CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

SECTION A. General description of project activity

A.1. Title of the project activity:

Combined cycle natural gas based grid connected power plant at Jegurupadu, India
Version: 06
Date: 16/07/2012

A.2. Description of the project activity:

The project activity is construction and operation of a 228 MW natural gas based power plant. GVK Industries Limited, the PP for this proposed activity has been promoted by GVK Group[1]. GVK Group is involved in development of various infrastructure projects in the areas of Power, Roads, Airports, Urban Infrastructure, Coal and Special Economic Zones. GVK Group is also involved in the hospitality industry, manufacturing industry and also in bio-sciences.

Purpose of the project activity
The purpose of the project activity is construction and operation of a new 228 MW natural gas based power plant. The electricity generated will be exported to the southern grid. The project activity once operational will help in reducing the carbon intensity and power deficit on the southern grid.

The proposed project activity comprises of one combustion turbine, one Heat recovery Steam Generators (HRSG) and one Steam Turbine Generator (STG). This configuration has been adopted due to (a) higher efficiency of Combustion Turbines of larger size and (b) shorter implementation period of the power project. The Combustion Turbine and Steam turbine are designed as indoor equipments.

At the site ambient temperature of 29ºC and a frequency of 50 Hz, the combustion turbine generator with NG as fuel would have an output of 148 MW while the output from the steam turbine generator would be 80 MW. The heat content of the exhaust gas from the combustion turbine would be recovered in a triple pressure heat recovery steam generator. The steam generated would then be expanded in a condensing type non reheat steam turbine driving an electric generator.

The proposed project activity is installed by GVK Industries Ltd. at Jegurupadu site near Rajahmundry town in East Godavari District (in Andhra Pradesh). To achieve the project commissioning within the normal period stipulated under the typical PPA, the proposed project activity has been executed under the Engineering, Procurement and Construction (EPC) contracts basis. The EPC contract is entered into with Alstom (Switzerland) and Alstom Projects India Limited. The Operation and Maintenance of the project is proposed to be carried out by GVK Power and Infrastructure Limited.

The Combustion Turbine is a single shaft machine with the compressor and turbine installed in a single casting. Annular combustor of dry low NOx type is being adopted. The combustion turbine drives the generator directly. The combustion turbine would be started by operating the generator as a variable speed motor. The variable frequency power required for this purpose will be supplied by the static frequency converter system.

[1] www.gvk.com

The Heat Recovery Steam Generator (HRSG) is triple pressure natural circulation heat recovery steam generators for outdoor installation that would generate the steam for the steam turbine set, utilising the waste heat from the gas turbine (GT) exhaust. The Steam Turbine is of the triple-pressure single-casing design with an axial exhaust. The live steam supplied by the HRSG is admitted to the HP- turbine through the main stop valve and the main control valve. IP and LP- steam is admitted via one stop valve and one control valve for each pressure level. From the LP-turbine exhaust the expanded steam flows into the condenser.

Pre-project scenario- The project activity is a new, independent natural gas based power plant and thus no power generating equipment existed in the project site before the project activity plant. Thus, the pre-project scenario is continuation of existing fuel mix in the grid to generate power at huge total deficit in the grid.

The PP has 235.4 MW NG based combined cycle power plant commissioned phase wise in 1996-98 in the project activity premises. That project has a different tariff structure (which includes 16% ROE and the fuel pass through PPA) and is discussed in detail in the Section B.5.

How the project activity reduces greenhouse gas emissions
In the absence of the project activity the PP would have opted for a coal based power plant as described in the section B.4. The project activity thus reduces anthropogenic GHG emissions into the atmosphere due to the use of relatively lower GHG intensive fuel (Natural Gas) and much higher efficient power generation due to combined cycle operation in comparison to coal.

Contribution of the project activity to sustainable development
Ministry of Environment and Forests, Govt. of India has stipulated the social well being, economic well being, environmental well being and technological well being as the four indicators for sustainable development in the host country approval eligibility criteria for Clean Development Mechanism (CDM) projects[2].

Socio-economic well-being:
The plant management has been involved in several social activities like and would continue need based developments

- Building bus shelters in Jegurupadu and Kadiyam village for the benefit of the travellers using the bus shelters
- Building the school building in Jegurupadu village, to provide high school facilities benefiting to a population of the 12,000 villagers
- Undertaking the responsibility of repairing the state highway from Dowleshwaram and Kesawaram villages, which has benefited more than one lakh of people living in the vicinity

Environmental well being:

- The electricity generated by project activity will be supplied to Southern grid, which otherwise would have been generated by more carbon intensive fossil fuels. Hence the project activity will help in reduction of the greenhouse gases emission and air pollutants (especially NOx and SO_2).

Economic well being

[2] http://www.cdmindia.in/approval_process.php

- Employment – the project activity provided direct employment to about 525 persons during the construction and 125 during the normal operation. In addition it is expected that up to 30 persons will be directly benefited through casual work, subcontracts, trading etc.

Technological well being

- The project activity demonstrates application of a cleaner technology, the use of natural gas for efficient combined cycle power generation

The PP has also committed to spend 2% of the CDM revenue received towards socio-economic development. The project activity was awarded host country approval on 03/09/2008.

A.3. Project participants:

Name of the party involved (*) (host) indicates Host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant(yes/No)
India (host country)	GVK Industries Limited (Private entity)	No

GVK Industries Limited, Hyderabad is the sole owner of the project activity power plant and the CERs generated from it. The company is listed on stock exchange and some shares are held by public.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

India

A.4.1.2. Region/State/Province etc.:

Andhra Pradesh

A.4.1.3. City/Town/Community etc.:

Jegurupadu Village, Rajahmundry, East Godavari District

A.4.1.4. Details of physical location, including information allowing the unique identification of this project activity (maximum one page):

The proposed project activity is near Jegurupadu village south east of Rajahmundry in east Godavari district. The location is close to Krishna-Godavari pipeline of Gas Authority of India Limited.
Geographic location and accessibility:
Nearest village: Kondaguntur (1.5 km); Nearest town: Rajahmundry (15 km)
Nearest highway: NH-5 (5 km); Nearest railway station: Kadiyam (4 km)
Nearest airport: Rajahmundry (15 km); Nearest seaport: Kakinada (50 km)
The geographical coordinates of the project activity are 16º 55’ 43” N and 81º 51’ 47” E.

(Source: www.mapsofindia.com)

Figure 1: Map of (A) India and (B) East Godavari district showing the site of project activity

A.4.2. Category(ies) of project activity:

The project activity is construction and operation of a new natural gas fired grid-connected electricity generation using combined cycle power plant.

As per the scopes of the project activity listed in the "List of Sectoral scopes" (Document CDM-ACCR-06 Version 04)', the project activity will fall in Scope Number 1, Sectoral scope – Energy industries (renewable - / non-renewable sources) being a Grid-connected electricity generating project using non-renewable fuel in energy industries.

Sector: Energy
Category 1: Energy industries (renewable - / non-renewable sources)

A.4.3. Technology to be employed by the project activity:

The pre-project scenario is continuation of existing fuel mix in the grid to generate power at huge total deficit in the grid. No power generation units existed at the project activity location in the pre-project scenario.

The project activity is commissioning and operation of a new natural gas based 228 MW power plant. It includes one ALSTOM 13E2 dual fuel Gas Turbine (however the project activity will only use only one

fuel i.e. natural gas), one ALSTOM make triple pressure unfired HRSG and one ALSTOM make Steam Turbine. This being a new standalone NG based power plant, any of the equipments in the project activity did not exist at the site in pre-project scenario.

The nameplate capacities of the turbine generators are – 210,000 kVA and 0.8 power factor (i.e. 210 x 0.8 = 168 MW) for GT and 110,000 kVA and power factor = 0.8 (i.e. 110 x 0.8 = 88 MW) for ST (total 256 MW under ISO conditions). However, this value is under standard test conditions and can undergo change at instantaneous production by factors including power factor. The PPA capacity is 220 MW and EPC design is 228 MW. During the commissioning test approved by Andhra Pradesh Power Coordination Committee (dt. 14/04/2009), the gross generation capacity in the test corrected for site conditions was demonstrated as 228.85 MW.

S.No.	Document	Plant capacity
1	PPA (2003)	220 MW
2	EPC (2003)	228 MW
3(a)	Capacity test by APPCC (09/01/2009)	231.98 MW
3(b)	Capacity test correction for site conditions letter from APPCC (14/07/2009)	228.85 MW
4	Nameplate Capacity under ISO condition	256 MW

The project activity plant has a PPA for sale of 220 MW. To be able to supply net 220 MW, after accounting for auxiliary consumption (4%) and station heat degradation in the later life of plant, a higher configuration 228 MW was chosen for EPC contract. The name plate capacity by the supplier converted from rating in kVA and using power factor is 256MW (at ISO condition). This is never likely to be achieved as Indian climatic conditions are not in range of ISO conditions. Please refer to schedule F; Test Procedure of the PPA wherein standard site reference conditions for capacity test are prescribed. Notably, the section reads '*the gross generation capacity is related to the following conditions* and includes ambient temperature, atmospheric pressure, humidity, frequency and base load condition'. Thus, based on these conditions, the gross generation can vary on a given time. Further, as can be seen from the communication from APPCC, the gross generation capacity observed during the capacity test was also corrected via letter dt. 14/07/2009.

However, the annual performance guaranty by EPC is for 228 MW. Also, net generation with 228 MW after accounting for auxiliaries (3%) will be about 220 MW which is also the PPA capacity. Thus, using 228 MW capacity will be conservative for the financial analysis and emission reduction calculation. Thus, further analysis is done based on 228 MW installed plant capacity.

The Gas turbine is a single shaft machine with the compressor and turbine sections assembled in a single casing. Annular type combustor using EV (Environmental) Burners are provided to limit the NOx emissions to below 40 ppm. The compressed air exits the unit compressor and is passed to the Combustion Chamber where Natural Gas is fired. The hot gases generated in the Combustion Chamber would be passed into the turbine, at about 1100ºC where the Heat Energy of the hot gases is converted into Mechanical Energy, thus rotating the Turbine / Generator. The output of the Electrical Energy is controlled by regulating the flow rate of the fuel sent to the combustor. The gas turbine is designed for option of dual firing, the other possible fuel being HSD. However, the project activity will run only using natural gas for the crediting period as per the management decision and the proposed amendment to the PPA.

The exhaust gas from the turbine is sent to HRSG (Heat Recovery System Generator) depending on the mode of operation. The exhaust gas after giving away its heat in the HRSG is dispersed through stack at about 100ºC. The HRSG is unfired type and there will not be any supplementary firing.

