



Monitoring report form (Version 03.2)

Monitoring report

Title of the project activity	Natural Gas based grid connected power project at Peddapuram, A.P. by Gautami Power Limited
Reference number of the project activity	4828
Version number of the monitoring report	05
Completion date of the monitoring report	03/05/2014
Registration date of the project activity	09/09/2011
Monitoring period number and duration of this monitoring period	01 Duration: 09/09/2011 to 10/03/2012 (including both these dates)
Project participant(s)	GVK Gautami Power Limited, Hyderabad (Private entity)
Host Party(ies)	India
Sectoral scope(s) and applied methodology(ies)	Sectoral scope : 01- Energy Industries (renewable - / non-renewable) Applied methodology: AM0029- Baseline Methodology for Grid Connected electricity Generation Plants using Natural Gas
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	652,026 tCO ₂ e (<i>estimated CERs for 184 days during the crediting period in accordance with revised PDD version 6.0, dated 07/09/2013</i>)
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	342,818 tCO ₂ e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	342,818 tCO ₂ e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	0

SECTION A. Description of project activity**A.1. Purpose and general description of project activity**

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Project activity:

The project activity is commissioning and operation of a new, green field 469 MW Natural Gas fired, gas turbine based combined cycle power plant. The project activity is installed by GVK Gautami Power Limited (GPL)¹ 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 avoids significant GHG emission compared to the usual practice in coal dominated Indian power sector.

Purpose of the project activity:

The purpose of the project activity is commissioning and operation of 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.

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 29°C 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	Equipments	Specification
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°C, 70% RH and 50Hz frequency.
2	Heat recovery steam generators (HRSG)	Make -ALSTOM Power, Triple Pressure Capacity: High Pressure (HP)/ Intermediate Pressure (IP)/light Pressure (LP) Flow: 56.95/ 11.1/ 9.7 kg/s Temp: 508.3/ 506/ 151.2°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°C, 70% Relative Humidity (RH) and 50Hz frequency.

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

Project Execution Step	Date
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

¹ GVK Gautami Power Limited is the new name of PP as per order dt. 08/09/2009 (letter from 'Registrar of Companies, Andhra Pradesh' submitted to DOE)

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 342,818 tCO₂e.

A.2. Location of project activity

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Host Party: India**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 17°03'03" N and 82°07'04" E.

**A.3. Parties and project participant(s)**

Party involved (host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (host country)	GVK Gautami Power Limited Hyderabad (Private entity)	No

A.4. Reference of applied methodology

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Type : I - Energy industries (renewable- / non-renewable sources)**Category** : AM0029

("Baseline Methodology for Grid Connected electricity Generation Plants using Natural Gas")

Version No : 03, EB 39**Sectoral** : 01 Energy Industries (renewable/non-renewable)

Scope

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

Title: “Tool to calculate emission factor for an electricity system”

Version 02.2

EB 61

A.5. Crediting period of project activity

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Fixed crediting period of 10 years is chosen

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

The registered PDD had chosen crediting period from 01/08/2011 (or the date of registration whichever later), however project activity was registered on 09/09/2011. Thus, the crediting period is started from this date.

SECTION B. Implementation of project activity**B.1. Description of implemented registered project activity**

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Description of the project activity technology:

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 thermo syphon 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 29°C 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.

