Monitoring report form for CDM project activity

(Version 06.0)

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT		
Title of the project activity	Grid connected natural gas based power project in Raigad District, Maharastra, India	
UNFCCC reference number of the project activity	9124	
Version number of the PDD applicable to this monitoring report	Version 6.0 dated 4th June 2015	
Version number of this monitoring report	Version 1.0	
Completion date of this monitoring report	14th April 2018	
Monitoring period number	1	
Duration of this monitoring period	1st July 2016 to 28th February 2018	
Monitoring report number for this monitoring report	1 of 1	
Project participants	Pioneer Gas Power Limited (PGPL)	
Host Party	India	
Sectoral scopes	1- Energy industries (renewable - / non-renewable sources)	
Applied methodologies and standardized baselines	Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas, AM0029 Version 3.0	
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013
	0 tCO2e	115,041 tCO2e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	884,568[1] tCO2e	

[1] Estimated Emission reduction as per registered PDD =1,328,673 tCO2e per 365 days

Number of days in this monitoring period = 243 days

Estimated emission reduction = 884,568 tCO2e per 243 days

SECTION A. Description of project activity

A.1. General description of project activity

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The Project activity comprises of green field, natural gas fired 388 MW Combined Cycle Gas Turbine (CCGT) Technology power generation plant, developed by Pioneer Gas Power Limited (hereinafter-called PGPL) in Raigad District, Maharashtra, India. Electricity generated by the project activity is evacuated to the NEWNE region grid (project boundary) through the High-voltage transmission network. In the absence of the project activity, the same amount of electricity would have been generated by the coal-based power plants, which leads to more GHG emissions compared to the Natural gas based power generation, which is less carbon intensive fuel. Thus, the proposed project activity leads to the reduction of the greenhouse gases (GHGs).

A.2. Location of project activity

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The project activity is located at MIDC Ville-Bhagad, Mangaon Taluk, Raigad District, Maharashtra, India. Geographical coordinates: Latitude +73.35° and Longitude +18.36°

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (host Party)	Pioneer Gas Power Limited (Private)	No

A.4. Reference to applied methodologies and standardized baselines

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Title of the applied methodology: Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas AM0029 version 3.0 https://cdm.unfccc.int/methodologies/view?ref=AM0029

No standardised baseline was used for this project.

A.5. Crediting period type and duration

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1st July 2016 to 31 March 2026 (ten years)

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

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The project activity comprises of green field, natural gas fired 388 MW Combined Cycle Gas Turbine (CCGT) Technology power generation plant in Raigad District, Maharashtra, India. Electricity generated by the project activity is evacuated to the NEWNE region grid (project boundary) through the High-voltage transmission network. The proposed project activity is the natural gas based power plant of 388 MW capacity. This consists of One (Gas Turbine Generator) GTG, One Steam Turbine Generator (STG) and Heat Recovery Steam generator (HRSG).

The process involves Combined Cycle Power Plant (CCPP) in which the natural gas is combusted to generate high-pressure gas. The Gas Turbine Generator which in turn connected with the individual A.C. Generator by means of speed reduction gearbox which generates power of 259 MW. The GT exhaust is connected to the HRSG through suitable ducts. The HP Steam system supplies high pressure superheated steam from the superheater outlet of HRSG to the steam turbine. The LP steam system consists of superheated steam from the HRSG, which are combined together and admitted into the LP stage of steam turbine.

The Exhaust gas from the GTG at the temperature of 614°C passes through the HRSG to generate HP, IP and LP steam and the steam generated is allowed to pass through the Steam Turbine Generator coupled with the generator to generate power of 129 MW. The auxiliary steam requirements for steam turbine

auxiliaries such as gland sealing steam is catered from main steam line through suitable pressure reducing and de-superheating stations (PRDS). The exhaust from the HRSG is discharged to atmosphere at 60 m above local grade level through main stack.