The following are the technical specifications of the main equipments:

Gas Turbine:
The gas turbine block consists of the turbine and the compressor. The annular combustor is installed between these units. The main parts are:

- rotor, with the turbine blades and the compressor blades, supported and guided in two journal bearings and one thrust bearing
- compressor casing and the turbine casing which also surrounds the annular combustor
- variable compressor inlet guide vanes
- compressor inlet
- compressor vanes, installed in the compressor casing and the compressor vane carrier
- compressor diffuser
- turbine vane carrier and turbine vanes
- exhaust casing
- blow-off system, with the blow-off valves of the first two stages installed under the blow-off hood (the valve for the third stage is mounted at the side and blows off into the exhaust duct)
- supports on the turbine end and the compressor end.

Heat Recovery steam Generator (HRSG): The main features of the HRSG are as follows

- Triple pressure natural circulation heat recovery steam generator
- Horizontal type
- Outdoor installation
- Internal insulated (Cold casing design)
- Maximum extent of shop assembly allowing short erection time
- High degree of standardisation enabling the use of the same basic elements for different HRSG sizes
- Serrated finned tube design
- Special welding process assures high heat transfer rate
- Large HP, IP and LP steam drums

Steam Turbine Generator (STG):
The single casing steam turbine consists of a standardised inlet- and exhaust-casing. Depending on the steam parameters different inlet and exhaust casings can be combined. The concept features of the steam turbine are as follows:

- modular product structure
- base mounted turbine with axial exhaust
- pre-assembled turbine packages

- compact turbine arrangement

The modular product structure enables the connection of different modular turbine parts for special requirements and therefore an optimised concept of the proposed steam turbine. Base mounted turbine with axial exhaust and pre-assembled turbine packages economise foundation- and erection- expenses.

The main components of the steam turbine are:
- HP-casing with flanged valve casing
- HP inner casing
- blade carriers in the low pressure section
- reaction blading
- welded (built-up) rotor
- integral friction coupling

The axial fix-point of the turbine casing is the support of the LP-part on the foundation. To compensate thermal expansion, the turbine casing and the front bearing pedestal are free to move into the direction of the front end. The thrust bearing is located within the front bearing pedestal and represents the fix-point of the shaft. The advantage of this design is the minimised differential expansion between static and rotating elements.

Under the EPC contract, all the major units were imported from Alstom Europe for the project activity. The initial training of the employees for the operation and maintenance has taken place as part of the EPC. The training was on the project activity site as well as the EPC contractor's European offices.

The age of the equipments installed under the project activity is 0 years (new) and the lifetime is 15 years. The installed capacity is 228 MW and will not alter in the crediting period or project life. The plant load factor is estimated to be 85%. The heat rate of the plant would be 1850 kcal/kWh on GCV (or 1682 kcal/kWh on NCV). The power plant will deliver annual 1647 GWh exportable electricity and consume 1.07 million standard cubic meter (SCM i.e. m^3) natural gas per day. The gas supply agreement with the Gas Authority of India Ltd. (GAIL) is signed for supply of 1.10 million SCM gas. The monitoring for the project activity constitutes the electricity exported, quantity of natural gas consumed and its NCV. The electricity exported in measure at the dispatch sub-station by two separate meters (main and check). The quantity of gas is monitored at the gas suppliers' terminal at the project site and also checked before the usage at GT. The supplier terminal also measures continuous NCV of the gas being fed.

The technology for the power generation is best available in the category. The choice of the technology will further reduce the GHG emission associated with the most probable alternative choice – coal fired thermal power plant and open cycle option. In addition, the emissions of CO, particulates (fly ash) will also be reduced compared to the identified alternate. The project activity will abide by all the regulatory norms of the pollution control board and will maintain environmentally clean and sound process.

The project technology was the best available at the time of EPC. It includes advanced features like dry low NOx EV burners for reducing the emissions of NOx[3]. The PP will not replace the units in the project activity more efficient technology within the project period.

[3] http://www.power.alstom.com/home/equipment___systems/turbines/gas_turbines/gt13e2

There is no technology transfer involved in the project activity.

In absence of the project activity, as identified in the section B.4, the PP could have chosen a coal fired power plant of similar power output resulting in substantially higher GHG emissions. The main equipments in the baseline include boilers and turbine generators equivalent to the same electricity export as that of the project activity.

A.4.4. Estimated amount of emission reductions over the chosen crediting period:

Years	Annual estimation of emission reductions in tonnes of CO_2e
2012	448,988
2013	448,988
2014	448,988
2015	448,988
2016	448,988
2017	448,988
2018	448,988
2019	448,988
2020	448,988
2021	448,988
Total estimated reductions (tonnes of CO_2e)	**4,489,880**
Total number of crediting years	**10**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**448,988**

A.4.5. Public funding of the project activity:

The total project cost is met by the PP by debt finance from banks and financial institutes. Public funding from Annex I countries and diversion of official development assistance (ODA), is not involved in this project activity.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

The approved baseline and methodology, AM0029 has been used to determine the baseline and monitoring of the project activity. The title of the methodology is "Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas" (Version 3, EB 39**).**

The methodology mentioned above makes reference to the following tools, which have also been used in the project activity.

Tool for the demonstration and assessment of additionality	Version 06.0.0, EB 65, Annex 21
Tool to calculate the emission factor for an electricity system	Version 02.2.1, EB 63

B.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The project activity is construction and operation of a new natural gas fired grid-connected electricity generation using combined cycle power plant.

Requirements as per the Baseline Methodology, AM0029, Ver. 03	Applicability to this Project Activity
The project activity is the construction and operation of a new natural gas fired grid-connected electricity generation plant	The project activity involves the construction and operation of a new natural gas fired combined cycle power plant (CCPP), of 228 MW capacity for electricity generation. The project activity is connected to the Southern regional grid of India. Natural Gas is the only fuel to be used in the project activity. There is no other fuel used either during the start up or co-fired.
The geographical/ physical boundaries of the baseline grid can be clearly identified and information pertaining to the grid and estimating baseline emissions is publicly available.	In this case the baseline grid is Southern regional grid of India and the information pertaining to the grid and estimating baseline emission is publicly made available by the Central Electricity Authority (CEA) of India[4].
Natural gas is sufficiently available in the region or country, e.g. future natural gas based power capacity additions, comparable in size to the project activity, are not constrained by the use of Natural Gas in the project activity.	Appendix 1 discusses further on the gas availability and it is concluded that the gas for project activity will not be diverted from existing users and also there is potential for future capacity addition. Thus, natural gas is sufficiently available in the region and country and future capacity addition of comparable size is not constrained due to the project activity plant.

Gas supply agreement to support the availability

Considering the total project activity size 228 MW and 100% PLF, the maximum gas requirement is 1.07 million SCM/day. The PP has a long term fuel supply agreement with GAIL to supply 1.1 million SCM/day[5].

The maximum gas requirement is calculated as below

Maximum gas requirement = electricity generated at 100% PLF (kWh) x heat rate (kcal/kWh) / calorific value (kcal/SCM)

= (228 x 1 x 24 x 365 x (1682/ 8570) / (365 x 10^3))

= 1.07 million SCM / day

< 1.1 million SCM / day (fuel supply agreement)

[4] http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm

[5] Fuel Supply Agreement with GAIL, was signed before the start date of the project activity

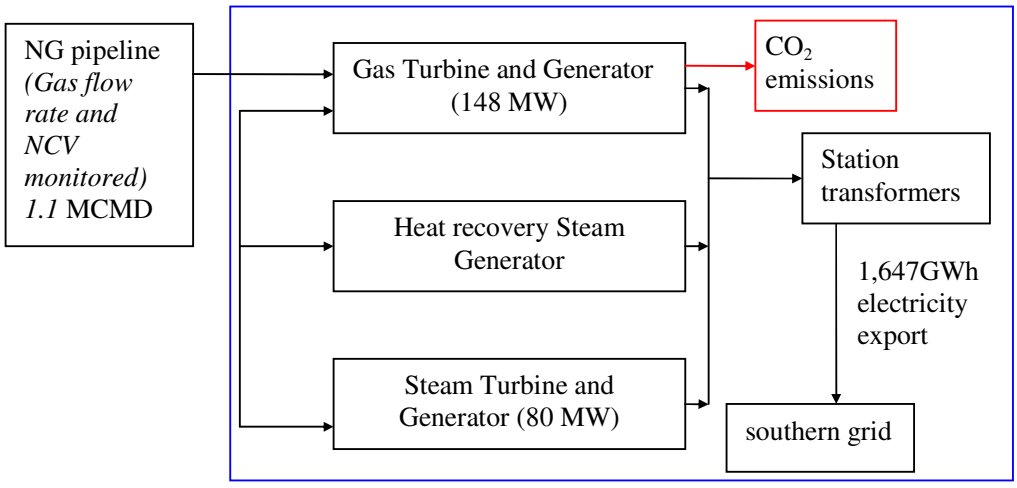
Thus, the maximum gas requirement even at the 100% PLF is less than that project activity has access to as per the fuel supply agreement.

Thus the applicability conditions of baseline methodology AM0029, V. 03 are fulfilled and it can be used for the project activity.

B.3. Description of the sources and gases included in the project boundary:

According to AM0029, the spatial extent of the project boundary includes the project site and all power plants connected physically to the baseline grid as defined in "Tool to calculate the emission factor for an electricity system." According to the Tool to calculate the emission factor for an electricity system, for the baseline emission factor, the spatial extent of the project boundary includes the project site and all power plants connected physically to the electricity system that the CDM project power plant is connected to.

Since the CDM project is connected to the regional grid it is also preferred to take the Southern regional grid as project boundary than the state boundary. It also minimizes the effect of interstate power transactions, which are dynamic and vary widely. Thus the project boundary comprises the project site and all power plants connected physically to the southern grid. The specific components and facilities included in the project boundary are (1) Gas Turbine -one (2) Heat recovery steam generator – one (3) steam turbine generator – one (4) Station transformers (5) Auxiliary equipments of Gas Turbine and Generator, Heat Recovery Steam Generator and Steam Turbine and Generator; meters (gas, electricity) and gas supply pipelines.



	Source	Gas	Included/ Excluded	Justification/Explanation
Baseline	Power Generation in baseline	CO_2	Included	Main emission source
		CH_4	Excluded	Excluded for simplification. This is conservative

		N_2O	Excluded	Excluded for simplification. This is conservative
Project Activity	On-site fuel combustion due to the project activity	CO_2	Included	Main emission source
		CH_4	Excluded	Excluded for simplification. This is a minor emission source.
		N_2O	Excluded	Excluded for simplification. This is a minor emission source.

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

National and Sectoral Policies:

The Indian power demand has been growing with the growth of economy and so was the demand supply gap. According to projections made by the CEA, in the 17th Electric Power Survey (EPS), demand for electricity is likely to surge from 648 billion kWh in 2006-07 to 969 billion kWh in 2011-12. Peak demand is expected to grow from 105,825 MW to 167,054 MW during the same period. The government had targeted capacity additions of about 78,700 MW during the Eleventh Five-Year Plan which has now been revised to 62,400 MW due to slow on-ground progress made by some projects[6]. As in August, 2011, the total installed capacity was 181,558.12 MW with gas constituting only 9.75% of this[7].

