.00016	18.06
February-08	1646580	1598093	0.0370	0.0373	0.00016	19.30
March-08	1845930	1945768	0.0371	0.0371	0.00016	22.49
April-08	1770250	1741747	0.0373	0.0369	0.00016	20.85
May-08	1477908	1374726	0.0366	0.0362	0.00016	16.62
June-08	1385998	1361458	0.0366	0.0369	0.00016	16.14
July-08	1197386	2091686	0.0367	0.0368	0.00016	19.35
August-08	1965090	2061698	0.0368	0.0369	0.00016	23.76
September-08	1795460	1439732	0.0367	0.0367	0.00016	19.01
October-08	1853279	1963136	0.0368	0.0367	0.00016	22.46
November-08	1706479	1530239	0.0367	0.0367	0.00016	19.01
December-08	1652342	1940624	0.0366	0.0368	0.00016	21.09
Sub-Total	**19782796**	**20590019**				**238.13**
January-09	1900278	1625394	0.0367	0.0367	0.00016	20.71
February-09	1406499	1249791	0.0366	0.0367	0.00016	15.57
March-09	1451610	1567444	0.0367	0.0368	0.00016	17.75
April-09	1700224	1456665	0.0368	0.0368	0.00016	18.59
May-09	1439468	1861723	0.0369	0.0369	0.00016	19.47
June-09	1549844	1491436	0.0368	0.0368	0.00016	17.90
July-09	1443397	1435388	0.0368	0.0370	0.00016	16.99
August-09	1409897	1978024	0.0368	0.0367	0.00016	19.93
September-09	1513829	1529321	0.0369	0.0369	0.00016	17.97
October-09	1585334	1619779	0.0366	0.0368	0.00016	18.81
November-09	1739219	1635833	0.0367	0.0370	0.00016	19.90
December-09	1504648	1726646	0.0367	0.0365	0.00016	18.91
Sub-Total	**18644247**	**19177444**				**222.51**
Total	**78706623**	**80270904**				**937.19**

Fugitive Methane Emissions in the Baseline Scenario:				*Net Fugitive Emissions*	
Month	**Net Electricity Generation**	**Emission factor for upstream methane emissions in the baseline scenario**	**Fugitive Emissions in the Baseline Scenario**	**Global warming potential of Methane**	**Net Fugitive Emissions increase due to the the project activity**
		$EF_{BL,upstream,CH4}$		GWP_{CH4}	$LE_{CH4,y}$
	MWh	tCH_4/MWh	tCH_4		tCO_2
April-06	17026.583	0.000583	9.9315	21	283.99
May-06	17804.656	0.000583	10.3853	21	294.05
June-06	17315.019	0.000583	10.0997	21	286.55
July-06	17178.019	0.000583	10.0198	21	283.62
August-06	18184.367	0.000583	10.6068	21	304.04
September-06	17710.074	0.000583	10.3301	21	302.50
October-06	17079.630	0.000583	9.9624	21	290.40
November-06	17258.715	0.000583	10.0669	21	293.84
December-06	16411.077	0.000583	9.5724	21	271.05
Sub-Total	**155968.140**		**90.97**		**2611**
January-07	18746.678	0.000583	10.9348	21	311.27
February-07	16322.669	0.000583	9.5209	21	271.91
March-07	18316.752	0.000583	10.6840	21	309.63
April-07	16799.703	0.000583	9.7991	21	290.03
May-07	15660.166	0.000583	9.1344	21	280.21
June-07	15410.351	0.000583	8.9887	21	269.24
July-07	15393.015	0.000583	8.9786	21	277.43
August-07	17470.995	0.000583	10.1907	21	301.53
September-07	13474.116	0.000583	7.8593	21	236.31
October-07	12715.028	0.000583	7.4166	21	218.59
November-07	13053.102	0.000583	7.6138	21	219.07
December-07	12935.656	0.000583	7.5453	21	219.64
Sub-Total	**186298.231**		**108.67**		**3205**
January-08	12810.868	0.000583	7.4725	21	222.25
February-08	13596.144	0.000583	7.9305	21	238.68
March-08	15909.506	0.000583	9.2799	21	277.39
April-08	14624.116	0.000583	8.5301	21	258.66
May-08	11508.933	0.000583	6.7131	21	208.08
June-08	11425.574	0.000583	6.6644	21	199.02