The detailed technical specifications of the equipment is tabulated below

S. No	Equipment	Specifications
1.	Gas Turbine Generator (GTG)	→ Make & Type: GE- frame 9FA m/c, → Output: 259 MW, ISO Base Rating. → The GT exhaust temperature will be around 614°C.
2.	Heat Recovery Steam Generator (HRSG)	→ Unfired, Natural circulation, triple pressure type e.g. HP steam, IP Steam and LP steam. → HP steam generating capacity of 257.2 TPH at 144.7 ata & 567 °C , → IP steam of 305.2TPH, 22.71 ata, 566 °C and → LP steam of 29.86 TPH at 4.177 ata & 307 °C.
3.	Steam Turbine Generator (STG)	→ One (1) no. Multistage, single flow, condensing type steam turbine with injection steam and with a radial exhaust with a STG power output of 129 MW. The steam pressure and temperature at the HP stage inlet is 141.2 ata and 566 Deg C, IP stage inlet is 21.84 ata & 566 deg C and LP stage inlet is 3.854 ata & 305 Deg C.

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies or standardized baselines

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No such deviation for this monitoring period.

B.2.2. Corrections

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No correction in this monitoring period.

B.2.3. Changes to the start date of the crediting period

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The focal of PP has requested the CDM Secretariat for postpone of crediting period from 1st April 2016 to 1st July 2016 on 22nd February 2018 through an email. The same was accepted on 23rd February 2018.

B.2.4. Inclusion of monitoring plan

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Not applicable.

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other applied standards or tools

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No such change.

B.2.6. Changes to project design

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No such change.

SECTION C. Description of monitoring system

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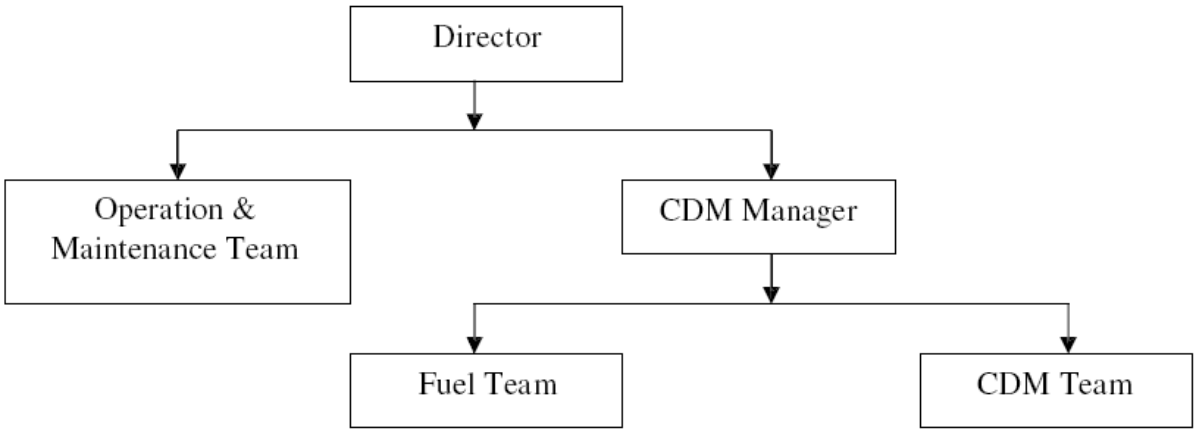
1. The Monitoring plan

The monitoring plan describes management systems and procedures implemented by PGPL in order to ensure consistent project operation as well as monitoring, processing and reporting of data required for the

calculation of emission reductions (ERs) taking into account the methodology AM0029 requirement and the guidance presented in the Validation and Verification Standards.

2. Description of organizational structures & procedures for collection, processing, review, storage and reporting of data

The organization structure and responsibility matrix for this CDM project activity is as below:
CDM Organization Structure:



CDM Manager is vested with the power to direct the O&M team, and fuel team, CDM team to:

a) Provide all information/data required for this monitoring plan
b) Comply with all the requirements as per the Project Design Document and Monitoring Plan.
c) Adherence to the laid down protocols, procedures and processes, in relation to CDM project activity, by the aforesaid O & M team, fuel team and the CDM team
d) Refer all conflicts, discrepancies, mistakes etc in relation to the Monitoring Plan of the CDM project activity, to the CDM manager for resolution, whose resolution in this regard shall be final and binding on the aforesaid teams. The O&M team is headed by the Head, O & M and the Fuel team is headed by the Fuel Manager.