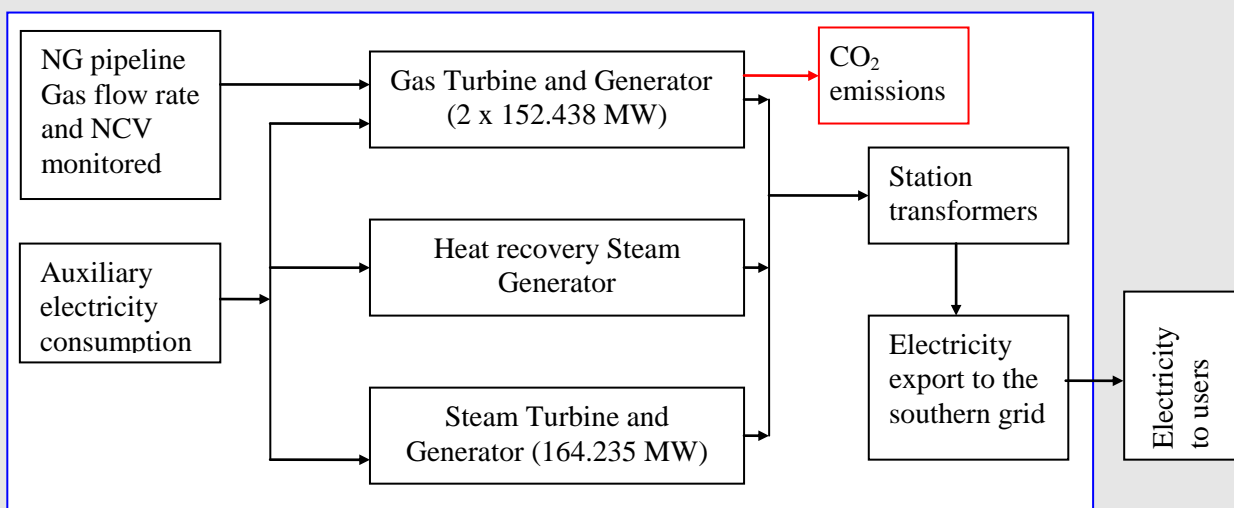


Figure: Line diagram of the project activity

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 registered monitoring plan or applied methodology

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Not applicable – project activity has not applied any temporary deviations from the registered monitoring plan or the applied methodology.

B.2.2. Corrections

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Not applicable – project activity has not applied any corrections during this monitoring period.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

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The project activity had applied for permanent changes from the registered monitoring plan. This was approved on 17/10/2013 reference PRC-4828-001². A summary of these changes is presented below.

- 1) Section A.4.3 of PDD – clarity on the monitoring points of gas flow meters and NCV
- 2) Section B.6.1 of PDD – provision to calculate leakage if LNG is used in the project activity
- 3) Section B.6.2 of PDD – included monitoring table for EF_{CO2, Upstream,LNG}
- 4) Section B.7.1 of PDD – Inclusion of monitoring parameters to be consistent with the monitoring methodology AM0029 and corrections in the existing monitoring parameters' tables
- 5) Section B.7.2 of PDD – Corrections in the designations of the monitoring team and clarity in the monitoring plan

B.2.4. Changes to project design of registered project activity

² <http://cdm.unfccc.int/PRCContainer/DB/prcp491309224/view>

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Not applicable – project activity has not applied any changes to the project design of the registered project activity.

B.2.5. Changes to start date of crediting period

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Not applicable – project activity has not applied any changes to the start date of crediting period.

B.2.6. Types of changes specific to afforestation or reforestation project activity

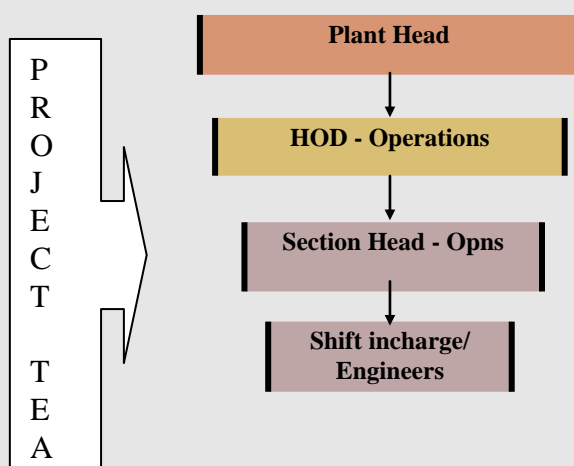
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Not applicable – project activity is not an afforestation or reforestation project activity.

SECTION C. Description of monitoring system

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The project activity is operated and managed by the PP. The natural gas based power project abides by all regulatory and statutory requirements as prescribed under the state and central laws and regulations. A monitoring 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 is stored, recorded and will be 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. Also any change within the project boundary, such as change in spare and or equipment is recorded and any change in the emission reduction due to such alteration is studied and recorded.