The Government has been encouraging private sector participation. The Electricity Act, 2003 was the key in the power sector reforms process. It consolidated the previous policies, thereby streamlining the sector and improving efficiency. Following the Electricity Act 2003, the National Electricity Plan 2005 and National Tariff Policy 2006 were introduced, which primarily covered power for all and competitive bidding for projects.

Baseline scenario identification as per the requirements of AM0029 leads us to the following assessment at the start of the project activity.

1. Identify plausible baseline scenarios

As required under AM0029 Version 03, the approach 48 (b) of CDM modalities and procedures "*Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment"* is being used to determine the baseline scenario.

The purpose of the project activity is to generate electricity and deliver it to the Southern Grid to cater to the base load power requirement of the grid.

The various possible alternatives available with the PP at the time of the starting date of the project activity, which is considered as the date of notice to proceed to the EPC Contractor, include the following:

[6] State of the Industry, November 2010. CRISIL Research. Pg. 15 (copy provided to DOE)

[7] http://powermin.gov.in/indian_electricity_scenario/introduction.htm

a) The project activity i.e. 228 MW NG based Combined Cycle power plant with an efficiency of 50%[8] and with a lifetime of 15 years not taken as a CDM project activity.

The purpose of the project activity is to generate electricity from the Natural Gas and deliver it to the Southern Grid to meet the base load power requirement of the grid. This alternative is in compliance with all the applicable legal and regulatory guidelines. Hence this option can be a part of the baseline scenario.

b) Power generation using Natural Gas as the fuel but with different alternative technologies.

The different possible technologies that are available with the PP to generate power using natural gas as the fuel include

b.1) Power generation using Combustion Turbine with an installed capacity of 228 MW (ISO Conditions) with an efficiency of 34%[9] using Open cycle mode of operation with a lifetime of 15 years.
This alternative generates electricity using Natural Gas as the fuel and can cater to the base load demand of the southern grid but has lower system efficiency compared to the project activity. As the option has lower system efficiency in comparison to the power generation using Combined Cycle mode of operation, it is not a realistic and credible alternative to the PP to opt for open cycle mode of operation for high capacities such as the case of project activity. Also, it does not deliver the output/ services equivalent to the project activity. Therefore this alternative cannot be a part of the baseline scenario.

b.2) Power generation using Gas Turbine in Cogeneration mode of operation.

This alternative generates both steam and electricity from Natural Gas, though the thermal efficiency is very high in this mode of operation (63%)[10] the electrical efficiency is low in comparison with the Combined Cycle Mode of Operation (50%)[7]. The Cogeneration mode of operation is mainly used to provide electricity and steam for industrial facility and the project activity's purpose is to deliver the power to the grid. Hence this option does not deliver the similar output/ services comparable to the project activity. Hence, this is also not a credible and realistic alternative for the PP and therefore this alternative cannot be a part of the baseline scenarios.

c) Power generation using energy sources other than Natural Gas
The various alternative energy sources that can generate power other than natural gas include:
c.1) Power generation with thermal power plants using coal as the energy source with an efficiency of 34%-36%[11] with a life of 25 years[12]

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[8] http://www.energymanagertraining.com/CHPMaterial/07-II-Gas_Combined_Cycle.doc (pg. 4 of 14)

[9] Plant Engineer's Reference Book, Second Edt. Dennis Snow, Butterworth-Heinemann, 2002

ISBN 0750644524, pg. 22/7; (reference submitted to DOE)

[10] http://www.netl.doe.gov/publications/proceedings/01/carbon_seq/2B1.pdf (p. 3)

[11] http://www.iea.org/textbase/work/2004/zets/apec/presentations/sharma.pdf (p. 15)

[12] cercind.gov.in/160502/comp_bidding.pdf (p. 12)

The baseline methodology AM0029, pg 2 under the 'Identification of the baseline scenario' requires '***the baseline scenario candidates identified may not be available to project participants, but could be other stakeholders within the grid boundary*** *(e.g. other companies investing in power capacity expansions). Ensure that all relevant power plant technologies that have recently been constructed or are under construction or are being planned (e.g. documented in official power expansion plans) are included as plausible alternatives.*'

There were two coal based IPP projects under development in Andhra Pradesh with same power purchaser (as that of the project activity i.e. APTransco) (1) 2x260 MW coal-based plant of BPL Power Projects (AP) Ltd. at Ramagundam[13] (2) 2x520 MW Visakhapatnam Power Project by Hinduja National Power Corpn. Ltd.[14] Thus, the coal based power plant option was available to other stakeholders in the grid. Thus, the option of developing a subcritical coal based power project was also a credible alternative.

A number of actions are needed to assess the feasibility of a project including EPC contract, PPA, FSA, environmental clearances etc. Thus, these different steps were also taken by PP to study the feasibility of a power project and the public hearing referred was part of this feasibility study. These pre-feasibility steps are needed to approach financiers including banks as evident from the letter from Bank (submitted to the DOE).

Also, in January 2002, GVK was awarded a coal mine for a 500 MW coal based power plant[15]. Thus, GVK management had the option of going for a coal based power plant instead of the CDM project activity power plant. Thus, coal can be considered a credible alternative.

This is a realistic and credible alternative to the PP which delivers base load power to the grid. Hence this is a plausible baseline scenario.

c.2) Power generation with thermal power plants using lignite as the energy source
The option is not a plausible scenario given its low calorific value and property of spontaneous combustion[16], lignite is likely to remain a captive energy resource for pit head power plants. In India, lignite is produced mainly in Tamil Nadu by Neyveli Lignite Corporation and Gujarat Mineral Development Corporation Ltd. in Gujarat[17]. GMDC not in same grid and NLC does not sale to other users[18].
c.3) Power generation using wind as the energy source with an average PLF of 20%[19].
Power generation from wind does not meet the base load requirement for the grid on a continuous basis as wind is seasonal in nature and the capacity utilization factor is very low. Due to the high uncertainty of

[13] http://www.financialexpress.com/printer/news/63579/

[14] http://www.processregister.com/Visakhapatnam_Power/Project/pid6967.htm;

http://hindujanationalpower.com/

[15] (http://coal.nic.in/alloblocklist.htm) [Refer Sl. No. 19 - GVK Power (Govindwal Sahib) Ltd.]

[16] www.benetechusa.com/pdf/article/SpontaneousCombOfPRBCoal.pdf

[17] http://www.indiaenergyportal.org/subthemes_link.php?themeid=10&text=coal#

[18] http://www.nlcindia.co.in/index.php?file_name=products//products_01.htm

[19] Refers to data from Ministry of Non-conventional Energy Sources, Govt. of India.
www.energymanagertraining.com/kaupp/Article28.pdf

wind it is not a credible and realistic option for the PP for such high capacity comparable to the project activity.

c.4) Power generation using Hydro as the energy source (lifetime 35 years)
The different types of hydro power projects available with the PP include:
c.4.1) Reservoir storage based hydro power plants:
This is not a plausible baseline scenario as it delivers peak-load power to the grid and not the base load power[20]. Thus it does not deliver same level of services as the project activity.
c.4.2) Run-of-river based hydro power projects
Power generation from hydro is not a feasible alternative to the project activity as it involves high gestation periods and also cannot meet the base load power requirement for the grid on a continuous basis due to the uncertainty of monsoons. Moreover, the hydro power projects are not credible and realistic alternative to the PP due to the following reasons.

- Hydro power projects generally entail a long gestation period. In addition to this, these projects are comparatively capital intensive[21]. In the context of resource shortages and continuing power shortages, thermal projects (coal, liquid fuel and gas), which need a relatively short gestation period, have been getting priority in fund allotments[22].
- The existing tariff formulation norms for hydro projects (based on a cost plus approach) with no premium for peaking services and the provision for 12% free power to distressed states from the initial years are also proving to be deterrents[23].

Hence, the above alternative cannot be an option for baseline scenario.

c.5) Power generation using cluster of Diesel Engine and oil based power plants with an efficiency of 50%[24] and a lifetime of 15 years[25].
The following table gives the list of various oil based power plants connected to the Southern grid[26].

Diesel based power plants in database

Name of plant	Date of commissioning	Capacity on 31/03/2007	State	Sector
LVS Power DG	18/10/2001	36.8	Andhra Pradesh	Pvt
Yelhanka (DG)	1993-94	127.92	Karnataka	State

[20] The Base Load Fallacy, Author: Mark Diesendorf;
http://www.cana.net.au/documents/Diesendorf_TheBaseLoadFallacy_FS16.pdf

[21] http://www.adb.org/Documents/Reports/Hydropower-Devt-India/Hydropower-Devt-India.pdf (pg. 9)

[22] http://www.adb.org/Documents/Reports/Hydropower-Devt-India/Hydropower-Devt-India.pdf (pg. 9)

[23] http://www.adb.org/Documents/Reports/Hydropower-Devt-India/Hydropower-Devt-India.pdf (pg. 11)

[24] Power generation technologies, P. Breeze. Elsevier Publications. Pg. 66.
http://books.google.com/books?id=D9qSDgTbRZoC&pg=PA66&dq=diesel+power+plant+efficiency&ei=4l7TSbfIJYGUkAS70KCmCQ#PPA66,M1

[25] http://mnes.nic.in/baselinepdfs/annexure2c.pdf

[26] CEA – CO_2 baseline database for Indian power sector, version 03 (choose data – SR region and fuel 1 – oil, diesel, naphtha)

Bellary DG	20/09/2000	25.2	Karnataka	Pvt
Brahmapuram DG	06/05/1997	106.5	Kerala	State
KOJIKODE DG	01/09/1999	128	Kerala	State
KASARGODE DG	06/06/1999	21.9	Kerala	Pvt
SAMAYANALLUR DG	22/09/2001	106	Tamil Nadu	Pvt

Oil based power plants in database

Belgaum DG	31/03/2001	81.3	Karnataka	Pvt
B. BRIDGE D.G	1998-99	200	Tamil Nadu	Pvt
SAMALPATTI DG	01/03/2001	105.7	Tamil Nadu	Pvt

The above table show that all the plants were installed before 2001 and lately the IPPs are not going for the liquid fuel based generation due to the increase in the fuel costs. The State Electricity Boards are also discouraging the IPPs to go for Liquid fuel based power plants for the same reason[27]. The prices of petroleum products have long since been controlled by the Government of India (GoI) under the Administered Pricing Mechanism (APM) to reduce the burden on the consumers. However, in April 2002 the GoI dismantled the APM on the oil derived fuels (petrol, diesel etc.) after which there has been sharp increase in their prices to match international parity prices. Hence the option is not an economically viable alternative to any individual IPP with such a large capacity as it was mandated by the Central Government that sanction of IPPs should be through the competitive bidding mechanism[28]. Moreover, the fully rupee denominated tariffs not being financeable also owes itself to the failures that have been observed in the Indian power sector particularly relating to the short gestation liquid fuel projects[29]. In the Merit Order Dispatch regime, the dispatch from the individual power producing stations will be taken by the DISCOM based on the merit order. In the power surplus scenario, the generating station which produces high cost power will be first asked to back down. This system is to bring the cost competitiveness in the market and would not allow the high priced generating stations to operate. The cost of electricity generation at central generating stations was ₹ 5.36/ kWh[30] in 2004-05 and ₹ 7.00/ kWh in 2005-06.