3. CDM Responsibility Matrix:

S. No	Designation	Responsibilities
1.	Director	Implement the organization structure. Issue office orders, authorizing the CDM Manager to implement the Monitoring plan and delegating to him all powers in relation thereto.
2.	CDM Manager	Direct the O& M team, fuel team, CDM team in relation to conformance with PDD and monitoring plan Storage of aggregated data. Coordinate with DOE during verification process. Monitor raw data in relation to Build Margin, Oxidation factor and where national institutions data / AM0029 default data are involved. Independently check the authenticity of data and take corrective actions wherever required. Resolve all conflicts in relation to CDM project activity. Calculate ER and submit them to DOE. Implement the Monitoring Plan
3.	O & M Team	Calibrate the identified monitoring equipment and maintain data. Monitor raw data as per enclosed task
4.	CDM Team	Data review, data processing and aggregation, Monitoring plan, Report non-conformances with PDD, and CDM manager's directions
5.	Fuel Manager	Monitor raw data as per enclosed task

The following table provides detailed information on the organizational structures & procedures for collection, processing, review, storage and reporting of data during operation of the project activity.

Table : Organizational Structures and Procedures for Monitoring, Processing, Review, Storage, and Transfer

Parameters		Project Emissions			Baseline Emissions
		FC $NG_{,y}$	**NCV $NG_{,y}$**		**EG_y**
Monitoring of raw data	Responsible person at PGPL	Head O&M	Fuel Manager		Head O&M
	Data source	Flow meter	Fuel supplier(s) / transporter(s)		Electricity meters
	Frequency of data collection	Daily	Fortnightly		Hourly measurement, monthly recording
	Data format	Electronic	Electronic		Electronic
Data processing	Procedures of maintenance and calibration of monitoring equipment	As per calibration and maintenance protocol	N/A		As per calibration and maintenance protocol
	Responsible person at PGPL	CDM Team			
	Description of procedure	Consistency check, validation and recording			
	Frequency of processing	Daily	Monthly		Daily
Data review Monthly/yearly aggregation of data	Responsible person at PGPL	CDM Team			
Storage of data	Responsible person at PGPL	CDM Manager			
	Frequency of storage	Monthly			
	Duration of storage	Data will be archived for crediting period + 2 years			

Electricity generation at the project activity (CCPP) is at 15.75 kV which is then stepped-up to 200kV, before power evacuation is done at the sub station level through two nos double circuit transmission lines. Grid interfacing is done through 15.75/200kV, using generator step-up transformers located at the plant premises. Metering arrangements are in place to measure the electricity supplied, through the 200kV transmission line, to the NEWNE grid from PGPL switch yard.

The electricity generation by power station for supply and the fuel consumption are measured by electricity meter and flow meter respectively. Following guidelines is followed for the A) Data Monitoring B) Calibration and maintenance and C) Verification of monitoring results.

A) Data Monitoring

The data that is monitored include:

a) Monitoring of electricity generated by the project: The electricity generated by the project is monitored through energy meter at the plant. The data is also monitored and recorded at the on-site control center using a computer system.
There is a main metering system and backup metering system with accuracy class of 0.2 Calibration test records is maintained for verification.

b) Monitoring of quantity of gas combusted: Quantity of gas (including LNG if used) combusted is monitored through metering equipments. Detailed monitoring procedure of quantity of gas combusted by the project is established in accordance with the agreements with the gas suppliers and gas transporter. Calibration test records is maintained for verification.

c) Monitoring of NCV: The NCV of gas is used in the calculation of CO_2 emission coefficient.
Hence the NCV of gas from the fuel supplier is maintained.

B) Calibration and Maintenance

The detailed calibration, testing and maintenance procedures for all the identified monitoring instrument is prepared by the CDM Manager based on the agreements with the fuel supplier(s), equipment manufacturer's recommendations and the industry /national standards as applicable.

C) Verification of Monitoring Results

The verification of the monitoring results of the project is mandatory process required for all CDM projects.
The responsibilities for verification of the project are as follows:

- The CDM Manager arranges for the verification and prepares for the audit and verification process.
- The CDM Manager facilitates the verification process by providing the DOE with all required necessary information.

Organizational structures & procedures during project implementation

Before the start of the crediting period the CDM Manager develops the following protocols whose functions are described below, based upon the organizational structures & procedures described in this MP.