Designation	Responsibilities
Plant head	^a Registration
HOD - Operations	^b Project Execution
Section Head - Operations	^c Operation ^d Verification of data ^e Inspection of data whenever necessary to independently check the authenticity of data and take corrective actions wherever required. ^f Storage of data
Shift in-charge/ Engineers	^g Operation, Monitoring and Verification of Data

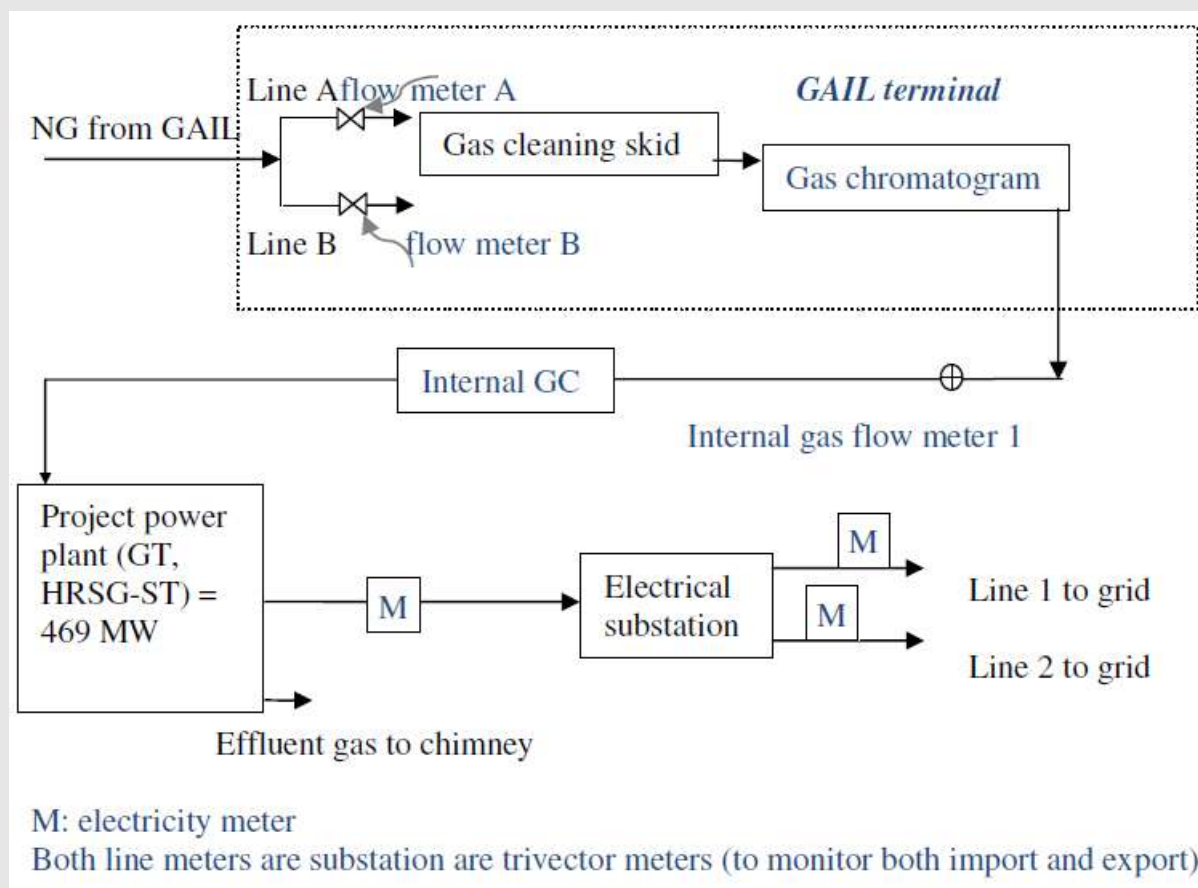
	h Data Recording i Storage of data
Plant head	j Operation and Maintenance k Storage of data l Data Recording m Data Collection n Archiving of data o Observation, Monitoring

The net electricity export for this period will be 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



QA & QC PROCEDURES

During the monitoring period, the Electronic Meters are calibrated by Electronic test at accredited calibration centre. Both the energy meter Sl.no 07615227 and 09451715 are calibrated on 04/08/2011 and it has validity till 03/08/2012. The natural gas flow measuring GAIL flow meters had 1st calibration on 18/07/2011, 2nd calibration on 21/10/2011, 3rd calibration on 17/01/2012. These flow meters calibration are done by GAIL.