Therefore this alternative cannot be a part of the baseline scenario.

c.5) Power generation using Nuclear Fuel

This scenario is available only to Nuclear Power Corporation of India Limited, a 100% Government of India owned Company[31], whose capacity additions are driven by the Government of India initiatives based on its long term strategic programmes and not by the project activity. Hence, this option is not available for any of the stakeholders including the PP. Therefore this alternative cannot be a part of the baseline scenario.

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[27] http://www.capitalmarket.com/Magazine/cm1409/indrep.htm

[28] www.cercind.gov.in/160502/comp_bidding.pdf

[29] www.cercind.gov.in/160502/comp_bidding.pdf

[30] Reference submitted to DOE

[31] Atomic Energy Act, 1962 & news letter issued by Business Line- http://www.blonnet.com/2006/05/22/stories/2006052202930300.hmt

c.6) Electricity imports from other grids:

This is not a realistic alternative as all the other grids are themselves facing shortages in meeting the energy demands and especially at the peak demand. The monthly average peak deficit for the year 2004-05 being: Northern Region – 9.1% deficit; Eastern Region – 2.5% deficit; North-Eastern Region – 13.6% deficit; Southern Region – 2.5% deficit and Western Region – 20.3 % deficit[32]. This alternative also does not deliver the same output comparable to the project activity due to the high transmission losses. Hence this alternative cannot be a part of the baseline scenario.

c.7) Electricity generation using Naphtha as fuel

The Naphtha based power plant comprises naphtha turbine and heat recovery system in the combined cycle mode. The overall efficiency in combined cycle is 39%[33]. In 2000, Government of Andhra Pradesh discontinued naphtha based proposals due to the fuel price volatility[34]. Thus, the option is not considered further.

c.8) Coal fired supercritical power plant

The coal fired supercritical power plant is new advanced technology. However, the technology was not available in India in 2003 (at the time of project activity decision was made). The first supercritical power plant in India was being built in 2006[35,36]. The first supercritical power plant in India had started operation in December 2010[37].

From the above discussion it is evident that the plausible baseline scenarios identified by the PP include:

a) The project activity i.e. 228 MW NG based Combined Cycle power plant with an efficiency of 50%-55% in combined cycle mode of operation and with a lifetime of 15 years not taken as a CDM project activity.
b) Power generation using coal as the energy source with an efficiency of 35%-38% with a life of 25-30 years

Based on the investment analysis presented in the following section B.5, table below summarizes the levelized cost of electricity generation for identified alternatives.

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[32] http://www.cea.nic.in/about_us/Annual%20Report/2004-05/Contents.htm (Chapter 4)

[33] Plant Engineer's Reference Book, Second Edt. Dennis Snow, Butterworth-Heinemann, 2002

ISBN 0750644524, pg. 22/7; NG and Naphtha based plants are same – duel fired capacity, so efficiency taken same as that of NG power plant. (reference submitted to DOE)

[34] PPA of VPGL dt. 12/04/2003 pg. 9, first line 'GoAP in March 2000 decided not to allow projects in Naphtha and converted the project fuel to natural gas …' Also, the data from Ministry of Commerce and Industry, Government of India shows wide fluctuation and steep increase in naphtha prices over 2004-05 to 2010-11 (evidence submitted to DOE).

[35] Suresh et al., 2006. Advances in Energy Research. http://www.ese.iitb.ac.in/aer2006_files/papers/031.pdf

[36] http://goliath.ecnext.com/coms2/summary_0198-211733_ITM

[37] Media release from Adani Power Ltd. (http://www.adanipower.com/Data/APLMediaReleasefirst660Unit.pdf) and Article from The Economic Times on 24/12/2010 (http://articles.economictimes.indiatimes.com/2010-12-23/news/27609644_1_power-plant-mw-coal-adani-power)

Sr. No.	**Baseline Scenario**	**Levelized Cost of generation (₹/ kWh)**
(a)	Project activity implemented without the CDM	1.54
(b)	Power generation using coal as the energy source	1.43

Thus, the economically attractive baseline scenario as identified by the investment analysis using the levelized cost of electricity generation (in ₹/ kWh) as the financial indicator is the alternative i.e. (b) power generation using coal as the energy source.

Sensitivity Analysis: Further a sensitivity analysis is performed on both the alternatives to vary important parameters in line with Guidance 20 of the EB62, Annex 5. The justification on the selected range of sensitivity parameters is also presented in the Section B.5 and it is concluded that the actual plant performance is within this sensitivity range.

S.N.	Parameter varied	**Levelized Cost of generation (₹/ kWh)**	
		Project activity implemented without the CDM	Power generation using coal as the energy source
		+10%	+10%
1	Capital cost	1.61	1.51
2	Fuel cost	1.62	1.50
3	Heat rate	1.62	1.50
4	Plant load factor	1.47	1.36
5	O&M cost	1.56	1.45
6	Auxiliary consumption	1.54	1.45
7	Interest rate	1.56	1.46
8	Escalation on O&M cost	1.55	1.44

S.N.	Parameter varied	**Levelized Cost of generation (₹/ kWh)**	
		Project activity implemented without the CDM	Power generation using coal as the energy source
		-10%	-10%
1	Capital cost	1.48	1.37
2	Fuel cost	1.46	1.37
3	Heat rate	1.46	1.37
4	Plant load factor	1.61	1.51
5	O&M cost	1.52	1.42
6	Auxiliary consumption	1.53	1.42
7	Interest rate	1.51	1.41
8	Escalation on O&M cost	1.53	1.42

As the sensitivity results is conclusive that under no scenario, the project activity without CDM is financially attractive compared to the alternative 'Power generation using coal as the energy source'. Thus, this is chosen as the baseline.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

The PP has continued steps to demonstrate Additionality.

2. Identify the economically most attractive baseline scenario alternative.

Sub Step -1: Benchmark Investment Analysis

As per Additionality tool Version 06.0.0, Sub-step 2b, option III "Identify the financial/economic indicator, such as IRR, most suitable for the project type and decision context".

Hence, the benchmark used for proving the additionality can be any financial indicator, such as IRR which is most suitable for the decision making context.

The tariff structure[38] for the concerned project activity is the two part tariff system, which consists of two components Viz.

1. Capacity Charge: Capacity charge includes Foreign Debt Service Charge ("FDSC") and other fixed charge ("OFC"). The FDSC of US$ 0.006 per unit of Cumulative Available Energy is converted into Rupees at the prevailing exchange rate. Under the PPA, the FDSC shall be payable to us only for a period of 11 years to cover our foreign debt repayment obligations. The OFC of ₹ 0.699 per unit of the Cumulative Available Energy is fixed for the term of the PPA, (i.e. 15 years from COD).

2. Energy Charge. The Energy Charge, which includes the cost of fuel as delivered at the fuel metering point at the site. The formula for computing the Energy Charge under the tariff is as given below:

Energy Charge = EU x {(hC) /G x (1-A/100)}, where:

EU = The total number of energy units (kWh) delivered at the interconnection point;

h = Station Heat Rate of 1,850 Kilo Cal/kWh;

G = GCV of gas in Kilo Cal/unit of fuel;

C = cost of gas in Rupees per unit of fuel as delivered at the fuel metering point at the site; and

A = Auxilliary consumption which is 3% of generation.

Based on these two parameters a levelized tariff is fixed by the SEBs and it is paid for the concerned power generating stations throughout the PPA term.

Hence in the power policy regime, power plants are deemed to get a fixed return on investment (in line with tariff regulations of CERC, Ministry of Power). However, the dispatch from the individual power producing stations will be taken by the DISCOM based on the Merit order dispatch. In the power surplus scenario, the generating station which produces high cost power will be first asked to back down. This system is to bring the cost competitiveness in the market and would not allow the high priced generating stations to operate at the design efficiency. In the event of back down, the plant will operate at lower PLF and lower efficiency consuming more fuel than that at the design heat rate. Thus, the actual operating efficiency and the IRR would be lower than that covered by the tariff structure and additional fuel cost is

[38] Appraisal note by IDBI, 2001. pg. 50. Also the actual PPA (signed post decision) confirms same,

not 'pass through', but would be borne by the PP. The actual IRR will be dependent on the actual dispatch possible in the case of demand supply scenario in the future and availability of power to grid from other power plants, which cannot be predicted by PP during project conceptualization stage.

In the case of ABT and merit order dispatch, the PP is prone to fall in power off take preference list to the central sector coal based power plants. Hence for the project activity in such a power policy regime, taking the levelized cost of power generation as the financial indicator is justified.

The equity IRR is again irreverent in the project activity as it is 100% debt financed. The PP has chosen to compare the levelized cost of electricity production in "₹/kWh" for identified plausible baseline scenarios.

The levelized cost for the alternative (a) i.e. implementing the project activity without the consideration of CDM revenue is calculated by the following assumptions:

The following table details the assumptions used for the financial calculations. All the assumptions used in the financial model are based on the inputs that were used in the financial closure obtained by the project activity.

Techno Economic parameters 228 MW NG based power plant			**References**
Installed Capacity	228	MW	Performance guarantee as per EPC quote (GT = 148 MW and HRSG = 80 MW)
Total Investment	7251.6	₹ Million	Project cost estimate by the PP (based on Detailed Appraisal Memorandum by bank, 2001 pg. 57) and EPC quote from Alstom Projects India Ltd.
Debt: Equity	100:0	-	
Interest rate	10.75	%	PLR given by RBI in latest weekly publication before the investment decision.
Exchange rate	1 USD = ₹ 47.66		exchange rate on 27/02/2003 (evidence submitted to DOE)
O&M Costs	4% of the capital Cost	-	Project cost estimate by the PP based on three years operating history of existing power plant (evidence submitted to DOE)
annual escalation on O&M costs	6	%	
Plant Load Factor	85	%	Detailed Appraisal Memorandum by bank, 2001 (pg. 35)
Auxiliary Consumption	3	%	CERC (Terms & Conditions of Tariff) Regulations, 2001, pg. 8
Gross Calorific Value	10,000	kcal/ m^3	Fuel Supply Agreement dt 05 Oct 1999 Annex I, pg. no. 36 (gas pricing is adjusted as per this GCV value)
Station Heat Rate	1850	kcal/ kWh	draft PPA dt. 30/11/2001 Pg. 13, para 57

Fuel Charges	₹ 4200 / 1000 m^3	-	Detailed Appraisal Memorandum by bank, 2001. pg. 13
(Incl. Royalty, Transmission Charges and Sales tax)			
Book Depreciation Rate (Straight Line Method basis)			
annual depreciation	8.24	%	Gazette Notification, Ministry of Power, 1994 (copy submitted to DOE)
Book Depreciation up to (% of asset value)	90	%	
Income Tax			
Income Tax rate	35	%	IT Act, rates prevalent in 2002-03 at decision making
Minimum Alternate Tax	7.5	%	
Surcharge	5	%	
Working capital			
Fuel cost	12	days	CERC Regulations 2001 pg 13 and Project Note Page, Pg. 4 PLR given by RBI in latest weekly publication before the investment decision.
Spares	1% of capital cost		
Working capital margin	75	%	
Working capital interest rate	10.75	%	

The levelized cost of electricity generation using Natural gas as the energy source calculated using the above values comes out to be 1.54 ₹/kWh.