July-08	13752.148	0.000583	8.0215	21	237.86
August-08	16819.069	0.000583	9.8104	21	293.03
September-08	13515.275	0.000583	7.8833	21	233.76
October-08	15853.252	0.000583	9.2471	21	277.42
November-08	13364.257	0.000583	7.7953	21	235.42
December-08	14804.362	0.000583	8.6353	21	261.58
Sub-Total	**167983.504**		**97.98**		**2944**
January-09	14804.221	0.000583	8.6352	21	253.54
February-09	11121.666	0.000583	6.4872	21	190.78
March-09	12686.202	0.000583	7.3998	21	217.45
April-09	12926.552	0.000583	7.5399	21	232.01
May-09	13765.228	0.000583	8.0291	21	240.34
June-09	12475.098	0.000583	7.2766	21	223.10
July-09	11932.793	0.000583	6.9603	21	210.71
August-09	14095.479	0.000583	8.2218	21	245.81
September-09	12465.974	0.000583	7.2713	21	224.72
October-09	13252.085	0.000583	7.7298	21	232.59
November-09	13965.936	0.000583	8.1462	21	246.92
December-09	13398.206	0.000583	7.8151	21	233.05
Sub-Total	**156889.440**		**91.51**		**2752**
Total	**667139**				**11512**

EMISSION REDUCTIONS

To calculate the emission reductions, the following equation has been applied:
$ER_y = BE_y – PE_y – LE_y$

Month	Baseline Emissions	Project Emissions	Leakage	Emission Reductions
	BE_y	PE_y	LE_y	ER_y
	tCO_2e	tCO_2e	tCO_2e	tCO_2e
April-06	13926.44	8223.80	283.99	5418.00
May-06	14562.84	8550.99	294.05	5717.00
June-06	14162.36	8325.59	286.55	5550.00
July-06	14050.30	8248.63	283.62	5518.00
August-06	14873.42	8795.36	304.04	5774.00
September-06	14485.48	8672.63	302.50	5510.00
October-06	13969.83	8341.66	290.40	5337.00
November-06	14116.30	8435.69	293.84	5386.00
December-06	13423.00	7881.89	271.05	5270.00
Sub-Total	**127569**	**75477**	**2611**	**49481**
January-07	15333.34	9031.07	311.27	5991.00
February-07	13350.69	7878.15	271.91	5200.00
March-07	14981.70	8915.79	309.63	5756.00
April-07	13740.87	8278.22	290.03	5172.00
May-07	12808.81	7881.26	280.21	4647.00
June-07	12604.48	7646.98	269.24	4688.00
July-07	12590.30	7780.14	277.43	4532.00
August-07	14289.93	8607.56	301.53	5380.00
September-07	11020.79	6701.16	236.31	4083.00
October-07	10399.92	6250.07	218.59	3931.00
November-07	10676.44	6327.23	219.07	4130.00
December-07	10580.37	6312.83	219.64	4047.00
Sub-Total	**152377**	**91611**	**3205**	**57561**
January-08	10478.31	6330.78	222.25	3925.00
February-08	11120.60	6765.78	238.68	4116.00
March-08	13012.75	7885.17	277.39	4850.00
April-08	11961.40	7309.59	258.66	4393.00

May-08	9413.42	5828.03	208.08	3377.00
June-08	9345.24	5659.61	199.02	3486.00
July-08	11248.20	6783.90	237.86	4226.00
August-08	13756.71	8332.37	293.03	5131.00
September-08	11054.46	6667.13	233.76	4153.00
October-08	12966.74	7874.23	277.42	4815.00
November-08	10930.94	6663.91	235.42	4031.00
December-08	12108.83	7395.12	261.58	4452.00
Sub-Total	**137397**	**83496**	**2944**	**50957**
January-09	12108.72	7260.93	253.54	4594.00
February-09	9096.67	5459.89	190.78	3445.00
March-09	10376.34	6225.10	217.45	3933.00
April-09	10572.93	6517.45	232.01	3823.00
May-09	11258.90	6828.03	240.34	4190.00
June-09	10203.67	6276.27	223.10	3704.00
July-09	9760.11	5958.49	210.71	3590.00
August-09	11529.02	6986.83	245.81	4296.00
September-09	10196.21	6301.55	224.72	3669.00
October-09	10839.19	6593.75	232.59	4012.00
November-09	11423.06	6978.92	246.92	4197.00
December-09	10958.70	6631.28	233.05	4094.00
Sub-Total	**128323**	**78019**	**2752**	**47552**
Total	**545666**	**328603**	**11512**	**205551**