Data handling protocol

The establishment of a transparent system for the collection, computation and storage of data, including adequate record keeping and data monitoring systems is required. It is the CDM Manager's responsibility with the assistance of CDM team to ensure implementation of a protocol that provides for these critical functions and processes. For electronic -based and paper-based data entry and recording systems, there is clarity in terms of the procedures and protocols for collection and entry of data, usage of the spreadsheets and any assumptions made, so that compliance with requirements can be assessed by the DOE.
Stand-by processes and systems, e.g. paper-based systems, must be outlined and used in the event of, and to provide for, the possibility of systems failures.

Training protocol

It is the CDM Manager's responsibility to ensure that the required capacity and internal training is made available to assigned staff, to enable them to undertake the tasks required by this MP. All staff involved in any of the procedures are trained before the start of the crediting period in order to perform the tasks specified in this MP. For this purpose a training protocol is prepared.

Calibration and maintenance protocol

It is the CDM Manager's responsibility to ensure that the calibration and maintenance procedures for all measurement instruments relevant for monitoring the parameters included in this MP are followed. A calibration and maintenance protocol will be established for this purpose which will be prepared by the CDM manager based on the agreements with the fuel supplier(s), equipment manufacturer's recommendations and the applicable industry / national standards.

Data review protocol

It is the CDM Manager's responsibility to prepare a data review protocol that in case of failure of an instrument, or inconsistency of the data, enables staff to adjust the data according to the procedures outlined in this protocol. The data review protocol includes procedures for emergency preparedness for cases where emergencies can cause unintended emissions.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

(Copy this table for each data or parameter.)

Data/Parameter	$EF_{BM,y}$
Unit	tCO2e/GWh
Description	Build Margin Emission Factor of NEWNE Grid

Source of data	"CO2 Baseline Database for the Indian Power Sector" Version 7.0, January 2012, published by the Central Electricity Authority, Ministry of Power, Government of India. http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm
Value(s) applied	858.78
Choice of data or measurement methods and procedures	CO2 Baseline Database is a publicly available national data, with high level of reliability.
Purpose of data/parameter	To calculate the baseline emissions
Additional comments	-

Data/Parameter	$EF_{OM,y}$
Unit	tCO2e/GWh
Description	Operting Margin Emission Factor of NEWNE Grid
Source of data	"CO2 Baseline Database for the Indian Power Sector" Version 7.0, January 2012, published by the Central Electricity Authority, Ministry of Power, Government of India. http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm
Value(s) applied	997.27
Choice of data or measurement methods and procedures	CO2 Baseline Database is a publicly available national data, with high level of reliability.
Purpose of data/parameter	To calculate the baseline emissions
Additional comments	-

Data/Parameter	NCV_{coal}
Unit	kCal/ Kg
Description	Net calorific value of coal
Source of data	"CO2 Baseline Database for the Indian Power Sector" Version 7.0, January 2012, published by the Central Electricity Authority, Ministry of Power, Government of India. http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm
Value(s) applied	3624.52 (GCV to NCV conversion done – 3755 kCal/kg /1.036)
Choice of data or measurement methods and procedures	CO2 Baseline Database is a publicly available national data, with high level of reliability.
Purpose of data/parameter	To calculate the baseline emissions
Additional comments	-

Data/Parameter	$EF_{CO2,coal}$
Unit	tCO2/TJ
Description	Carbon di oxide emission factor of coal.
Source of data	"CO2 Baseline Database for the Indian Power Sector" Version 7.0, January 2012, published by the Central Electricity Authority, Ministry of Power, Government of India. http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm
Value(s) applied	95.8
Choice of data or measurement methods and procedures	CO2 Baseline Database is a publicly available national data, with high level of reliability.
Purpose of data/parameter	To calculate the baseline emissions
Additional comments	-

Data/Parameter	$OXID_{coal}$
Unit	-
Description	Oxidation Factor of Coal
Source of data	"CO2 Baseline Database for the Indian Power Sector" Version 7.0, January 2012, published by the Central Electricity Authority, Ministry of Power, Government of India. http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm
Value(s) applied	0.98
Choice of data or measurement methods and procedures	CO2 Baseline Database is a publicly available national data, with high level of reliability.
Purpose of data/parameter	To calculate the baseline emission
Additional comments	-