The assumptions considered for calculating the levelized cost of generation for the alternative (b) i.e. power generation using coal as the energy source are described in the table below. For coal based power plant, the nearest capacity in the standard available[39] TG Set i.e. 250 MW which is used for comparison. This 250 MW plant at 85% PLF and 9% auxiliary consumption will generate 1,693,965 MWh electricity. Whereas, a 228 MW gas based unit at 85% PLF and 3% auxiliary consumption will generate 1,646,757 MWh electricity. The difference is only 2.87% (higher for the coal based unit) between the baseline and project plant.

Techno Economic parameters for power generation using coal as the energy source		
Installed Capacity	250 MW	Capacity chosen to give same output as project activity (as explained above this table)
Total Investment	₹ 10,000 Million	Based on 4 Cr/ MW cost for other project by PP[40]
Debt : Equity	70:30	CERC (Terms & Conditions of tariff) Regulations, 2001
Interest rate	10.75%	Kept same as the alternative 1
O&M Costs + Insurance Charges	2.5% of the capital Cost	CERC (Terms & Conditions of tariff) Regulations, 2001, pg. 11
Plant Load Factor	85 %	Kept same as gas based power project to

[39] CERC - Terms & Conditions of Tariff applicable from 1.4.2004. pg. 53

[40] Evidence given to DOE based on approved project cost of another similar project

		get comparable output
Auxiliary Consumption	9.0%	CERC (Terms & Conditions of tariff) Regulations, 2001, pg. 8
Gross Calorific Value	4,940.0 kcal/kg	Price Notification No. 7/2001-2002 dated 9th April, 2001 from The Singereni Collories Co. Ltd
Station Heat Rate- Post Stabilization	2,500 kcal/ kWh	CERC (Terms & Conditions of tariff) Regulations, 2001, pg. 7
Fuel Charges	₹ 1,183 / 1,000 kg	Price Notification No. 7/2001-2002 dated 9th April, 2001 from The Singereni Collories Co. Ltd
Depreciation rate for revenue calculation (Straight Line Method basis)		
Annual depreciation	7.84%	Gazette Notification, Ministry of Power, 1994 (copy submitted to DOE)
Book Depreciation up to (% of asset value)	90%	
Book Depreciation Rate (Straight Line Method basis)		
Civil Works	3.34%	The Companies Act
Plant and Machinery	5.28%	
Book Depreciation up to (% of asset value)	90%	
Surcharge	5%	
Working capital		
Fuel cost	12	Kept same as other baseline alternative
Spares	1% of capital cost	
Working capital margin	75	
Working capital interest rate	10.75	

The levelized cost of electricity generation using Coal as the energy source calculated using the above values comes out to be 1.43 ₹/ kWh.

The table below summarizes the levelized cost of electricity generation for various alternatives.

Sr. No.	**Baseline Scenario**	**Levelized Cost of generation (₹/ kWh)**
(a)	Project activity implemented without the CDM	1.54
(b)	Power generation using coal as the energy source	1.43

Thus, the economically attractive baseline scenario as identified by the investment analysis using the levelized cost of electricity generation (in ₹/ kWh) as the financial indicator is the alternative (b) which is power generation using coal as the energy source.

As specified in the approved methodology AM0029, Version 03, the assessment and demonstration of additionality is to be carried by the following steps.

Step 1: Benchmark investment analysis

Demonstrate that that the proposed CDM project activity is unlikely to be financially attractive by applying sub-steps 2b (Option III: Apply benchmark analysis), Sub-step 2c (Calculation and comparison of financial indicators), and 2d (Sensitivity Analysis) of the latest version of the "Tool for demonstration assessment and of additionality" agreed by the CDM Executive Board. These sub steps are in following paragraphs

Sub-steps 2b (Option III: Apply benchmark analysis):
The financial indicator chosen is project IRR, which is the most commonly used by lenders for financial viability study. Further, as the project activity is 100% debt financed, the project IRR is compared with the commercial lending rate. This is in line with Guidance 12 of the EB62, Annex 5. The IDBI bank had issued a letter of intent in 2001 for financial assistant and the interest rate was fixed at 2% above the minimum term lending rate (MTLR) of the bank. The MTLR at the time of investment decision was 12.50%[41] and thus the lending rate is 14.50%. This is used as the benchmark for the benchmark analysis.

Sub-step 2c (Calculation and comparison of financial indicators)

Sr. No.	Alternatives	Value (%)
(a)	Project IRR of project activity implemented without the CDM revenue	10.06
(b)	Benchmark	14.5

From the above table it can be seen that the project IRR from the project activity is lower than the benchmark.

Sub-step 2(d)
A sensitivity analysis is performed to confirm that the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions i.e. Capital cost, Fuel price, Heat rate and Plant load factor.

S.N.	Parameter varied	Project IRR with variation of studied parameter		Benchmark
		+10%	-10%	
1	Capital cost	9.39%	10.71%	14.5%
2	Fuel price	10.00%	10.13%	
3	Heat rate	10.00%	10.13%	
4	Plant load factor	10.18%	7.47%	
5	O&M cost	9.33%	10.70%	
6	Auxiliary consumption	10.06%	10.06%	
7	Interest rate	10.05%	10.08%	
8	Escalation on O&M cost	9.78%	10.33%	

The sensitivity analysis also confirms that under all the possible scenarios, the project IRR for the project activity is below the benchmark. Thus, the project activity is financially not viable without CDM.

Conservativeness of inputs used in the financial analysis compared to actual values of parameters and range of sensitivity:

[41] The latest available RBI Weekly Statistical Supplement at investment decision in Feb. 2003 http://rbidocs.rbi.org.in/rdocs/Wss/PDFs/34625.pdf

The actual project cost from the common loan agreement (pg. 137 – copy submitted to DOE) is ₹ 7203.66 million and is covered in the sensitivity analysis (range covered is ₹ 7,976.76 – 6,526.44). The fuel price in the month of plant commissioning (taken from the suppliers' invoices) is 8,664.20/ 1000 m^3. The additionality is shown using about half of this cost (i.e. ₹ 4,200/ 1000 m^3) and thus, the input may be considered conservative. The heat rate in last two years from commissioning was 1,806 and 1,854 respectively. The sensitivity analysis covers these values (range covered is 2,035 – 1,665 kcal/kWh). The PLF in last two years was 90.34% and 81.75%. Both these values are already covered in the sensitivity analysis performed on the PLF (range covered is 76.5 - 93.5%).

Further, O&M cost, auxiliary consumption, interest rate and the escalation on O&M cost are also subjected to ±10% sensitivity to cover any possible change in these parameters during the life of the project activity. As per the O&M cost (submitted to DOE) for the project activity, the project will spend on an average 3.3% for the regular and major maintenance. Thus, the sensitivity was extended to -17% (from 4% used in the investment analysis as per investment decision) and the levelized cost at that O&M cost is ₹ 1.50/kWh (compared to ₹1.43/kWh of coal at base conditions) and project IRR is 11.24% compared to 14.5% benchmark. Thus, the sensitivity range may be considered conservative.

Hence from the above it can be concluded that the Baseline scenario – Coal based power generation is the most financially attractive option and the project activity - Natural gas based power generation without CDM revenue is not the most financially attractive option.

Step 2: Common Practice Analysis

According to the "Tool for the demonstration assessment and of additionality", version 06.0.0; analysis of any other activities implemented previously or currently underway that are similar to the proposed project activity needs to be performed to describe whether and to which extent similar activities have already diffused in the relevant region.

The following table represents the total installed capacity in India and the share of the coal based power plants and natural gas based power plants[42].

Region	Total Thermal Power Generation, (MW)	Generation using Coal as fuel (MW)	% generation using coal as fuel of the thermal power generation	Generation using gas as fuel (MW)	% generation using gas as fuel of the total installed capacity
Northern	19,143	15,915	83	3,213	10
Western	25,845	20,792	80	5,035	16
Southern	16,982	13,393	79	2,650	9
Eastern	15,235	15,027	97	190	1
North Eastern	1,223	330	27	751	32
Island	64	0	0	0	0
All India	78,491	65,456	83	11,840	11

[42] Infralines' paper on "Natural gas for power sector: issues and challenges". Infraline Energy Research & Information Services. New Delhi. (Copy of paper provided to DOE)

As it can be seen from the above table, the percentage of the gas based power plants in the entire India is 11% of the total installed capacity and that of coal based power plants is 83% of the thermal capacity and 60% of the total installed capacity in India. The total percentage of the gas based power plants in Southern Region is only 9% of the total installed capacity. This collaborates the fact that Natural Gas based power generation is not commonly carried out practice in India.

Step 4: Common practice analysis

Sub-step 4a: Analyze other activities similar to the proposed project activity

The first step in the tool is to - Analyze other activities '*that are operational and that are similar to the project activity*' viz., projects that are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing etc. (but excluding the other CDM project activities). Accordingly, we are to analyze the following project activities (that are similar):

1) Technology: The technology of the project activity is natural gas based combined cycle power plant (NG CCPP). Thus, all the NG CCPP projects in operating before the project activity start date are listed below from CEA CO_2 database for Indian Power Sector (Ver. 03 – latest available at the start of validation of the project activity.)

2) Comparable Environment (regulatory framework, investment climate, access to technology and finance): The similar power project in the grid same as the project activity (Southern grid only) are considered.

3) Time line: Here, the projects that were commissioned before the start date of the project activity only are considered.

By applying these three criteria, following 32 projects were found.