Baseline emissions = 5,45,666 tCO_2e
Project emissions = 3,28,603 tCO_2e
Leakage = 11,512 tCO_2e
Emission Reductions = 2,05,551 tCO_2e

The net emission reductions by the project activity during the monitoring period from 1 April 2006 to 31 December 2009 = **2,05,551tCO_2e,**

E.5. Comparison of actual emission reductions with estimates in the VCS-PD

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Item	Values applied in ex-ante calculation of the registered VCS-PD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)	**43,418**	**April 2006 – December 2006: 49,481** **January 2007 – December 2007: 57,561** **January 2008 – December 2008: 50,957** **January 2009 – December 2009: 47,552**

E.6. Remarks on difference from estimated value in the PDD

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As per the registered PD the estimated VERs per annum are 43,418 tCO_2e. As per the table presented above in section E.5, there is an increase in VERs.

Reason: The estimated PLF considered during validation was 87.82% (as per CERC norms). However, the actual PLF achieved during the monitoring period (on an average) works out to be 73.38%. The PLF achieved by the project activity each year is detailed below:

Period	Gross electricity generation (GWh)	PLF
Apr 06 - Dec 06	157207.442	90.95%
Jan 07 - Dec 07	187861.184	81.88%
Jan 08 - Dec 08	170030.9062	74.11%
Jan 09 - Dec 09	158308.854	69.00%
Entire Monitoring Period: Apr 06 - Dec 09	673408.3862	**73.38%**

As per page 5 of the applied methodology, AM0029, version 1.1, the emission factor used to calculate the emission reductions should be determined ex-post if build margin (BM) of combined margin (CM) are selected. The ex-ante value of the emission factor is 0.71 tCO_2/MWh while the emission factor calculated ex-post for this monitoring period is 0.8179 tCO_2/MWh, a higher value, This increase in the value of the emission factor is one of the reasons why there is an increase in the emission reductions than that determined ex-ante in the registered PD.

To achieve a PLF of 87.82%, the quantity of natural gas consumed in the project activity was calculated ex-ante as 46.96 Million SCM. Considering the actual PLF achieved by the project activity during the monitoring period, the quantity of natural gas consumed by the project activity was:

Period	Natural gas consumption (Million SCM)
Apr 06 - Dec 06	36.5777
Jan 07 - Dec 07	44.2053
Jan 08 - Dec 08	40.3728
Jan 09 - Dec 09	37.8217

This reduction in the quantity of natural gas consumption caused a reduction in the quantity of project emissions and leakage emissions.

As a result of an increase in the baseline emissions, reduction in the project and leakage emissions, there was an increase observed in the quantum of emission reductions.

Annex 1

Aux	Auxiliary
BM	Build Margin
CEA	Central Electricity Authority
CH_4	Methane
CM	Combined Margin
CO_2	Carbon dioxide
DOE	Designated Operational Entity
GAIL	Gas Authority of India Limited
GE	Gas Engine
GHG	Greenhouse Gas
GJ	Giga Joule
GWP	Global Warming Potential
IC	Internal Combustion
IPCC	Inter-governmental Panel on Climate Change
kCal	Kilo calories
kW	Kilo Watt
kWh	Kilo Watt hour
MW	Mega Watt
MWh	Mega Watt hour
NCV	Net Calorific Value
NG	Natural Gas
OM	Operating Margin
PD	Project Document
QA/QC	Quality Assurance/Quality Control
SCM	Standard Cubic Meter
tCH_4	Tonnes of methane
tCO_2e	Tonnes of carbon dioxide equivalent
TNEB	Tamil Nadu Electricity Board
VCS	Voluntary Carbon Standard
VERs	Verified Emission Reductions
VGTPP	Valathur Gas Turbine Power Plant