Monitoring report form for CDM project activity
(Version 06.0)

MONITORING REPORT		
Title of the project activity	Natural Gas based grid connected power project at Peddapuram, A.P. by Gautami Power Limited	
UNFCCC reference number of the project activity	4828[1]	
Version number of the PDD applicable to this monitoring report	06	
Version number of this monitoring report	01	
Completion date of this monitoring report	16/04/2018	
Monitoring period number	02	
Duration of this monitoring period	11/03/2012 to 10/02/2018 (both days included)	
Monitoring report number for this monitoring report	01	
Project participants	M/s GVK Gautami Power Limited	
Host Party	India	
Sectoral scopes	1 : Energy industries (renewable / non-renewable sources)	
Applied methodologies and standardized baselines	AM0029 ver. 3 - Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas	
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
	112,543 tCO_2e	468,937 tCO_2e
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	7,664,854 tCO_2e	

[1] http://cdm.unfccc.int/Projects/DB/SIRIM1305857412.14/view

SECTION A. Description of project activity

A.1. General description of project activity

The proposed project activity has commissioned the operation of a new, green field 469 MW Natural Gas fired, gas turbine based combined cycle power plant. The project activity has been installed by GVK Gautami Power Ltd. (GPL)[2] at Industrial Development Area, Peddapuram, near Samalkot in East Godavari district, Andhra Pradesh, India. The project activity uses relatively cleaner fuel, natural gas instead of most common fuel in the grid i.e. coal for power generation. Thus, the project activity will avoid significant emission compared to the usual practice in coal dominated Indian power sector.

Purpose of the project activity:

The purpose of the project activity is a 469 MW natural gas fired power plant. The project activity is less emission intensive compared with the common coal based power and average fuel mix in the grid. Thus, the project activity aims at reducing the GHG emission reduction by use of a relatively lesser GHG intensive fuel i.e. natural gas.

This being a green field project activity, the pre-project scenario is electricity generation using the current fuel mix in the grid.

Description of the technology applied in the project activity:

The power generation components of the project activity comprise of two gas turbine generators (GTG), two heat recovery steam generators (HRSG) and one steam turbine generator (STG). The turbine unit has annular type combustors. The combustion of air fuel mixture takes place in the combustors. The major components located in the auxiliary block are lubricating oil system with lube oil reservoirs and lube oil coolers.

The generators (210 MVA) are coupled to gas turbines and steam turbine. They deliver the power at 15.75 kV with 0.8 PF; 3 phase; 50 Hz at site ambient conditions of 29ºC and a relative humidity of 70%. The power generated at 15.75 kV is stepped-up to 400kV through step-up transformers. The step-up transformers are connected to project switchyard by overhead transmission lines. The 400kV project switchyard is connected to APTRANSCO's 400kV sub-station.

The details of the equipments are summarized in the table below.

S.N.	Equipment	Specifications
1	Gas turbine (GT)	Two (2) nos. Alstom Power make (Type- GT13E2) heavy duty industrial gas turbines equipped with the lean premix dry low NOx EV burners; holds 21-stages compressor and 5-stage turbine blades; **Capacity-** 2 x 152.438 MW at site conditions of 29 deg C, 70% RH and 50Hz frequency
2	Heat recovery steam generators (HRSG)	**Make -** ALSTOM Power, Triple Pressure **Capacity:** HP/ IP/ LP **Flow:** 56.95/ 11.1/ 9.7 kg/s **Temp:** 508.3/ 506/ 151.2 deg C **Pressure:** 96.35/ 24.6/ 4.8 bar
3	Steam turbine generator (STG)	ALSTOM Power, Triple Pressure Capacity- 164.235MW at site conditions of 29 deg C, 70% RH and 50Hz frequency

Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.)

Project Execution	Date

[2] GVK Gautami Power Ltd. is the new name of PP as per order dt. 08/09/2009 (letter from 'Registrar of Companies, Andhra Pradesh' submitted to DOE)

Step	
Commissioning	05/06/2009 (as per COD approval from Andhra Pradesh Power Coordination Committee)
Operation period	Project plant operated continuously without major shut down with routine maintenance in this monitoring period

Total GHG emission reduction:

The total GHG emission reduction achieved by the project activity in the current monitoring period is 581,480 tCO2e.

A.2. Location of project activity

State: Andhra Pradesh
Town: Industrial Development Area, Samalkot, East Godavari District

The 469 MW combined cycle power plant is located at Industrial Development Area, Samalkot, near the port town Kakinada, Andhra Pradesh. The site is 15 km from the sea port at Kakinada and 3 km from the Samalkot railway station. The geographical coordinates of the Samalkot are 17º03'03" N and 82º07'04" E.