Table: Summary of calibrations of all meters

Calibration Details of Energy Meters			
Location	Serial No	Calibration Date	Calibration Date

Line 1 electricity meter	07615227	8/4/2011	31/05/2012
On line 1 Meter no 07615227 replaced by 07615234 on 06/01/2012	07615234	18/10/2011	4/2/2013
Line 2 electricity meter	09451715	8/4/2011	31/05/2012
On line 2 Meter no 09451715 replaced by 09451716 on 06/01/2012	09451716	18/10/2011	4/2/2013

Calibration Details of Flow Meters					
Meter Location	Serial No	Calibration Date	Calibration Date	Calibration Date	Calibration Date
Gas flow meter - at GAIL - Line A	FB-S600/17418241	18/07/2011	21/10/2011	17/01/2012	19/04/2012
Gas flow meter - at GAIL - Line B	FB-S600/17418252	18/07/2011	21/10/2011	17/01/2012	19/04/2012

Calibration Details of Gas Chromatograph			
Meter Location	Serial No	Calibration Date	Calibration Date
Gas chromatogram at GAIL	09007289	26/08/2011, 27/09/2011, 21/10/2011, 21/11/2011, 23/12/2011	16/01/2012, 16/02/2012, 20/03/2012, 19/04/2012

Verification: The quantitative details indicating the net exported electrical energy, natural gas consumed and the net calorific value audited by the internal audit team constituted for the purpose is used, for verification of the CERs. Further, the joint energy meter reading jointly signed by PP and APTransco and the invoices raised by PP on APTransco is the base audit document for verification protocol.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data / Parameter:	EF _{NG,upstream,CH4}
Unit:	tCH ₄ /PJ
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 PJ fuel supplied to final consumers
Source of data:	Table- 2 of AM 0029 Version 03
Value(s) applied:	296
Purpose of data:	Leakage emission calculations
Additional comment:	Nil

Data / Parameter:	OXID _{NG}
Unit:	Unit less factor
Description:	Oxidation Factor of NG
Source of data:	Table 1.4, Chapter 1, Volume 2, 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	1

Purpose of data:	Project emission calculations
Additional comment:	As IPCC emission factors are not updated from the value used at the time of project activity registration, same value is used

Data / Parameter:	NCV _{Coal}
Unit:	kCal/Kg
Description:	Net Calorific Value of Coal
Source of data:	GCV and conversion factor (GCV to NCV) sourced from "CO ₂ Baseline Database of the Indian Power Sector Version 5.0, issued by Central Electricity Authority, Ministry of Power, Government of India"
Value(s) applied:	3,625
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	Nil

Data / Parameter:	EF _{Coal}
Unit:	kg CO ₂ e/TJ
Description:	Emission Factor of Coal
Source of data:	CEA CO ₂ Baseline Database, version 05
Value(s) applied:	95,800
Purpose of data:	The value is taken from the database developed by Central Electricity Authority (CO ₂ Baseline database for the Indian power sector, Version 5.0). The database is Government of India's official publication based on the 'Tool to calculate the emission factor for an electricity system'.
Additional comment:	Nil

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 of AM 0029 Version 03
Value(s) applied:	6
Purpose of data:	Leakage emission calculations
Additional comment:	Nil

D.2. Data and parameters monitored

Data / Parameter:	EG _{PJ}
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:	1,251220.72
Monitoring equipment:	<p>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.</p> <p>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 APTRANSCO for electricity sold.</p> <p>Since the monitoring period started on 09/09/2011 and the JMR for next month started on 10/09/2011, so for simplicity the value of electricity exported on only 09/09/2011 has been forgone for the computation of baseline emissions, which is conservative.</p> <p>On 06/01/2012 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.</p>
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:	<p>The calibration of the instruments was done annually at ETDC (Hyderabad and Vadodara). During this monitoring period, the meters were replaced by pre-calibrated meters and used meters were sent for calibration.</p> <p>Both the transmission lines have individual check meters by the power purchaser (APDISCOMS through APTransco) and readings are given in JMR.</p> <p>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.</p>
Purpose of data:	Baseline and Leakage Emission calculations
Additional comment:	-
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 were used to get total gas consumption.
Value(s) of monitored parameter:	263,014,329
Monitoring equipment:	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 ³ based on ultrasound and does not require calibration ⁴ . The device also uses pressure transducer, temperature transducer and flow computer for mass flow calculation and these transducers were 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 ⁵ 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 were used for the emission reduction calculations. The meter calibration dates are given in Section C above.
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 by the gas flow meter that is installed 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 were calibrated jointly by gas supplier and PP quarterly). TT – Accuracy and calibration frequency = $\pm 0.2\%$, once in a quarter PT - Accuracy and calibration frequency = $\pm 0.075\%$, once in a quarter
Purpose of data:	Project and Leakage Emission calculations
Additional comment:	--