Data/Parameter	η_{BL}
Unit	%
Description	Power plant efficiency of the most likely baseline scenario technology. Energy efficiency of coal fired power plant which has been identified as the baseline scenario. It is assumed that baseline plant would be 500 MW sub critical power plant based on Indigenous sub Bituminous coal or imported coal.
Source of data	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 for non-coking coal pit-head power generation. www.cercind.gov.in
Value(s) applied	37.78 %
Choice of data or measurement methods and procedures	Central Electricity Regulatory Commission is Government of India undertaking, mandated to publish information on performance of power sector in India by the Indian Electricity Act 2003.
Purpose of data/parameter	To estimate the baseline emissions
Additional comments	-

Data/Parameter	$EF_{NG, upstream, CH4}$
Unit	t CH4 / GJ
Description	Emission factor for upstream fugitive methane emissions of natural gas from production, processing, transportation & distribution, and, in the case of LNG, liquefaction, transportation, re-gasification and compression into a transmission or distribution system.
Source of data	Table- 2 of AM0029 version 3.0
Value(s) applied	0.00016
Choice of data or measurement methods and procedures	USA and Canada values have been used. Justification is given in Appendix 4.
Purpose of data/parameter	To estimate the leakage emissions
Additional comments	-

D.2. Data and parameters monitored

(Copy this table for each data or parameter.)

Data/Parameter	$EF_{BM,y}$
Unit	tCO2e/GWh
Description	Build Margin Emission Factor of NEWNE Grid
Measured/calculated/ default	Calculated

Source of data	"CO2 Baseline Database for the Indian Power Sector" Version 11.0, published by the Central Electricity Authority, Ministry of Power, Government of India. CO2 Baseline Database is a publicly available national data, with high level of reliability.
Value(s) of monitored parameter	930
Monitoring equipment	The parameter is calculated based on officially published national data, it will be updated as per the latest 'CO2 Baseline Database for the Indian Power Sector' available on year to year basis.
Measuring/reading/recording frequency	Every year
Calculation method (if applicable)	To estimate the baseline emissions
QA/QC procedures	No additional QA/QC procedures planned.
Purpose of data/parameter	For the calculation of baseline emissions
Additional comments	Data will be archived for crediting period + 2 years

Data/Parameter	$FC_{f,y}$
Unit	m^3
Description	Quantity of Natural Gas combusted in the project plant for the year, y
Measured/calculated/ default	Measured
Source of data	Data type*:* Measured Data Archival: Paper & Electronic Monitoring procedure and responsibility: Flow meter will be used in monitoring of this parameter. The total fuel consumption will be monitored both at supplier and project end for cross verification and measured in standard cubic meters. CDM Manager will have the overall responsibility for monitoring of this parameter Calibration Procedures and frequency: In accordance with stipulation of the meter supplier
Value(s) of monitored parameter	53,584,410.36
Monitoring equipment	Fuel flow meter reading at the project boundary.
Measuring/reading/recording frequency	Recording Frequency: continuous monitoring, recorded daily and reported monthly
Calculation method (if applicable)	NA
QA/QC procedures	Calibration Procedures: In accordance with stipulation of the meter supplier Calibration frequency: Once in every 5 years from the date of installation of the meter Quantity of natural gas consumed by the project activity is cross-checked with the invoices raised by the fuel supplier.
Purpose of data/parameter	For the calculation of project emissions
Additional comments	Data will be archived for crediting period + 2 years.

Data/Parameter	$FC_{LNG,y}$
Unit	m^3
Description	Quantity of LNG combusted in the project plant for the year, y
Measured/calculated/ default	Measured

Source of data	Data type*:* Measured Data Archival: Paper & Electronic Monitoring procedure and responsibility: Flow meter will be used in monitoring of this parameter. The total fuel consumption will be monitored both at supplier and project end for cross verification and measured in standard cubic meters. CDM Manager will have the overall responsibility of monitoring this parameter.
Value(s) of monitored parameter	0
Monitoring equipment	Fuel flow meter reading at the project boundary.
Measuring/reading/recording frequency	Recording Frequency: continuous monitoring, recorded daily and reported monthly
Calculation method (if applicable)	NA
QA/QC procedures	Quantity of natural gas consumed by the project activity will be cross-verified with the invoices raised by the fuel supplier. Calibration Procedures: In accordance with stipulation of the meter supplier Calibration frequency: Once in every 5 years from the date of installation of the meter
Purpose of data/parameter	For the calculation of project emissions
Additional comments	Data will be archived for crediting period + 2 years