(Source: www.mapsofindia.com)

Figure 1: Location of the project activity

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)	M/s GVK Gautami Power Limited (Private entity)	No

A.4. Reference to applied methodologies and standardized baselines

Title: "Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas"

Reference: Approved baseline methodology AM0029, Version 03, EB 39

Sectoral Scope: 01

Title: "Tool for the demonstration and assessment of additionality", Version 05.2, EB 39

Title: "Tool to calculate emission factor for an electricity system", Version 02.1, EB 50

A.5. Crediting period type and duration

Fixed crediting period of 10 years is chosen for project activity,

Crediting Period: 09/09/2011 – 08/09/2021

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

The power generation components of the project activity comprise of two gas turbine generators (GTG), two heat recovery steam generators (HRSG) and one steam turbine generator (STG). The combustion turbine module consists of a 21-stage compressor and 5-stage turbine. The turbine unit has annular type combustors. The combustion of air fuel mixture takes place in the combustors. The accessory module is mounted on a separate base frame and houses the mechanical and the control elements required for the combustion turbine operation. The major components located in the auxiliary block are lubricating oil system with lube oil reservoirs and lube oil coolers. The combustion turbine is started by operating the generator as a variable speed motor. The variable frequency power required for this purpose is generated by the static frequency converter system from station auxiliary power systems (only during start up). This electricity usage is accounted in the total auxiliary consumption for calculation of net export. The combustion turbine is a single shaft machine with the compressor and turbine installed in a single casing.

The heat recovery steam generator (HRSG) is a triple pressure, unfired, horizontal gas flow type with internal thermal insulation, platforms and ladders. Feed water and steam sampling arrangements are provided as required. The water circulation through the evaporator is by means of natural circulation set up by thermos symphonic action. Steam from HRSG is supplied to a condensing type non-reheat steam turbine through steam piping.

The steam turbine generator (STG) is triple pressure condensing type. The steam entry to the turbine is through the emergency stop and control valves, which govern the speed/ load on the machine. The turbine control system is electro-hydraulic type. The STG is complete with lube oil and control oil system, governing system, protection system and gland sealing steam system. The turbine is provided with low speed barring gear, which rotates the coupled shaft. The turbine is also provided with a rotor jacking oil system. The steam turbine has a condenser for condensing the exhaust steam from the steam turbine.

The generators (210 MVA) are coupled to gas turbines and steam turbine. They deliver the power at 15.75 kV with 0.8 PF; 3 phase; 50 Hz at site ambient conditions of 29ºC and a relative humidity of 70%. In absence of the project activity, this electricity would have been generated with the current fuel mix in the carbon intensive grid. As derived in the Section B.4, the project proponent could have opted for a coal based power plant, which is used as a baseline for the project activity emission reduction calculations here. CO2 is considered as the major emission source in both the baseline and project activity. Leakage and project activity emissions are due to fugitive emissions from extraction to distribution of NG.

The details of the equipments used in the project activity are given in the Section A.1 above in this document.

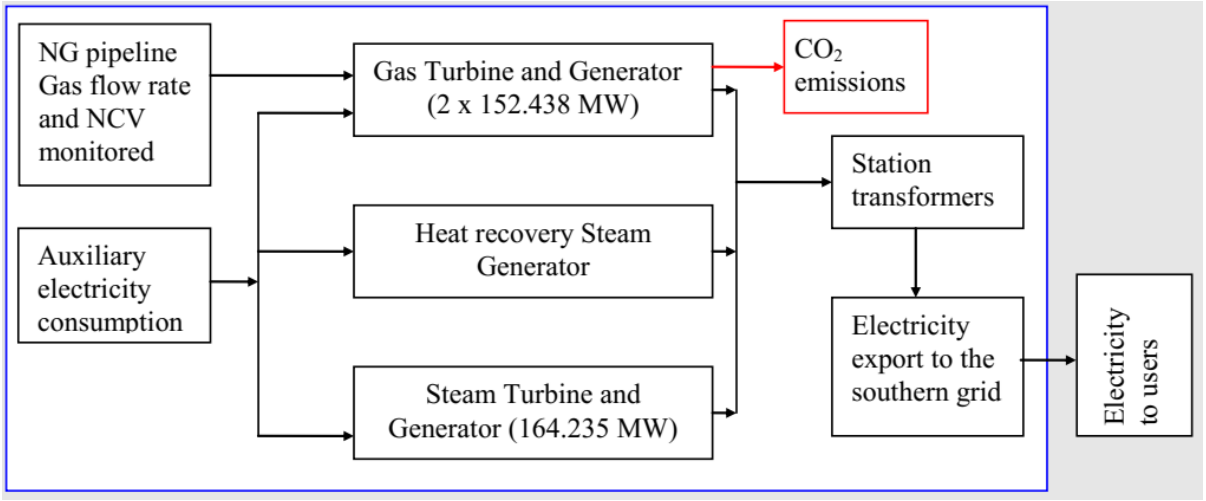


Figure 2: Line diagram of the project activity

The implementation and operational status of the project as of this monitoring period:

1. The start date of commercial operation of the project activity – 05/06/2009.

2. There have not been any events and situations during this monitoring period which may impact the applicability of the methodology.

B.2. Post-registration changes

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

Not Applicable, as there are no deviations during the current monitoring period.

B.2.2. Corrections

Not Applicable, as there are no corrections applicable during the current monitoring period.

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

Not Applicable, as there is no change of start date of crediting period.

B.2.4. Inclusion of monitoring plan

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

The project activity was requested the Permanent changes from the monitoring plan earlier and same is approved on 17/10/2013. Please refer below web link for the same
https://cdm.unfccc.int/PRCContainer/DB/prcp491309224/view

The summary changes in the registered PDD was as below

Section A.4.3

1) The information of the gas supply arrangement and data sources for quantity & calorific value of natural gas supplied to project activity for power generation is included in section A.4.3.