Data / Parameter:	FC _{LNG}
Unit:	m ³
Description:	Quantity of LNG consumed in the project activity
Measured/ Calculated / Default:	Measured

³ <http://www2.emersonprocess.com/en-us/brands/daniel/Flow/ultrasonics/Pages/Ultrasonic-Series-3400.aspx>

⁴ <http://igs.nigc.ir/igs/ARTIC/NG-31.PDF>

⁵ Alstom GT13E2 Gas turbine control system (EGATROL-8) has an in-built mechanism to calculate Gas mass flow requirement to the turbine. This calculation is done in turbine closed loop controllers and is based on the real time parameters of the certain process measurements such as Gas Pressure, differential pressure across gas control valves and Gas temperature. The Calculated Gas Flow readings are in kg/S only and is displayed automatically and logged in to Egatrol-8 Historian server.

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.
Value(s) of monitored parameter:	0
Monitoring equipment:	The quantity of Natural Gas is measured by the gas flow meter 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 ⁶ based on ultrasound and does not require calibration ⁷ . The device also uses pressure transducer, temperature transducer and flow computer for mass flow calculation and these were calculated annually. The gas consumed is also continuously measured by PP using inbuilt system in the gas turbines (Alstom make – same mass flow is used for GT functioning). Gas flow meter of PP is a mass flow meter and gives readings kg/s and density of gas is also continuously displayed using same meter in the DCS. Thus, using this mass flow and density, PP gets data in m ³ to cross check. The meter calibration dates are given in Section C above.
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 by the gas flow meter that is installed 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 were calibrated jointly by gas supplier and PP quarterly). TT – Accuracy and calibration frequency = $\pm 0.2\%$, once in a quarter PT - Accuracy and calibration frequency = $\pm 0.075\%$, once in a quarter.
Purpose of data:	Project and Leakage Emission calculations
Additional comment:	There has been no 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:	Invoice from the supplier

⁶ <http://www2.emersonprocess.com/en-us/brands/daniel/Flow/ultrasonics/Pages/Ultrasonic-Series-3400.aspx>

⁷ <http://igs.nigc.ir/igs/ARTIC/NG-31.PDF>

Value(s) of monitored parameter:	0.0368
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 installed by GAIL at their terminal. The meter calibration dates are given in Section C above.
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 were provided by supplier. This measurement is done on continuous basis using a Gas Chromatograph installed by GAIL. The weighted average of NCV for the monitoring period was 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:	Project and Leakage Emission calculations
Additional comment:	--

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
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. The meter calibration dates are given in Section C above.
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 was provided by supplier. This measurement is done on continuous basis using a Gas Chromatograph installed by GAIL. The weighted average of NCV for the monitoring period was 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:	Project and Leakage Emission calculations
Additional comment:	There has been no LNG consumption by project activity during current monitoring period.

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:	0.00206
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):	$COEF_{f,y} = NCV_{f,y} * EF_{CO_2,f,y} * OXID_f$ <p>Where, NCV_{f,y} is as per parameter 3 under section D.2 "Data and Parameters monitored". EF_{CO₂,f,y} is as per parameter 3 under section D.1 "Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors". OXID_{NG} is as per parameter 2 under section D.1 "Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors"</p>
QA/QC procedures:	None as accepted under applicable methodology AM0029
Purpose of data:	Project emission calculations
Additional comment:	--