Data/Parameter	NCV_f
Unit	$kCal/m^3$
Description	Net calorific value of natural gas
Measured/calculated/ default	-
Source of data	Data from fuel supplier will be used Data type: Estimated Data Archival: Electronic & Paper Monitoring procedure and responsibility: The calorific value will be taken from the supplier regularly. CDM Manager will have the overall responsibility of monitoring this parameter. Proportion of data monitored: 100%
Value(s) of monitored parameter	9090.91
Monitoring equipment	Data from fuel supplier
Measuring/reading/recording frequency	Recording Frequency: Monitored and recorded fortnightly and reported monthly
Calculation method (if applicable)	NA
QA/QC procedures	No additional QA/QC procedures planned Calibration Procedures: Not Applicable Calibration Frequency: Not Applicable
Purpose of data/parameter	For the calculation of project emissions
Additional comments	Data will be archived for crediting period + 2 years

Data/Parameter	$EG_{PJ,y}$
Unit	GWh
Description	Net electricity generation in the project plant (delivered to the grid) during the year y.
Measured/calculated/ default	Measured & calculated

Source of data	Main and check meters are installed at all the outgoing lines as per the applicable regulatory requirement. Data Archiving Policy: Paper & Electronic Monitoring procedure and responsibility: Energy meter is used for monitoring of this parameter. The accuracy class of this meter will be 0.2s. CDM Manager will have the overall responsibility of monitoring this parameter. Proportion of data monitored: 100%
Value(s) of monitored parameter	246,647.93
Monitoring equipment	Data measured and recorded from Energy meters installed in the plant complying with the regulatory requirement.
Measuring/reading/recording frequency	Recording Frequency: continuous monitoring, recorded daily and reported monthly
Calculation method (if applicable)	-
QA/QC procedures	Calibration Procedures: As per (Govt / regulatory authority) regulations. Calibration Frequency: Once in every 5 years from the date of installation of the meter The value is crossed verified with the receipts raised by the power distribution company. .
Purpose of data/parameter	To estimate the baseline emissions
Additional comments	Data will be archived for crediting period + 2 years

Data/Parameter	$EF_{CO2,f,y}$
Unit	tCO2/TJ
Description	CO2 Emission Factor of Natural Gas
Measured/calculated/ default	Data type: Estimated Data Archiving Policy: Paper & Electronic Responsibility: CDM Manager will have the overall responsibility for monitoring of this parameter. Proportion of data monitored: 100%
Source of data	Table 1.4, Chapter 1, Volume 2, 2006 IPCC Guidelines for National Greenhouse Gas Inventories. This is also in conformity with the recommendations of the GHG inventory information report submitted by India's Initial National Communication (Chapter 2)
Value(s) of monitored parameter	56.1
Monitoring equipment	-
Measuring/reading/recording frequency	Recording Frequency: Recorded annually The emission factor will be updated as per the latest IPCC information on national greenhouse gas inventory available on year to year basis.
Calculation method (if applicable)	-
QA/QC procedures	No additional QA/QC procedures may need to be planned Calibration Procedures: Not Applicable Calibration Frequency: Not Applicable
Purpose of data/parameter	To estimate the project emissions
Additional comments	Data will be archived for crediting period + 2 years

Data/Parameter	$OXID_f$
Unit	-
Description	Oxidation Factor of Natural Gas

Measured/calculated/ default	Data type: Estimated Data Archiving Policy: Paper & Electronic Responsibility: CDM Manager will have the overall responsibility for monitoring of this parameter. Proportion of data monitored: 100%
Source of data	Default values as per Table 1.6 Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual has been considered. This is also in conformity with the recommendations of the GHG inventory information report submitted by India's Initial National Communication (Chapter 2)
Value(s) of monitored parameter	1.0
Monitoring equipment	-
Measuring/reading/recording frequency	Recording Frequency: Recorded annually The Oxidation factor will be updated as per the latest IPCC information on national greenhouse gas inventory available on year to year basis.
Calculation method (if applicable)	-
QA/QC procedures	No additional QA/QC procedures is planned Calibration Procedures: Not Applicable Calibration Frequency: Not Applicable
Purpose of data/parameter	To estimate the project emissions
Additional comments	Data will be archived for crediting period + 2 years

D.3. Implementation of sampling plan

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No sampling is used as all data is measured.