Section B.6.2

2) EFCO2, upstream,LNG (Emission factor for upstream CO2 emissions due to fossil fuel combustion / electricity consumption associated with the liquefaction, transportation, regasification and compression of LNG into a natural gas transmission or distribution system has been included in section B.6.2

Section B.6.4

3) The representation of the years in the table in section B.6.4 is changed to match with the year of registration of project activity

Section B.7.1

4) For the monitoring parameter EGPJ,y, the details of the measuring points and meter location is explained clearly. The revised PDD now clearly shows that there are two transmission lines evacuating power from project activity, 1 main meter and 1 check meter is installed at each transmission line. The net electricity exported from the project activity will be the summation of the net electricity supplied by Line 1 & line 2 and measured by the main meters installed, by APEPDCL – Andhra Pradesh Eastern Power Distribution Company Limited, on each line the same was confirmed by the validation team from the monthly joint meter reading report (Ref-/8/). The arrangement of energy meters presented in the revised PDD is correct and same is in line with actual practice at site. The measurement unit of electricity EGPJ,y, in the revised PDD has been changed to MWh which is in line with monitoring methodology. The calibration frequency of the energy meters has been changed from six monthly to annual.

5) For monitoring parameter FCNG, the description on location of monitoring equipment is improved. It has now been included in the revised PDD that there are two gas metering lines (Loop A & Loop B) at the gas supply terminal of GAIL (Gas transporter). Each line is equipped with an ultrasonic gas flow meter of Daniel make owned by the gas supplier GAIL. The quantity of the gas supplied to the project activity will be the sum of the reading of Loop A & Loop B. The present arrangement was verified by the verification team during the physical site visit. The revised PDD also states that, quantity of the natural gas supplied to the project activity will be cross checked with the readings of the mass flow meters inbuilt into each Gas turbine. The DCS system measures the mass flow, LHV & density of gas and gives the computed quantity of gas in m3. The quantity of gas supplied to project activity is measured at supplier ends as well as project end and the higher value among the two will be used for calculating project emissions, for a conservative value.
6) For monitoring parameter NCVNG, the description of the QA/QC procedures have been revised. The crosschecking mechanism for the NCV of the gas supplied to project activity, not being a requirement of the methodology, is removed from the revised PDD.

The same is in line with applicable monitoring methodology AM0029 version 03 does not mandate the crosschecking of this parameter. The source of the data will be the fortnightly or daily joint ticket signed jointly by the Project participant and the gas supplier GAIL. The unit of NCV has been revised to GJ/m3 which is in line with the requirement of monitoring methodology.

7) Parameters EFBL,CO2,y (Baseline CO2 emission factor), EFBL,upstream,CH4 (Emission factor for upstream fugitive methane emissions), EFCO2,NG,y (Emission factor of natural gas) also have been included as monitoring parameters in the revised PDD. The monitoring methodology requires these parameters to be monitored.

8) In the revised PDD the parameters Quantity of LNG (FCLNG), net calorific value of LNG consumed in the project activity (NCVLNG) also have been included as monitoring parameters in section B.7.1.

9) The oxidation factor of natural gas OXIDNG also is added to the list of monitoring parameters in section B.7.1. This is in line with the methodology table of monitored parameters which includes this parameter.

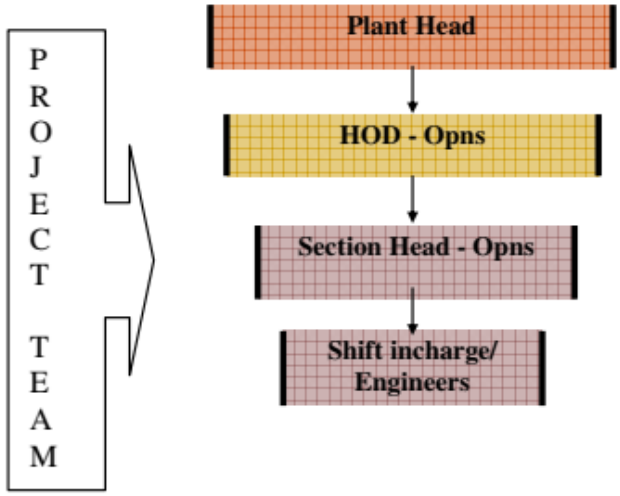
These above changes are applicable for current monitoring period. Apart from above approved permanent changes, there are no any permanent changes requested during the current monitoring period.

B.2.6. Changes to project design

Not Applicable, as there are no changes to the project design applicable during the current monitoring period.

SECTION C. Description of monitoring system

The project activity is operated and managed by the project proponent. The individual plants record data related to their respective project activity. The natural gas based power project abides by all regulatory and statutory requirements as prescribed under the state and central laws and regulations. A CDM project team has been established at the plant site. The project team is entrusted with the responsibility of storing, recording the data related to the project activity. The project team is also responsible for calculation of actual creditable emission reduction in the most transparent and relevant manner. Installed meters are calibrated according to the maintenance schedule programmed at the start of the operation and recalibrated according to the plant's performance requirement. All the monitoring data are stored, recorded and kept under safe custody of the Project Executor and Head (Power Plant and Utilities) at the plant site for the full crediting period + 2 years. In addition, any change within the project boundary, such as change in spare and or equipments are recorded and any change in the emission reduction due to such alteration are studied and recorded.