S.N.	NAME	UNIT NO	DT_ COMM	CAPACITY MW	STATE	SYSTEM
1	VIJESWARAN GT	1	31/08/90	33	ANDHRA PRADESH	APGENCO
2	VIJESWARAN GT	2	02/03/91	33	ANDHRA PRADESH	APGENCO
3	VIJESWARAN GT	3	01/04/98	112.5	ANDHRA PRADESH	APGENCO
4	VIJESWARAN GT	4	30/03/92	34	ANDHRA PRADESH	APGENCO
5	VIJESWARAN GT	5	23/12/97	59.8	ANDHRA PRADESH	APGENCO
6	JEGURUPADU GT	1	04/07/96	52.8	ANDHRA PRADESH	GVK IND
7	JEGURUPADU GT	2	26/10/96	52.8	ANDHRA PRADESH	GVK IND
8	JEGURUPADU GT	3	11/12/96	52.8	ANDHRA PRADESH	GVK IND
9	JEGURUPADU GT	4	01/04/98	77	ANDHRA PRADESH	GVK IND
10	GODAVARI GT	1	11/07/97	47	ANDHRA PRADESH	SPECT IND
11	GODAVARI GT	2	11/02/97	47	ANDHRA PRADESH	SPECT IND
12	GODAVARI GT	3	09/03/97	47	ANDHRA PRADESH	SPECT IND
13	GODAVARI GT	4	19/04/98	67	ANDHRA PRADESH	SPECT IND
14	KONDAPALLI GT	1	22/06/00	112	ANDHRA PRADESH	KONDAPALI
15	KONDAPALLI GT	2	22/06/00	112	ANDHRA PRADESH	KONDAPALI
16	KONDAPALLI GT	3	22/06/00	126	ANDHRA PRADESH	KONDAPALI

17	PEDDAPURAM CCGT	1	26/01/02	220	ANDHRA PRADESH	REL
18	TANIR BAVI	1	08/06/01	42.5	KARNATAKA	GMR ENERG
19	TANIR BAVI	2	08/06/01	42.5	KARNATAKA	GMR ENERG
20	TANIR BAVI	3	08-Jun-01	42.5	KARNATAKA	GMR ENERG
21	TANIR BAVI	4	08/06/01	42.5	KARNATAKA	GMR ENERG
22	TANIR BAVI	5	21/11/01	50	KARNATAKA	GMR ENERG
23	KAYAM KULAM GT	1	02/11/98	115.3	KERALA	NTPC
24	KAYAM KULAM GT	2	28/02/99	115.3	KERALA	NTPC
25	KAYAM KULAM GT	3	30/10/99	119.4	KERALA	NTPC
26	VALUTHUR GT	1	27/11/03	64	TAMIL NADU	TNEB
27	KUTTALAM GT	1	27/11/03	64	TAMIL NADU	TNEB
28	KOVILKALAPPAL	1	05/02/01	107	TAMIL NADU	TNEB
29	P.NALLUR CCGT	1	22/02/01	330.5	TAMIL NADU	PPNPG
30	KARAIKAL	1	05/03/99	32.5	PONDICHERY	PPCL
31	NARIMAN GT	1	14/01/92	5	TAMIL NADU	TNEB
32	NARIMAN GT	2	18/01/92	5	TAMIL NADU	TNEB

These projects are filtered further by the size of power plant to be between ±50% i.e. 114 to 342 MW. Then only six projects remain.

S. N.	NAME	UNIT NO	DT_ COMM	CAPACITY MW	STATE	SYSTEM
1	KONDAPALLI GT	3	22/06/00	126	ANDHRA PRADESH	KONDAPALI
2	PEDDAPURAM CCGT	1	26/01/02	220	ANDHRA PRADESH	REL
3	KAYAM KULAM GT	1	02/11/98	115.3	KERALA	NTPC
4	KAYAM KULAM GT	2	28/02/99	115.3	KERALA	NTPC
5	KAYAM KULAM GT	3	30/10/99	119.4	KERALA	NTPC
6	P.NALLUR CCGT	1	22/02/01	330.5	TAMIL NADU	PPNPG

Further, the Power Purchase Agreement for the project activity was signed with APTRANSCO with the tariff that was fixed for the short gestation projects (Natural Gas Based Power Generation Projects) selected under the International Competitive Bid Process (ICB). The other fixed charges was fixed at ₹ 0.669 per unit of cumulative available energy and the Foreign Debt Service Charge was fixed at US $ 0.006 per unit of cumulative available energy payable at the current exchange rate. The Foreign Debt Service Charges are payable only in respect of period ending on 11th annual anniversary of the COD of the project activity. The above plants have not come up under ICB or similar tariff structure as the project activity.

The tariff fixed for the project activity was to match the tariff fixed for the Natural Gas based Power Projects which have participated in the International Competitive Bid Process.

It should also be noted that there has been no other Natural Gas based Power Project that has been commissioned in the state of Andhra Pradesh with the similar tariff structure and without CDM consideration. Hence, it can be concluded no similar activities have diffused in the relevant region without the consideration of CDM revenue.

The project activity is also demonstrated to be not a common practice using para 47 of the Tool for the Demonstration and Assessment of Additionality (Ver. 06) and step wise analysis is presented below.

Step 1: *Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.*

The project activity is a 228 MW power plant. Thus, the applicable range in ±50% of this capacity is 114 and 342.

Step 2: *In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Step 1, as the proposed project activity and have started commercial operation before the start date of the project. Note their number N_{all}. Registered CDM project activities and projects activities undergoing validation shall not be included in this step.*

The PP has chosen the host country as the default geographic are for this analysis. The CEA's CO_2 baseline database for the Indian Power Sector (version 03, which was latest at the start of validation and gave all commissioned power projects at the starting date of the project activity i.e. 14/01/2004 is chosen). This is a national database published by the NCDMA and gives all the grid connected power plant.

By applying two filters, i.e. capacity within 114 – 342 MW and commissioning date before 14/01/2004, total 317 plants were found.

Thus,

N_{all} = 317

Step 3: *Within plants identified in Step 2, identify those that apply technologies different that the technology applied in the proposed project activity. Note their number N_{diff}.*

From the list that gave N_{all}, for further analysis to identify plants that apply different technologies, the natural gas based plants are removed to show plants using coal, diesel, lignite, naphtha, nuclear and hydro. This resulted in remaining plants different than the project activity to be 289.

Thus,

N_{diff} = 289

Step 4: *Calculate factor $F=1-N_{diff}/N_{all}$ representing the share of plants using technology similar to the technology used in the proposed project activity in all plants that deliver the same output or capacity as the proposed project activity.*

F =1 - (289/317)
= 0.09

The proposed project activity is a common practice within a sector in the applicable geographical area if both the following conditions are fulfilled:
(a) the factor F is greater than 0.2, and
(b) Nall-Ndiff is greater than 3.

In the case of the project activity, F = 0.09 < 0.2 and hence this condition is not fulfilled. Thus, the project activity is not a common practice.

The investment decision making body at the board level had seriously considered CDM revenue for the financial viability in approving the project activity. The board meeting where financial approval for the project activity was given considering the CDM revenue was held on 28/02/2003.

Techno-environment risks: The natural gas based power production technology which was sought to be installed by GVK Industries at that stage, presented a specific financial environment for the project (change from fixed tariff to two part tariff). Risks in that specific financial environment (created by the use of natural gas based power generation as the technology for power production), is referred to in the quoted statement from the minutes of the meeting. The carbon revenue was seen by the board as mitigating that risk.

The tariff structure discussed in the Section B.5 of the PDD, and the risk of lower capacity utilization because of merit order dispatch is elaborated.

Prior Consideration of the CDM:

The project implementation chronology and the steps in the CDM registration process are presented in following table.

SN	Time	Project Execution Step	CDM registration efforts	Evidence
1	04/01/2003	-	Meeting with CDM consultant for eligibility of plant (prior awareness)	Minutes of the meeting with CDM consultant – PWC, Mumbai
2	28/02/2003	Board meeting for the investment decision	The Board considered CDM revenue for the project viability	Extracts of the minutes of Board meeting
3	14/01/2004	Notice to proceed to the EPC contractor with first installment disbursement towards the same	**Start date of the CDM project activity** Lead banker has appraised the project based on CDM revenue	Notice to Proceed to the EPC contractor
4	11/02/2005	-	Emission Reduction Purchase Agreement with buyer	ERPA signed dt. 11/02/2005
5	19/05/2006	-	Baseline Methodology for Greenfield NG based power plants AM0029 approved	history of approval of AM0029[43]
6	04/01/2007	-	appointment of the CDM consultants for CDM registration process	Agreement with the CDM consultant –CO2e.com, London

[43] http://cdm.unfccc.int/methodologies/DB/WW4I82DG7LJUQE5E5YGT1NZE4PNS60/view.html

7	04/12/2007	-	Local stakeholders' meeting at the project site	Minutes of the meeting
8	09/02/2008	-	Appointment of the Validator	Appointment Letter
9	08/05/2008 and 31/05/2008	-	Submission of PDD for validation PDD web hosted for global stakeholder comments	-
10	21/07/2008	-	Meeting with NCDMA for consideration of HCA	HCA letter from NCDMA, India refers to meeting date
11	03/09/2008	-	Host Country Approval award	HCA letter from NCDMA, India
12	14/04/2009	Project activity plant COD	-	Letter of Acceptance of project COD by Andhra Pradesh Power Coordination Committee

As can be seen from the chronology, the PP had signed ERPA for sale of generated CERs from the project activity plant within 2 years from the start date. Then consultant was contracted for CDM services, agreement was signed with DOE for the validation of the project activity and the PDD was webhosted for global stakeholder comments within two years from each milestone. Thus, the PP has taken real and continual actions for the CDM registration in line with the Guidance of EB62, Annex 13, clause No. 7 and 8.

Based on the above discussions, it can be concluded that the project is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

According to the approved methodology AM0029, Version 3

Project emissions
The project activity is on-site combustion of natural gas to generate electricity. The CO_2 emissions from electricity generation (PEy) are calculated as follows:

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

$FC_{f,y}$: 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:
$COEF_{f,y} = \Sigma NCVy \times EFCO_{2f,f,y} \times OXIDf$
Where:
NCVf,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;

$EFCO_2,f,y$: 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;
OXIDf : is the oxidation factor of natural gas

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

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

According to the approved methodology AM0029 version 03, project participants shall use for EFBL,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" above, and calculated as follows:

$$EF_{BL,CO2}(tco2/Mwh) = \frac{COEF_{BL}}{\eta_{BL}} * 3.6GJ/MWh$$

where,
COEFBL = the fuel emission coefficient (tCO_2e/GJ), based on national average fuel data, if available, otherwise IPCC defaults can be used
ηBL = the energy efficiency of the technology, as estimated in the baseline scenario analysis above.

For the option 1, the build margin is calculated by the Central Electricity Authority (CEA) India according to the procedures prescribed in the "Tool to calculate emission factor for an electricity system". We have referred the same value for the baseline calculation.

For option 2, the combined margin is calculated with a 50/50 OM/BM weights. The Operating Margin (OM) and the Build Margin (BM) has been calculated by the Central Electricity Authority (CEA) India according to the procedures prescribed in the "Tool to calculate emission factor for an electricity system". We have referred the same value for the baseline calculation.