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

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Baseline Emissions

As shown in the methodology AM0029, version 3, baseline emissions (tCO_2e/year) are given by:

$$BE_y = EG_{PJ,y} \times EF_{BL,CO2,y}$$

Where,

$EG_{PJ,y}$ - electricity generated by the power plant

$EF_{BL,CO2,y}$ - baseline carbon dioxide emission factor

According to methodology AM0029 / Version 03, there are uncertainties in the determination of an appropriate value of the baseline emission factor $EF_{BL,CO2}$. The methodology states in order to address this uncertainty in a conservative manner, project participants shall use for $EF_{BL,CO2,y}$ the lowest emission factor among the following three options:

For the first crediting period:

Option 1: The build margin, calculated according to "Tool to calculate emission factor for an electricity system"; and

Option 2: The combined margin, calculated according to "Tool to calculate emission factor for an electricity system", 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" and calculated as follows:

$$EF_{BL,CO2}\ (tCO2 / MWh) = COEF_{BL} / \eta_{BL} \times 3.6GJ / MWh$$

Where,

$COEF_{BL}$ - fuel emission coefficient (tCO_2e/GJ), based on national average fuel data, if available, otherwise IPCC defaults can be used

η_{BL} - energy efficiency of the technology, as estimated in the baseline scenario analysis

As demonstrated in the registered PDD, ex-post build margin (option 1) as per **CO_2 Baseline Database for the Indian Power Sector'** version 12.0 is taken as baseline carbon dioxide emission factor**.** The values are calculated as per procedures prescribed in the "Tool to calculate emission factor for an electricity system" by Central Electricity Authority (CEA). The database is an official publication of the Government of India for the purpose of CDM Baselines and is based on the most recent data available with CEA.

E.2. Calculation of project emissions or actual net removals

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The approved methodology AM0029, Version 03 "Methodology for Grid Connected Electricity Generation Plants using Natural Gas" has been applied to the proposed project activity.

Project Emissions (PE_y):

The project activity consists of on-site combustion of natural gas to generate electricity. Then, CO_2 emissions from electricity generation (PE_y) are calculated as follows using Eq. (1) of AM0029

$$PE_y = FC_{f,y} \times COEF_{f,y}$$

Where,

$FC_{f,y}$ -total volume of fuel 'f' natural gas or other fuel combusted in the project plant (m^3) in year y

$COEF_{f,y}$-CO_2 emission coefficient (tCO_2/m^3) in year y for fuel f (natural gas / other fuel)

The emission coefficients of natural gas / other fuel are calculated as follows:

$$COEF_{f,y} = NCV_{f,y} \times EF_{CO2,f,y} \times OXID_f$$

Where,

$NCV_{f,y}$ = is the net calorific value of fuel 'f' natural gas / other fuel (GJ/m^3), in year y, which is determined from the fuel supplier.

$EF_{CO2,f,y}$ = is the CO_2 emission factor per unit of energy of fuel f (natural gas / other fuel) in year y (tCO_2/GJ), which is taken from the IPCC data.

$OXID_f$ = is the oxidation factor of fuel f (natural gas / other fuel)

E.3. Calculation of leakage emissions

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Leakage

Leakage may result from fuel extraction, processing, liquefaction, transportation, regasification and distribution of fossil fuels outside of the project boundary. This includes mainly fugitive CH_4 emissions and CO_2 emissions from associated fuel combustion and flaring. In this methodology, the following leakage emission sources shall be considered:

- Fugitive CH4 emissions associated with fuel extraction, processing, liquefaction, transportation, re-gasification and distribution of natural gas used in the project plant and fossil fuels used in the grid in the absence of the project activity.
- In the case LNG is used in the project plant: CO_2 emissions from fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression into a natural gas transmission or distribution system.

Thus, leakage emissions are calculated as follows:

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

Where,

LE_y - Leakage emissions during the year y in tCO_2e.