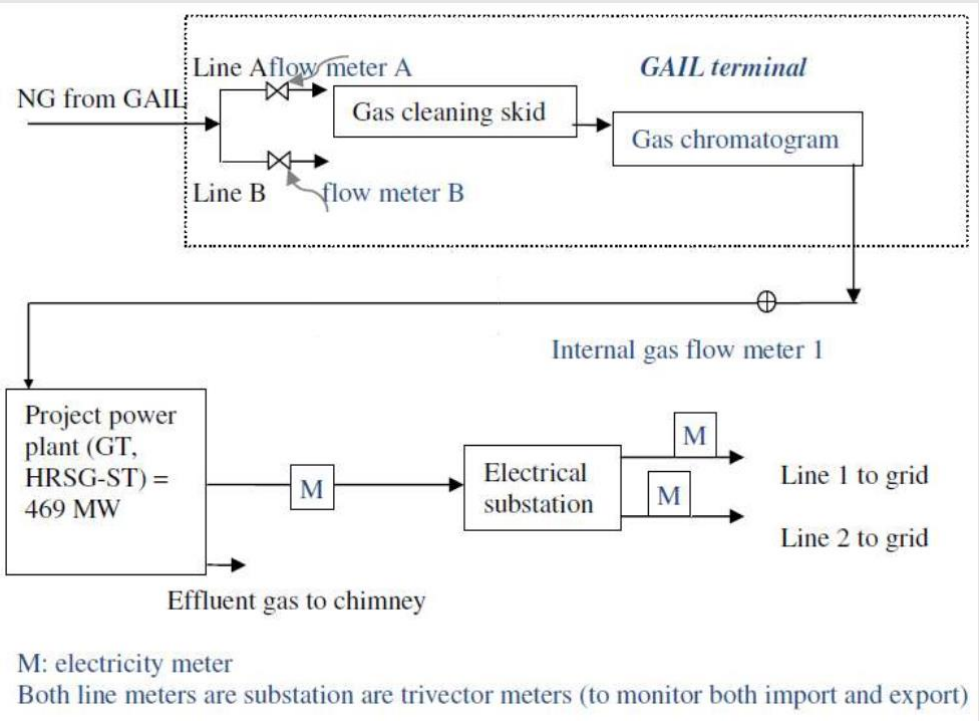
Designation	Responsibilities
Plant Head	• Registration • Project Execution
HOD- Operations	• Operation • Verification of data • Inspection of data whenever necessary to independently check the authenticity of data and take corrective actions wherever required. • Storage of data
Section Head- Operations	• Operation, Monitoring and Verification of Data • Data Recording • Storage of data
Shift In charge/ Engineers	• Operation and Maintenance • Storage of data • Data Recording • Data Collection • Archiving of data • Observation, Monitoring

The net electricity export for this period are monitored from the check meter/ DCS readings from the PP's monitoring system.

Data Back Up

The natural gas meter is tested for accuracy at least once in six months against an accepted laboratory standard meter in accordance with prescribed standards. The meters are deemed to be working satisfactory as long as the errors are within specifications for meters. The consumption registered by the main meter holds well as long as the error in the meters is within the permissible limits. In any case, the gas supplier data in the gas bills/ invoices is used for the emission reduction calculation.

Monitoring arrangement



Emergency plan:

The electricity meter (the main meter owned by PP) will be calibrated annually. In case, both the main and check meters have shown error more than the limit prescribed in the class, both the meters are taken for the calibration and correction are applied to the electricity generation recorded by the main meter. If main meter fails to record for some duration, then check meter readings are used for the calculation of emission reductions.

Monitoring of gas consumed in the project activity and NCV

Gas consumed is measured by GAIL's fuel flow meter reading (main meter) at project boundary. GAIL has a gas supply terminal near project plant, included in the project boundary, where gas quantity is metered and displayed in SCM i.e. standard cubic meters (at standard temperature and pressure).
Presently there are two gas metering lines and both have separate metering. At any time, any or both lines can be operated. If both lines operate for any period, the sum of these two line meters are used to get total gas consumption. There is a joint ticket signed by GAIL and PP's representative based on this reading, this is used as source of data for gas consumed.

Gas consumption is cross-verified by PP using GT's inbuilt mass flow indicator. The flow meter by GAIL is a volumetric flow meter and gives reading directly in m^3. Gas flow measurement of PP is a mass flow measurement and gives readings kg/s and density of gas is also continuously displayed in the DCS.

Thus, using this mass flow and density, PP gets data in m^3 to cross check. The net calorific value of natural gas consumed is provided by supplier. This is done on continuous basis using a Gas Chromatograph. The weighted average of NCV for the monitoring period will be calculated using daily joint ticket taken by GAIL and PP.

As the project activity crediting period may not coincide with the JMR date (both monitoring period start and the end), in that case, (1) the net electricity export for this period are taken from daily manual tariff meter readings taken by shift incharge and (2) gas quantity and NCV are taken from daily joint ticket OR (2) the crediting period start are taken from the subsequent JMR date after the registration date.