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:	CEA CO ₂ Baseline Database, version 07; January 2012
Value(s) of monitored parameter:	0.73389
Monitoring equipment:	Not Applicable
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	<p>Calculated as per monitoring methodology AM0029</p> <p>As the option 1 - build margin is chosen, this parameter was monitored ex-post and based on latest available database published from the CEA (CO₂ Baseline database for the Indian power sector).</p>

QA/QC procedures:	As per methodology requirement, this is monitored ex-post for ER calculation in the monitoring period (latest available database version 07, most recent year 2010-11 BM is used)
Purpose of data:	Baseline emission calculations
Additional comment:	-

Data / Parameter:	EF _{BL,upstream,CH4}
Unit:	tCH 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:	1.055
Monitoring equipment:	Not Applicable
Measuring/ Reading/ Recording frequency:	Annually
Calculation method (if applicable):	<p>Calculated as;</p> $\frac{\sum_j FF_{i,k} * EF_{k, upstream, CH4}}{\sum_j E_{G_i}}$ <p>Where: $\sum FF_{i,k}$: 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 $\sum E_{G_i}$: Electricity generation in the plant included in the build j margin</p> <p>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) Central Electricity Authority, Ministry of Power, Government of India, Version 7, January 2012. (b) AM 0029, version 03</p>
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:	Leakage emission calculations
Additional comment:	-

Data / Parameter:	EF _{CO2,NG,y}
Unit:	kgCO ₂ e/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:	Project emission calculations
Additional comment:	-

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

Data / Parameter:	PEy
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:	543,001
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 this is a calculated value
Purpose of data:	Project emission calculations
Additional comment:	-

D.3. Implementation of sampling plan

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The project activity monitors 100% of the data and sampling is not used.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

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$$BE_y = EG_{PJ,y} \cdot EF_{BL,CO_2,y}$$

Parameter	Description	Source	Value
EG _{PJ,y}	Electricity exported by the project plant	Refer to Parameter 6 detailed under sec. D.2 "Data and Parameters monitored"	1,251,20.720 MWh
EF _{BL,CO₂,y}	The Build Margin emission factor of Southern grid	Refer to Parameter 4 detailed under sec. D.2 "Data And Parameters monitored"	0.7338 tCO ₂ /MWh
BE _y	Emissions in the Baseline Scenario	Calculated as per equation number 2 of the methodology AM0029 version 03 as described in part 4.1 of section 4 of the registered PDD. $BE_y = EG_{PJ,y} \cdot EF_{BL,CO_2,y}$	918,258 tCO ₂ e

Based on the above the BE_y (Emissions in the Baseline Scenario) for the monitoring period is: 918,258 tCO₂e.

E.2. Calculation of project emissions or actual net GHG removals by sinks

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$$PE_y = \sum_i FC_{i,y} \cdot COEF_{i,y}$$

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

$COEF_{f,y}$: is the CO_2 emission coefficient (tCO_2/m^3 or similar) in year(s) for each fuel and is obtained as:

$$COEF_{f,y} = \sum NCV_{f,y} * EF_{CO2f,y} * OXID_f$$

Where:

$NCV_{f,y}$: is the net calorific value (energy content) per volume unit of natural gas in year 'y' (GJ/m^3) as determined from the fuel supplier, wherever possible, otherwise from local or national data;

$EF_{CO2f,y}$: 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;

$OXID_f$: is the oxidation factor of natural gas

Parameter	Description	Source	9 th Sept, 2011 to 10 th March, 2012
FC_{NG}	Quantity of NG consumed in the project activity	Refer to Parameter 1 detailed under section D.2 "Data and Parameters Monitored".	263,014,329 SCM
$NCV_{f,y}$	Net Calorific Value of Natural Gas	Refer to Parameter 2 detailed under section D.2 "Data and Parameters Monitored".	0.0368 GJ/SCM
$EF_{CO2f,y}$	Emission Factor of Natural Gas	Refer to Parameter 4 detailed under section D.1	0.0561 tCO_2/GJ
$OXID_f$	Oxidation factor of natural gas	Refer to Parameter 3 detailed under section D.1.	1
$COEF_{f,y}$	CO_2 Emission co-efficient of natural gas	Calculated as per equation no. 1a of AM 0029- version 3.0.	0.00206 tCO_2/SCM
PE_y	Emissions in the Project Scenario	Calculated as per equation no. 1 of AM 0029- version 3.0.	543,001 tCO_2e

Based on the above the PE_y (Emissions in the Project Scenario) for the monitoring period is: 543,001 tCO_2e .