$LE_{CH4,y}$ -Leakage emissions due to fugitive upstream CH_4 emissions in the year y in tCO_2e

$LE_{LNG,CO2,y}$ -Leakage emissions due to fossil fuel combustion/electricity consumption associated with liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system during the year y in t CO_2e.

Fugitive Methane Emissions ($LE_{CH4,y}$)

For the purpose of estimating fugitive CH_4 emissions, project participants should multiply the quantity of natural gas consumed by the project in year y with an emission factor for fugitive CH_4 emissions ($EF_{NG,upstream,CH4}$) from natural gas consumption and subtract the emissions occurring from fossil fuels used in the absence of the project activity, as follows:

$$LE_{CH\,4,\,y} = [FC_y \times NCV_y \times EF_{NG\,,upstream,\,CH\,4} - EG_{PJ\,,\,y} \times EF_{BL\,,upstream,\,CH\,4}] \times GWP_{CH4}$$

Where,

$LE_{CH4,y}$ -Leakage emissions due to fugitive upstream CH_4 emissions in the year y in tCO_2e
FC_y- Quantity of natural gas combusted in the project plant during the year y in m^3
$NCV_{,y}$- Average net calorific value of the natural gas combusted during the year y in GJ/m^3
$EF_{NG,upstream,CH4}$ - Emission factor for upstream fugitive methane emissions of natural gas from production, transportation, distribution and in the case of LNG, liquefaction, transportation, re-gasification and compression into a transmission or distribution system, in tCH_4 per GJ of fuel supplied to final consumers
$EG_{PJ,y}$- Electricity generation in the project plant during the year y in GWh.
$EF_{BL,upstream,CH4}$ - Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in tCH_4 per GWh electricity generation in the project plant, as defined below
GWP_{CH4} - Global warming potential of methane valid for the relevant commitment period

As per the applicable methodology, the emission factor for upstream fugitive CH_4 emissions occurring in the absence of the project activity $EF_{BL,upstream,CH4}$ should be calculated consistent with the baseline emission factor ($EF_{BL,\,CO2}$) used in equation (2) above. Since the option 1 'build margin' approach is used to calculate the emission factor ($EF_{BL,\,CO2}$), the $EF_{BL,upstream,CH4}$ is found using the following equation and it will be determined ex-post.

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

$EF_{BL,upstream,CH4}$ - Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in t CH_4 per MWh electricity generation in the project plant

j - Plants included in the build margin

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

$EF_{k,upstream,CH4}$ - Emission factor for upstream fugitive methane emissions from production of the fuel type k (a coal type) in t CH_4 per MJ fuel produced

EG_j - Electricity generation in the plant j included in the build margin in MWh/a

CO_2 emissions from LNG

Project activity does not use LNG in this monitoring period, so $LE_{LNG,CO2,y}$ is considered as 'zero'

$LE_{LNG,CO2,y} = FC_y * EF_{CO2,upstream,\,LNG}$

Where:
$LE_{LNG,CO2,y}$ -Leakage emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system during the year y in t CO2e
FCy -Quantity of natural gas combusted in the project plant during the year y in m^3
$EF_{CO2,upstream,LNG}$ - Emission factor for upstream CO2 emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system

Emission Reductions

To calculate the emission reductions the project participant shall apply the following equation:

$$ER_y = BE_y – PE_y – LE_y$$

Where,
ER_y -emissions reductions (tCO_2e)
BE_y -emissions in the baseline scenario (tCO_2e)
PE_y -emissions in the project scenario (tCO_2e)
LE_y -leakage emissions (tCO_2e)

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or baseline net GHG removals (t CO_2e)	Project GHG emissions or actual net GHG removals (t CO_2e)	Leakage GHG emissions (t CO_2e)	GHG emission reductions or net anthropogenic GHG removals (t CO_2e)		
				Before 01/01/2013	From 01/01/2013	Total amount
Total	229,382	114,341	0	0	115,041	115,041

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period (t CO_2e)	Amount estimated ex ante (t CO_2e)
115,041 tCO2e	884,568 tCO2e

E.6. Remarks on increase in achieved emission reductions

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Compared to the estimated value, emission reductions achieved is less, which is due to low PLF.

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Document information

Version	*Date*	*Description*
06.0	7 June 2017	Revision to: • Ensure consistency with version 01.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.

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