Internal Audit:

An internal audit team is constituted for verifying and auditing of the data recorded and archived with respect to the registered PDD and the monitoring plan. The audit team also verify and audit the calibration plan and

calibration record of the instruments with respect to the registered PDD and the monitoring plan. The audit team meet once in three months (quarterly) to verify and audit the data collected, the process followed and the quality control and assurance measures. They report any non-conformity to the Plant Head, who takes appropriate steps to rectify the non-conformity. The internal audit team also certify the annual consolidated data for the verification of CER.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

Data/Parameter	**$EF_{NG, Upstream,CH4}$**
Unit	t CH_4/GJ
Description	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 fuel supplied to final consumers.
Source of data	Table 2, page 8 of the approved methodology AM0029
Value(s) applied	296
Choice of data or measurement methods and procedures	In the absence of country specific values, the reference value from the approved methodology AM0029 is used as a conservative estimate.
Purpose of data/parameter	Leakage emission calculations
Additional comments	-

Data/Parameter	**$EF_{CO2, Upstream,LNG}$**
Unit	tCO_2/TJ
Description	Emission factor for upstream CO_2 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
Source of data	Page 10, Paragraph 1 of the approved methodology AM0029 (Ver. 03)
Value(s) applied	6
Choice of data or measurement methods and procedures	In the absence of country specific values, the reference value from the approved methodology AM0029 is used as a conservative estimate.
Purpose of data/parameter	Leakage emission calculations
Additional comments	-

The below parameters are not useful for calculations of emission reductions and were used for ex-ante estimation of emission reductions during validation stage, hence not mentioned in above section D.1 (Though these parameters are mentioned in registered PDD)

- The Build Margin emission factor of Southern grid ($EF_{BM , y}$),
- The Operating Margin emission factor of Southern grid ($EF_{OM , y}$),
- Emission Factor of Coal (EF_{Coal}),
- Oxidation Factor of Coal ($Oxid_{Coal}$)
- The Emission factor of the Southern grid ($EF_{electricity.y}$),
- Net Calorific Value of Coal (NCV_{Coal}),
- The energy efficiency of technology in the most likely baseline scenario (ηBL)

The below parameter is an ex post parameter and will be part of monitoring parameter (section D.2), hence not mentioned in above section D.1. (Though these parameters are mentioned in registered PDD)

- Emission Factor of Natural Gas ($EF_{CO2,NG,y}$)
- Oxidation Factor of NG ($Oxid_{NG}$)
- Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in terms of ton of methane per MWh ($EF_{BL, Upstream,CH4}$)

D.2. Data and parameters monitored

Data/Parameter	**$EG_{PJ,y}$**
Unit	MWh
Description	Electricity exported to the grid by the project activity in year y
Measured/calculated/ default	Measured and calculated
Source of data	The monthly joint meter readings (JMR) taken from the tariff meters (4 numbers, one main and one check on each of the two transmission lines) present in the Tariff metering room present in the switch yard.
Value(s) of monitored parameter	1,164,902,820
Monitoring equipment	The data represents the net electricity export from the project activity power plant measured by the tariff Meters. These four meters (one Main & one Check meter on each of the two lines - Line 1 & Line 2) are 3 phase 4 wire meters and of an accuracy of 0.2s class. These meters read both export and import values. The net export was calculated from readings of these meters (total export – total import).The total net export from power plant was calculated by summation of the readings measured by the tariff meters of Line-1 and Line-2. The monthly Joint meter reading (JMR) was taken by representatives of PP & APTRANSCO on 10th of every month. Based on this JMR the PP raised invoices to APTRANSO for electricity sold. During current monitoring period, the main meters of both the lines (Line 1 & Line 2) were replaced by pre calibrated meters. The calibration details of the energy meters used during the monitoring period are provided in Section C above. A copy of calibration certificates are provided to the DOE.
Measuring/reading/recording frequency	Continuous measurement with monthly recording
Calculation method (if applicable)	Calculated from meter readings on transmission line as (Total export by transmission line 1 meter – total import by transmission line 1 meter) + (Total export by transmission line 2 meter – total import by transmission line 2 meter)

QA/QC procedures	The calibration of the instruments was done annually at CPRI, Hyderabad/ ETDC (Hyderabad/Chennai/ Bangalore etc.) or alternatively at NABL accredited third party fixed/ mobile laboratory approved by AP Power Coordination Committee (APPCC). During this monitoring period, the meters were replaced by pre-calibrated meters and used meters were sent for calibration. Both the transmission lines have individual check meters by the power purchaser (APDISCOMS through APTransco) and readings are given in JMR. Check meters will be calibrated by APTransco/ APDISCOMs as per their procedures (and are not part of this monitoring). The readings of JMR were cross checked with the invoice sent to power purchaser and lower of the two was used for the calculation of emission reductions.
Purpose of data/parameter	Baseline and Leakage Emission calculations
Additional comments	-

Data/Parameter	**$EF_{BL,CO2,y}$**
Unit	tCO_2/MWh
Description	The Build Margin emission factor of Southern grid
Measured/calculated/ default	Calculated
Source of data	"CO2 Baseline Database for Indian Power Sector" published by Central Electricity Authority, Ministry of Power, Government of India, Version 12 dated May 2017
Value(s) of monitored parameter	**Value (tCO_2/MWh) / Year** 0.9212 / 2011-12 0.9717 / 2012-13 0.9550 / 2013-14 0.9285 / 2014-15 0.9083 / 2015-16
Monitoring equipment	Not Applicable
Measuring/reading/recording frequency	Annually
Calculation method (if applicable)	Calculated as per monitoring methodology AM0029 As the option 1 - build margin is chosen, this parameter will monitored expost and based on latest available database published from the CEA (CO_2 Baseline database for the Indian power sector).
QA/QC procedures	As per methodology requirement, this is monitored ex-post for ER calculation in the monitoring period
Purpose of data/parameter	Baseline emission calculations
Additional comments	-