For option 3, coal fired power plant using conventional i.e. sub-critical technology has been identified in section B.4. as the economically most attractive baseline scenario alternative due to its lowest levelized electricity generation cost, whose emission factor are calculated in accordance with and as per equation No. 4 of AM0029. The determination of baseline emissions will be made once at the validation stage based on an ex ante assessment, once again at the start of each subsequent crediting period (if applicable). If either option 1 (BM) or option 2 (CM) are selected, they will be estimated ex post, as described in "Tool to calculate emission factor for an electricity system".

Leakages

As per the approved methodology AM0029, leakage emissions are calculated as follows:

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

where:
LEy Leakage emissions during the year y in tCO2e
LECH4,y Leakage emissions due to fugitive upstream CH4 emissions in the year y in tCO2e
LELNG,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 tCO2e.

Fugitive methane emissions
According to the approved methodology AM0029, the fugitive methane emissions are calculated as follows:

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

where:
$LE_{CH4,y}$ Leakage emissions due to fugitive upstream CH_4 emissions in the year y in t CO_2e
FCy Quantity of natural gas combusted in the project plant during the year *y* in m³
$NCV_{NG,y}$ Average net calorific value of the natural gas combusted during the year *y* in GJ/m³
$EF_{NG,upstream,CH4}$ 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 t CH_4 per GJ fuel supplied to final consumers
$EG_{PJ,y}$ Electricity generation in the project plant during the year in MWh
$EFBL_{,upstream,CH4}$ 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
GWP_{CH4} Global warming potential of methane valid for the relevant commitment period

As the baseline emissions are calculated based on option 1 i.e. the build margin calculated by CEA in accordance with the procedures in "Tool to calculate emission factor for an electricity system", the emission factor for upstream fugitive CH_4 emissions occurring in the absence of the project activity is derived using the flowing equation:

Option 1. Build Margin:
$$EF_{BL,upstream,CH4} = \frac{\sum_j FF_{j,k} \cdot EF_{k,upstream,CH4}}{\sum_j EG_j}$$

Thus, the emission factor for upstream fugitive CH_4 emissions is consistent with the baseline emission factor calculation as per option-1.

During the crediting period for fugitive CH_4 emissions associated with NG, default values provided in Table 2 of the approved methodology AM0029 are used, as reliable and accurate national data are not available. The default values to be used in relation to NG production, processing, transport and distribution from Table 2 of AM0029 is default 'Rest of world'.

In the current context LNG is not being used in the project activity hence, $LE_{LNG,CO2,y} = 0$.

Upstream fugitive emissions occurring in the absence of the project activity electricity generation has been calculated using the Build Margin power plants. Therefore in line with the AM0029 requirement of ex-post determination of the Build Margin, the Emission factor for upstream fugitive methane emissions

occurring in the absence of the project activity electricity generation (tCH_4 /MWh) will also be determined ex-post.

Emission Reductions

ERy = BEy – PEy – LEy
Where:
ERy : emissions reductions in year y (t CO_2e)
BEy : emissions in the baseline scenario in year y (t CO_2e)
PEy : emissions in the project scenario in year y (t CO_2e)
LEy : leakage in year y (t CO_2e)

No credits are claimed for activities during the project construction activity.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	η_{BL}
Data unit:	%
Description:	The energy efficiency of technology in the most likely baseline scenario.
Source of data used:	Calculated from the actual electricity generation and fuel consumption data from CEA CO_2 Baseline Database, version 03, 15/12/2007
Value applied:	36.7
Justification of the choice of data or description of measurement methods and procedures actually applied :	The values are taken from the database developed by Central Electricity Authority (CO_2 Baseline database for the Indian power sector, Version 3.0). The database is Government of India's official publication based on the 'Tool to calculate the emission factor for an electricity system'.
Any comment:	--

Data / Parameter:	EF *electricity.y*
Data unit:	tCO_2/MWh
Description:	The combined margin emission factor of the Southern grid
Source of data used:	Calculated as the weighted average of the build margin emission factor and operating margin emission factor (with 50/50 weights to OM and BM)
Value applied:	0.8544
Justification of the choice of data or description of measurement methods and procedures actually applied :	The values are taken from the database developed by Central Electricity Authority (CO_2 Baseline database for the Indian power sector, Version 3.0). The database is Government of India's official publication based on the 'Tool to calculate the emission factor for an electricity system'.
Any comment:	BM 0.7054 OM 1.0033

Data / Parameter:	$EF_{BM,y}$
Data unit:	tCO_2/MWh
Description:	The Build Margin emission factor of Southern grid
Source of data used:	CEA CO_2 Baseline Database, version 03, 15/12/2007
Value applied:	0.7054
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value is taken from the database developed by Central Electricity Authority (CO_2 Baseline database for the Indian power sector, Version 3.0). The database is Government of India's official publication based on the 'Tool to calculate the emission factor for an electricity system'.
Any comment:	The value is used only for estimate now and will be monitored ex-post throughout the crediting period

Data / Parameter:	$EF_{OM,y}$
Data unit:	tCO_2/MWh
Description:	The Operating Margin emission factor of Southern grid
Source of data used:	CEA CO_2 Baseline Database, version 03, 15/12/2007
Value applied:	1.0033
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value is taken from the database developed by Central Electricity Authority (CO_2 Baseline database for the Indian power sector, Version 3.0). The database is Government of India's official publication based on the 'Tool to calculate the emission factor for an electricity system'.
Any comment:	The yearly Operating Margin emission factor of southern grid is as follows 2004-05: 1.00; 2005-06:1.01; 2006-07: 1.00; Average = 1.0033

Data / Parameter:	$EF_{CO2,coal,y}$
Data unit:	kg CO_2e/TJ
Description:	Emission Factor of Coal
Source of data used:	CEA CO_2 Baseline Database, version 03, 15/12/2007
Value applied:	95,800
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value is taken from the database developed by Central Electricity Authority (CO_2 Baseline database for the Indian power sector, Version 3.0). The database is Government of India's official publication based on the 'Tool to calculate the emission factor for an electricity system'.
Any comment:	CEA CO_2 Baseline Database, Assumptions sheet, Cell D7

Data / Parameter:	$EF_{CO2,NG,y}$
Data unit:	$kgCO_2e/TJ$
Description:	Emission Factor of Natural Gas
Source of data used:	Table 1.4, Chapter 1, Volume 2, 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Value applied:	56,100
Justification of the choice of data or description of measurement methods and procedures actually applied :	In absence of country specific data; IPCC default value used as recommended in methodology.
Any comment:	--

Data / Parameter:	$OXID_{Coal}$
Data unit:	Unit less factor
Description:	Oxidation Factor of Coal
Source of data used:	Table 1.4, Chapter 1, Volume 2, 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	1
Justification of the choice of data or description of measurement methods and procedures actually applied :	In absence of country specific data; IPCC default value used as recommended in methodology.
Any comment:	This value is used for estimation and will be monitored ex-post throughout the crediting period

Data / Parameter:	$OXID_{NG}$
Data unit:	Unit less factor
Description:	Oxidation Factor of NG
Source of data used:	Table 1.4, Chapter 1, Volume 2, 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	1
Justification of the choice of data or description of measurement methods and procedures actually applied :	In absence of country specific data; IPCC default value used as recommended in methodology.
Any comment:	This value is used for estimation and will be monitored ex-post throughout the crediting period

Data / Parameter:	NCV_{Coal}
Data unit:	tCO_2/TJ
Description:	Net Calorific Value of Coal
Source of data used:	GCV and conversion factor (GCV to NCV) sourced from "CO_2 Baseline Database of the Indian Power Sector, December 2006, issued by Central Electricity Authority, Ministry of Power, Government of India" (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm)
Value applied:	3,625

Justification of the choice of data or description of measurement methods and procedures actually applied :	The data used is from a national level and publicly accessible source and has a high level of reliability.
Any comment:	Converted from GCV value of 3,755 kcal/kg and delta of 3.6%

Data / Parameter:	$EF_{NG, Upstream,CH4}$
Data unit:	t CH_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 GJ fuel supplied to final consumers.
Source of data used:	Table 2, page 9 of the approved methodology AM0029 version 3
Value applied:	296
Justification of the choice of data or description of measurement methods and procedures actually applied :	In absence of the country specific data, default value given in the methodology for the world average is used.
Any comment:	--

Data / Parameter:	$EF_{BL, Upstream,CH4}$
Data unit:	t CH_4/MWh
Description:	Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in terms of ton of methane per MWh
Source of data used:	Calculated as: $$EF_{BL,upstream,CH4} = \frac{\sum_j FF_{j,k} \cdot EF_{k,upstream,CH4}}{\sum_j EG_j}$$ $\sum FF_{j,k}$: Refer to "Fuel consumed by power sources" under section B.7.1. $EF_{k,upstream,CH4}$: Table 2 of AM0029. $\sum EG_j$: Refer to "Electricity delivered to grid " under section B.7.1
Value applied:	16.03 CO_2/MU
Justification of the choice of data or description of measurement methods and procedures actually applied :	Wherever necessary default values suggested in the approved methodology AM0029 are used in the formula above to arrive at the above value.
Any comment:	Calculated using CEA CO_2 Baseline Database V. 3.0

B.6.3. Ex-ante calculation of emission reductions:

1. Calculation of baseline emissions
To calculate the baseline emissions the lowest of the three values amongst the build margin, combined margin and the emission factor for the most likely baseline scenario is taken as the baseline CO_2 emission factor.

In case of the build margin and operating margin, the grid emission factors available at the time of PDD web hosting for the global stakeholder comments is used. In October 2008, a new database of grid emission factors is published (Version 4.0) with higher values of emission factors (BM – 713.3 tCO_2/ GWh compared to earlier 705.4 tCO_2/ GWh). Thus, as a conservative approach, the earlier version (3.0) of the emission factors is retained.

A.) Build margin
The build margin is calculated by the Central Electricity Authority (CEA) India (CO_2 Baseline database for the Indian power sector, Version 3.0) according to the procedures prescribed in the "Tool to calculate emission factor for an electricity system". The value taken is 705.4 tCO_2e/GWh.

B.) Combined margin
The combined margin is calculated with a 50/50 OM/BM weights. The Operating Margin (OM) and the Build Margin (BM) has been calculated by the Central Electricity Authority (CEA,) India according to the procedures prescribed in the "Tool to calculate emission factor for an electricity system". The Operating margin is fixed ex-ante and is taken as the average of the recent three years of data given by the CEA at the time of PDD submission for validation (i.e. for the years 2003-2004, 2004-2005, and 2005-2006). The value applied for Operating Margin is 1003.3 tCO_2/GWh. The value applied for the build margin is 705.4 tCO_2e/ GWh. The value applied for the combined margin is **854.4** tCO_2e/GWh.