E.3. Calculation of leakage

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Calculated as: Calculated as per equation number-4 of AM 0029- version 3.0 as contained in part C of section 4 of the registered PDD.

$$LE_y = LE_{CH_4,y} + LE_{LNG,CO_2,y}$$

$$LE_{CH_4,y} = [FC_y \cdot NCV_y \cdot EF_{NG,upstream,CH_4} - EG_{PJ,y} \cdot EF_{BL,upstream,CH_4}] \cdot GWP_{CH_4}$$

Parameter	Description	Source	Value
FC_{NG}	Quantity of NG consumed in the project activity	Refer to Parameter 1 detailed under section D.2 "Data and Parameters Monitored".	263,014,329 SCM
$NCV_{f,y}$	Net Calorific Value of Natural Gas	Refer to Parameter 2 detailed under section D.2 "Data and Parameters Monitored".	0.0368 GJ/SCM
$EF_{NG,upstream,CH_4}$	Emission factor for upstream fugitive methane emissions of natural gas from production, transportation, distribution, and in the case of LNG, liquefaction, transportation, regasification and compression into a	Refer to Parameter 1 detailed under section D.1	296 tCH_4/PJ (0.000296 tCH_4/GJ)

	transmission or distribution system, in tCH ₄ per GJ fuel supplied to final consumers		
EG _{PJ,y}	Electricity exported by the project plant	Refer to Parameter 6 detailed under sec. D.2 "Data and Parameters monitored"	1,251,220.720 MWh
EF _{BL,upstream,CH4}	CO ₂ Emission Co-efficient of natural gas	Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in tCH ₄ /MWh electricity generation in the project plant	1.055 tCH ₄ /MWh
GWP _{CH4}	Global warming potential of methane valid for the relevant commitment period		21
LE _{CH4,y}	Leakage emissions due to fugitive upstream CH ₄ emissions	Calculated as per equation number-5 of AM 0029, version 3.0 as contained in section 4 of the registered PDD. Leakage emissions due to fugitive upstream CH ₄ emissions (LE _{CH4,y})	32,439.21 tCO ₂ e
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 (LE _{LNG,CO2,y})	Calculated as per the methodology, AM0029 version 3.0 as contained in of section 4 of the registered PDD 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 (LE _{LNG,CO2,y}) $LE_{LNG,CO2,y} = FC_{LNG,y} * EF_{CO2,upstream,LNG}$	0.0 tCO ₂ e
LE _y	Total Leakages	Calculated as per equation number-4 of AM 0029- version 3.0 as contained in Section 4 of registered PDD $LE_y = LE_{CH4,y} + LE_{LNG,CO2,y}$	32,439 tCO ₂ e

Based on above the LE_y (Total Leakages) for the monitoring period is: 32,439 tCO₂e.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Item	Baseline emissions or baseline net GHG removals by sinks (t CO ₂ e)	Project emissions or actual net GHG removals by sinks (t CO ₂ e)	Leakage (t CO ₂ e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO ₂ e)
Total	918,258	543,001	32,439	342,818

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO₂e)	652,026 (<i>estimated CERs for 184 days during the crediting period in accordance with revised PDD version 6.0, dated 07/09/2013</i>)	342,818

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

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Projected emission reductions as per CDM-PDD for the first monitoring period was estimated at 652,026 tCO₂. The actual emission reductions measured is 342,818 tCO₂. This resulted in 47.42% deviation on lower side.

The reduction in emission is due to following reason:

1. The build margin of southern grid decreased from 817.9 tCO₂/GWh to 733.89 tCO₂/GWh.
2. The PLF used in ex-ante calculation is 85% while the actual PLF for the monitoring period was lower. This resulted in lower output of electricity and thus lower emission reduction.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO₂e)	342,818	0

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Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
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 anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, 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	28 May 2010	EB 54, Annex 34. Initial adoption.
Decision Class: Regulatory Document Type: Form Business Function: issuance Keywords: monitoring report, performance monitoring		