Data/Parameter	**FC_{NG}**
Unit	m^3
Description	Quantity of NG consumed in the project activity
Measured/calculated/ default	Measured

Source of data	Gas supplier's fuel flow meter reading at project boundary given as fortnightly joint ticket. GAIL has a gas supply terminal near project plant, included in the project boundary, where gas quantity is metered and displayed in SCM i.e. standard cubic meters (at standard temperature and pressure). Presently there are two gas metering lines (line A and line B) and both have separate metering (flow meters). At any time, any or both lines can be operated. If both lines operate on any day, the sum of these two line meters will be used to get total gas consumption. PP and GAIL representative also sign a daily joint ticket. If any data not covered by fortnightly joint ticket is required, daily joint ticket will be used.
Value(s) of monitored parameter	211,039,603.313
Monitoring equipment	The quantity of Natural Gas is measured by the gas flow meter which would be installed by GAIL at their terminal. The flow meter by GAIL is a volumetric flow meter and gives reading directly in m^3. This is a Daniel make 4-path gas flow meter based on ultrasound and does not require calibration as per registered PDD. The device also uses pressure transducer, temperature transducer and flow computer for mass flow calculation and these transducers will be calibrated annually. The gas consumed is also continuously measured (cross check) by PP using inbuilt system in the gas turbine controls (Alstom GT 13E2/ ABB control system). Gas flow measurement of PP gives readings kg/s in DCS. Thus, using this mass flow and density, PP gets data in m^3 to cross check main meter reading from GAIL. Higher of the main and check meter readings will be used for the emission reduction calculations.
Measuring/reading/recording frequency	Continuous monitoring with once in fifteen days recording
Calculation method (if applicable)	This parameter is measured directly and does not require calculations
QA/QC procedures	The quantity of natural gas is cross checked with the quantity of Natural Gas measured using the gas flow controls by the project proponent. GAIL meter is out of PP's control and is a factory calibrated as per their standards. The temperature transmitter (TT) and pressure transmitter (PT) associated with gas flow meter will be calibrated jointly by gas supplier and PP quarterly). TT – Accuracy and calibration frequency = ± 0.2%, once in a quarter PT - Accuracy and calibration frequency = ± 0.075%, once in a quarter
Purpose of data/parameter	Project and Leakage Emission calculations
Additional comments	-

Data/Parameter	**FC_{LNG}**
Unit	m^3
Description	Quantity of LNG consumed in the project activity[3]
Measured/calculated/ default	Measured

[3] PP received LNG at project boundary in gas form. LNG is received at any of the LNG terminals in the country and regassified. Then this regassified LNG is pumped in the NG grid and supplied to end users. Thus, same meters as that for the NG are used for LNG metering as well.

Source of data	The LNG is also received in gas form at the project boundary as regasification happens at any of the LNG terminals in the country. Gas supplier's fuel flow meter reading at project boundary given as fortnightly joint ticket. GAIL has a gas supply terminal near project plant, included in the project boundary, where gas quantity is metered and displayed in SCM i.e. standard cubic meters (at standard temperature and pressure). Presently there are two gas metering lines (line A and line B) and both have separate metering (flow meters). At any time, any or both lines can be operated. If both lines operate on any day, the sum of these two line meters were used to get total gas consumption. PP and GAIL representative also sign a daily joint ticket. If any data not covered by fortnightly joint ticket is required, daily joint ticket will be used.
Value(s) of monitored parameter	26,864,671
Monitoring equipment	The quantity of Natural Gas is measured by the gas flow meter which would be installed by GAIL at their terminal. The flow meter by GAIL is a volumetric flow meter and gives reading directly in m^3. This is a Daniel make 4-path gas flow meter based on ultrasound and does not require calibration as per registered PDD. The device also uses pressure transducer, temperature transducer and flow computer for mass flow calculation and these transducers will be calibrated annually. The gas consumed is also continuously measured (cross check) by PP using inbuilt system in the gas turbine controls (Alstom GT 13E2/ ABB control system). Gas flow measurement of PP gives readings kg/s in DCS. Thus, using this mass flow and density, PP gets data in m^3 to cross check main meter reading from GAIL. Higher of the main and check meter readings will be used for the emission reduction calculations.
Measuring/reading/recording frequency	Continuous monitoring with once in fifteen days recording
Calculation method (if applicable)	This parameter is measured directly and does not require calculations
QA/QC procedures	The quantity of natural gas is cross checked with the quantity of Natural Gas measured using the gas flow controls by the project proponent. GAIL meter is out of PP's control and is a factory calibrated as per their standards. The temperature transmitter (TT) and pressure transmitter (PT) associated with gas flow meter will be calibrated jointly by gas supplier and PP quarterly). TT – Accuracy and calibration frequency = ± 0.2%, once in a quarter PT - Accuracy and calibration frequency = ± 0.075%, once in a quarter
Purpose of data/parameter	Project and Leakage Emission calculations
Additional comments	There has been some quantity of LNG consumption by project activity during current monitoring period.

Data/Parameter	**NCV_{NG}**
Unit	GJ/m^3
Description	Net Calorific Value of Natural Gas
Measured/calculated/ default	Measured
Source of data	fortnightly (or daily) joint ticket signed by the gas supplier
Value(s) of monitored parameter	0.0353

Monitoring equipment	The Supplier provides the value of the NCV in the daily/ fortnightly joint ticket given to the project proponent. The NCV is measured by the Gas chromatograph that would be installed by GAIL at their terminal.
Measuring/reading/recording frequency	Continuous monitoring with once in fifteen days recording
Calculation method (if applicable)	This parameter is measured directly and does not require calculations
QA/QC procedures	The net calorific value of natural gas consumed would be provided by supplier. This is done on continuous basis using a Gas Chromatograph installed by GAIL. The weighted average of NCV for the monitoring period will be calculated using daily joint ticket taken by GAIL and PP. **Cross check:** The monitoring methodology does not require cross checking this paramater
Purpose of data/parameter	Project and Leakage Emission calculations
Additional comments	-

Data/Parameter	**NCV_{LNG}**
Unit	GJ/m^3
Description	Net Calorific Value of LNG
Measured/calculated/ default	Measured
Source of data	Invoice from the supplier
Value(s) of monitored parameter	0.0353
Monitoring equipment	The Supplier provides the value of the NCV in the daily/ fortnightly joint ticket given to the project proponent. The NCV is measured by the Gas chromatogram installed by GAIL at their terminal.
Measuring/reading/recording frequency	Continuous monitoring with once in fifteen days recording
Calculation method (if applicable)	This parameter is measured directly and does not require calculations
QA/QC procedures	The net calorific value of natural gas consumed would be provided by supplier. This is done on continuous basis using a Gas Chromatograph. The weighted average of NCV for the monitoring period will be calculated using daily joint ticket taken by GAIL and PP. **Cross check:** The monitoring methodology does not require cross checking this parameter.
Purpose of data/parameter	Project and Leakage Emission calculations
Additional comments	-

Data/Parameter	**$COEF_{f,y}$**
Unit	tCO_2/ m^3
Description	Calculation of CO_2 Emission Co-efficient of natural gas
Measured/calculated/ default	Calculated
Source of data	Calculated
Value(s) of monitored parameter	0.00198
Monitoring equipment	Not Applicable (as it is a calculated value from one monitored and two default parameters)
Measuring/reading/recording frequency	Once in a monitoring period

Calculation method (if applicable)	$COEF_{f,y} = NCV_{f,y} * EF_{CO2,f,y} * OXID_f$ Where, $NCV_{f,y}$ is as per parameter under section D.2 "Data and Parameters monitored". $EF_{CO2,f,y}$ is as per parameter under section D.2 "Data and Parameters monitored". $OXID_{NG}$ is as per parameter under section D.2 "Data and Parameters monitored"
QA/QC procedures	None as accepted under applicable methodology AM0029
Purpose of data/parameter	Project emission calculations
Additional comments	-

Data/Parameter	**$Oxid_{NG}$**
Unit	Unit less factor
Description	Oxidation Factor of NG
Measured/calculated/ default	Default Value
Source of data	IPCC Default Value
Value(s) of monitored parameter	1
Monitoring equipment	-
Measuring/reading/recording frequency	-
Calculation method (if applicable)	IPCC default value used in absence of country specific data (Reference – Table 1.4, Chapter 1, Volume 2, 2006 IPCC Guidelines for National Greenhouse Gas Inventories)
QA/QC procedures	IPCC Default Value, so does not require QC
Purpose of data/parameter	Project emission calculations
Additional comments	-

Data/Parameter	**$EF_{BL, Upstream,CH4}$**
Unit	t CH_4/MWh
Description	Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity
Measured/calculated/ default	Calculated
Source of data	Not Applicable
Value(s) of monitored parameter	Please ER sheet for year wise emission factor calculated
Monitoring equipment	Not Applicable
Measuring/reading/recording frequency	Annually

Calculation method (if applicable)	Calculated as; $\frac{\sum_j FF_{j,k} * EF_{k,upstream,CH4}}{\sum_J EG_j}$ Where: $\Sigma FF_{j,k}$: Quantity of fuel type combusted in power plant included in j build margin $EF_{k, upstream,CH4}$: Taken from Table 2 of AM 0029, version 03 ΣEG_j : Electricity generation in the plant included in the build j margin $EF_{BL,upstream,CH4}$ is calculated for power plants included in the Build Margin, in line with the baseline emission factor selection. This data was computed consistent with the Build Margin emission factor based on latest available information from (a) "CO2 Baseline Database for Indian Power Sector" published by Central Electricity Authority, Ministry of Power, Government of India, Version 12 dated May 2017. (b) AM 0029, version 03
QA/QC procedures	The uncertainty level of this data is low as per the applied baseline methodology AM 0029. This is collected from official data sources. No additional QA/QC procedures are required.
Purpose of data/parameter	Leakage emission calculations
Additional comments	-

Data/Parameter	**$EF_{CO2,NG,y}$**
Unit	$kgCO_2e/TJ$
Description	Emission Factor of Natural Gas
Measured/calculated/ default	Table 1.4, Chapter 1, Volume 2, 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Source of data	Table 1.4, Chapter 1, Volume 2, 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) of monitored parameter	56,100
Monitoring equipment	Not applicable. In absence of country specific data; IPCC default value is used as recommended in baseline methodology.
Measuring/reading/recording frequency	Annual
Calculation method (if applicable)	Not applicable, this is a default value taken from source
QA/QC procedures	Not applicable, this is a default value taken from source
Purpose of data/parameter	Project emission calculations
Additional comments	-

Data/Parameter	**PE_y**
Unit	tCO_2
Description	Project emission due to combustion of fuel
Measured/calculated/ default	Calculated under project activity
Source of data	Calculated in Section E below
Value(s) of monitored parameter	Please refer ER sheet for this value

Monitoring equipment	Not applicable as this is a calculated value by using methodology given in the AM0029
Measuring/reading/recording frequency	Once in a monitoring period
Calculation method (if applicable)	Please refer Section E below
QA/QC procedures	Not applicable as it is a calculated value
Purpose of data/parameter	Project emission calculations
Additional comments	-

D.3. Implementation of sampling plan

Not Applicable

SECTION E. Calculation of emission reductions or net anthropogenic removals

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

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

Parameter	Description
$EG_{PJ,y}$	Electricity exported by the project plant
$EF_{BL,CO2,y}$	The Build Margin emission factor of Southern grid
BE_y	Baseline Emissions

Since Build Margin emission factor varies from year to year, here sample calculations is represented for year 2012-13.

For year 2012-13,

$BE_y = EG_{PJ,y} \times EF_{BL,CO2,y}$
$= 905239.14 \text{ MWh} \times 0.9717 \text{ tCO}_2/\text{MWh}$
$= 879{,}620.87 \text{ tCO}_2$

The total baseline emissions for complete monitoring period is 1,117,723 tCO_2 (rounded down value)

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

For year 2012-13, the Project emisison calculations áre as below

Volume of fuel combusted in project plant ($FC_{f,y}$) : 195,564,704.31 Sm^3

Calculation of CO_2 Emission Co-efficient of natural gas ($COEF_{f,y}$)
CO_2 Emission Co-efficient of natural gas is calculated as per equation number-1a of AM0029 Values of sub-variables:

1) Net Calorific Value of gas (NCV_y): 0.036016 GJ/Sm^3
2) CO_2 emission factor ($EF_{CO2,f,y}$): 0.0561 t CO_2/GJ
3) Oxidation factor of gas ($OXID_f$): 1

$COEF_{f,y} = NCV_{f,y} \times EF_{CO2,f,y} \times OXID_f$
$= 0.036016 \text{ GJ/m}^3 \times 0.0561 \text{ tCO}_2/\text{GJ} \times 1$
$= 0.002020 \text{ tCO}_2/\text{ m}^3$

$PE_y = FC_{f,}y \times COEF_{f,y}$
$= 195{,}564{,}704.31 \text{ m}^3 \times 0.002020 \text{ tCO}_2/\text{m}^3$
$= 395{,}139.85 \text{ tCO}_2$

The total project emissions for complete monitoring period is 480,180 tCO_2 (rounded up value)

E.3. Calculation of leakage emissions

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

Where:

LE_y: = Leakage emissions during the year y in tCO_2e
$LE_{CH4,y}$: = Leakage emissions due to fugitive upstream CH4 emissions in the year y in tCO_2e
$LE_{LNG,CO2,y}$: = 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 tCO_2e

For year 2012-13, the leakage emisison calculations áre as below

As per registered PDD, $LE_{CH4,y}$ is calculated as:

$LE_{CH4,y} = [FC_{f,y} \times NCV_{f,y} \times EF_{NG,\ upstream,CH4} - EG_{PJ,y} \times EF_{BL,\ upstream,\ CH4}] \times GWP_{CH4}$
$=[195564704.31\ m^3 \times 0.036016\ GJ/m^3 \times 0.000296\ tCH4/GJ - 905239.14\ MWh \times 0.00043\ tCH_4/MWh] * 25$
$= 42,303.37\ tCO_2$

As per registered PDD, $LE_{LNG,CO2,y}$ is calculated as:

$LE_{LNG,CO2,y} = FC_y \times EF_{CO2,upstream,LNG}$
$= 248.14\ TJ \times 6\ tCO_2/TJ$
$= 1,488.84\ tCO_2$

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

$= 42,303.37 + 1,488.84$
$= 43,792.21\ tCO_2$

The total Leakage emissions for complete monitoring period is 56063 tCO_2 (rounded up value)

Emissions Reduction (ER_y)

$= BE_y – PE_y – LE_y$
$= 1,117,723 – 480,180 – 56,063$
$= 581,480\ tCO_2$

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	1,117,723	480,180	56,063	112,543	468,937	581,480

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 ($t CO_2e$)
581,480	7,664,854

E.6. Remarks on increase in achieved emission reductions

Projected emission reductions as per CDM-PDD for the current monitoring period was estimated at 7,664,854 tCO_2. The actual emission reductions measured is 581,480 tCO_2. This resulted in 92.41 % deviation on lower side.

The reduction in emission is due to following reason:

1. Though the build margin of grid increased for current monitoring period, the PLF or operational period is lower than estimated.

This resulted in lower output of electricity and thus lower emission reduction.

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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.

Decision Class: Regulatory
Document Type: Form
Business Function: Issuance
Keywords: monitoring report