C) Emission factor of the most likely baseline scenario.
Calculated as per equation number- 4 of AM 0029 where the most likely baseline scenario is identified as the Coal based power plant Values of sub-variables:
Fuel CO_2 emission co-efficient (COEF BL): 0.0958 tCO_2e/GJ

Energy Efficiency of technology (h BL): 36.7%
= 0.0958 t CO_2e/GJ x 3.6 GJ/MWh x1000/0.367 = **938.7** t CO_2/GWh
Therefore, according to AM 0029, **705.4** t CO_2/GWh (i.e. Build Margin) is chosen as baseline emissions factor $EF_{BL,CO2,y}$.
Project electricity generation (i.e. net evacuation to the grid) EGy is estimated at 1,646.8 GWh per year.
[228 x 24 x 365 x 85% x (100-3)% / 1,000 = 1,646.8 GWh]

Therefore, the estimated annual baseline emissions (BE_y) will be (as per equation 3 of AM0029)
= 1646.8 GWh x 705.4 tCO_2/GWh = **1,161,623** tCO_2/ yr.

2. Calculation of Project Emissions (PE_y)
Calculated as per equation number-2 of AM 0029 as contained in part A (Procedure followed for estimating emissions in the project scenario) of section B.6.1 "Explanation of Methodological Choices".
The value of project emissions is **670,500 tCO_2e**
Values of sub-variables:
Volume of fuel combusted in project plant ($FC_{f,y}$) : 333,162,491 m^3
CO_2 emission coefficient of fuel ($COEF_{f,y}$) : 0.002013 t CO_2/ m^3 of natural gas

Based on the above, the estimated annual project emissions (PE_y) will be
= 0.002013 tCO_2/ m^3 x 333,162,491 m^3 = 670,500 tCO_2.
The Sub-variables are calculated as follows

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-2a of AM0029 Values of sub-variables:
1) Net Calorific Value of gas (NCV_y): 8,570 kcal/ m^3 (This value is from actual fuel supply bills for other IPP in the KG basin).

2) CO_2 emission factor ($EF_{CO2,f,y}$): 0.0561 t CO_2/GJ
3) Oxidation factor of gas ($OXID_f$): 1

$COEF_{NG,y}$ = 8,570 (kcal/ m^3) x 4.186 x 10^{-9} x 56.1 (t CO_2 / TJ) x 1 = **0.002013 tCO_2/ m^3**

3) Calculation of Leakages (LE_y)
Calculated as:

Leakages are calculated as per equation number-5 of AM 0029 is **42,134** tCO_2e

1) Leakage emission due to fugitive upstream CH_4 emissions ($LE_{CH4,y}$): 42,134 tCO_2 e.

3A) Calculation of leakage emissions due to fugitive upstream CH_4 emissions ($LE_{CH4,y}$)
Leakage emissions due to fugitive upstream CH_4 emissions are calculated as per equation number-6 of AM0029:
Quantity of natural gas combusted in the project plant (FC_y): 333,162,491 m^3
Average net calorific value of natural gas ($NCV_{NG,y}$): 8,000 kcal/ m^3
(This value is default used by CEA in the CO_2 baseline database, thus chosen for leakage calculation.)

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 t CH_4 per GJ fuel supplied to final consumers
($EF_{NG, upstream,CH4}$) : 296 t CH_4/ PJ

Electricity generated in the project plant ($EG_{PJ,y}$) : 1,697,700 MWh
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 ($EF_{BL, upstream, CH4}$): 16.03 t CO_2e/ GWh.

= 333,162,491 x 8,000 x 4.186 x 10^{-12} x 296 x 21 – 1,697.7 x 16.03
= 42,134 tCO_2e.

4. Emissions Reduction (ER_y)
According to the approved Methodology AM0029:

$$ERy = BEy - PEy - LEy$$

Where:
ERy : emissions reductions in year y (t CO_2e)
BEy : emissions in the baseline scenario in year y (t CO_2e)

PEy : emissions in the project scenario in year y (t CO_2e)
LEy : leakage in year y (t CO_2e)

ERy = 1,161,623– 670,500 – 42,134 = 448,988 tCO_2e

B.6.4 Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity emissions (tCO_2e)	Estimation of baseline emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of overall emission reductions (tCO_2e)
2012	670,500	1,161,623	42,134	448,988
2013	670,500	1,161,623	42,134	448,988
2014	670,500	1,161,623	42,134	448,988
2015	670,500	1,161,623	42,134	448,988
2016	670,500	1,161,623	42,134	448,988
2017	670,500	1,161,623	42,134	448,988
2018	670,500	1,161,623	42,134	448,988
2019	670,500	1,161,623	42,134	448,988
2020	670,500	1,161,623	42,134	448,988
2021	670,500	1,161,623	42,134	448,988
Total (tonnes of CO_2e)	**6,705,000**	**1,1616,230**	**421,340**	**4,489,880**

B.7. Application of the monitoring methodology and description of the monitoring plan:

Monitoring methodology and monitoring plan for the project activity has been prepared using the guidelines provided in Approved monitoring methodology AM0029, V- 03, EB 39.

Title -Grid Connected Electricity Generation Plants using Non-Renewable and Less GHG Intensive Fuel.

As per the methodology, the baseline emissions will be monitored per "Tool to calculate emission factor for an electricity system", if and as applicable. For the project emissions, a record of (1) Annual fuel consumption in project activity (2) Net Calorific Value of the fuel used in the project activity (3) Fuel emission factors for fuel used in the project activity.

B.7.1 Data and parameters monitored:

Data / Parameter:	**$EG_{Export,y}$**
Data unit:	kWh
Description:	Gross electricity exported by the project plant in year y
Source of data to be used:	The readings taken from the export meter present in the Tariff metering room present in the switch yard and a JMR is signed by PP's representative with electricity buyer's representative. This monthly JMRs will be used a primary source of monitoring for this parameter.

Value of data	1,697,700,000
Description of measurement methods and procedures to be applied:	The data represents the electricity measured by the electricity meters (main and check on line 1 and line 2). The meters are 3 phase 4 wire meters of standard make and of an accuracy of 0.2S class. The readings are taken by the shift engineers and are cross checked with check meter readings. The daily readings are stored in the power plant log book. Number of meters – 04 (2 main, 2 check on line 1 and 2 respectively) Accuracy class: 0.2s Recording frequency and responsible entities: continuous monitoring with monthly recording (JMR with PP and APTransco representative) Cross check mechanism: There is a main and a check meter on each of the two export lines
QA/QC procedures to be applied:	The calibration of the equipments will be done by Government approved agencies for undertaking calibrations and the instruments would be recalibrated annually. The readings will be cross checked with the monthly electricity sale invoices.
Any comment:	A metering diagram showing location of meters is shown in Annex 4 of the PDD. As there are two transmission lines for export of electricity to grid (line 1 and line 2), these two meter readings will be added to get $EG_{Export,y}$. The data will be archived for the crediting period + 2 years

Data / Parameter:	**$EG_{import,y}$**
Data unit:	kWh
Description:	Total electricity import from the grid by the project activity in year y
Source of data to be used:	The readings taken from the meter present in the Tariff metering room present in the switch yard and a JMR is signed by PP's representative with electricity buyer's representative. This monthly JMRs will be used a primary source of monitoring for this parameter. These meters are trivector meters and same meters record and show values of export as well as import.
Value of data	0
Description of measurement methods and procedures to be applied:	The data represents the electricity measured by the electricity meters (main and check on line 1 and line 2). The meters are 3 phase 4 wire meters of standard make. The readings are taken by the shift engineers and are cross checked with check meter readings. The daily readings are stored in the power plant log book. Number of meters – 04 (2 main, 2 check on line 1 and 2 respectively) Accuracy class: 0.2s Recording frequency and responsible entities: continuous monitoring with monthly recording (JMR with PP and APTransco representative) Cross check mechanism: There is a main and a check meter on each of the two transmission lines
QA/QC procedures to be applied:	The calibration of the equipments will be done by approved agencies and the instruments would be recalibrated annually. The readings will be cross checked with the monthly electricity purchase/sale invoices.
Any comment:	A metering diagram showing location of meters is shown in Annex 4 of the PDD. As there are two transmission lines for export of electricity to grid (line 1 and line 2), these two meter readings will be added to get $EG_{import,y}$. The data will be archived for the crediting period + 2 years

Data / Parameter:	$EG_{PJ,y}$
Data unit:	kWh
Description:	The net electricity export from the grid by the project activity in year y
Source of data to be used:	Calculated from $EG_{Export,y}$ $EG_{import,y}$ and as monitored above
Value of data	1,697,700,000
Description of measurement methods and procedures to be applied:	This value is calculated from above discussed monitored values
QA/QC procedures to be applied:	Not required as this value is calculated from above discussed monitored values
Any comment:	The data will be archived for the crediting period + 2 years

Data / Parameter:	$FC_{NG,y}$
Data unit:	m^3
Description:	Quantity of NG consumed in the project activity in year y
Source of data to be used:	Continuous monitoring is done at the gas suppliers' terminal in the project boundary and a JMR is signed fortnightly. This will be primary evidence for monitoring the parameter.
Value of data	333,162,491
Description of measurement methods and procedures to be applied:	The quantity of Natural Gas is measured by the gas flow meter which would be installed by gas supplier (GAIL) at their terminal which is within the project boundary. Number of meters – 04 (2 main by GAIL on line 1 and 2 respectively and 1 check meter by PP – common for both lines) Accuracy class: ±0.23% Recording frequency and responsible entities: daily recording with fortnightly JMR by PP and GAIL representative. JMR will show daily quantities. Cross check mechanism: There is check meter installed by PP in plant
QA/QC procedures to be applied:	The quantity of natural gas is cross checked with Check meter that is installed by the PP. The meter installed by GAIL will be calibrated jointly (by GAIL and PP) against a pre-calibrated master instrument - annually. The cross check meter will be calibrated annually at a third party laboratory. The readings can be cross checked by their invoices for the gas bills.
Any comment:	The data will be archived in paper form for the crediting period + 2 years

Data / Parameter:	$NCV_{NG,y}$
Data unit:	GJ/m^3
Description:	Net Calorific Value of Natural Gas
Source of data to be used:	Invoice from the gas supplier
Value of data	0.03587
Description of measurement methods and procedures to be applied:	The Supplier provides the fortnightly value of the NCV in the invoice that is being given to the PP.

QA/QC procedures to be applied:	Not applicable as it is a third party calculated value (gas supplier) in line with the monitoring methodology AM0029 The meter is gas transporter's (GAIL) terminal at the project activity location and in the project boundary. The meter will be calibrated jointly by PP and GAIL.
Any comment:	Presently the value is used from actual gas invoices from GAIL to an IPP in KG basin NCV = 8,570 x 4.186/10^6 = 0.03587 GJ/m^3 The data will be archived electronically for the crediting period + 2 years

Data / Parameter:	**$COEF_{NG,y}$**
Data unit:	tCO_2/m^3
Description:	CO_2 emission coefficient
Source of data to be used:	Calculated under project activity
Value of data	0.002013
Description of measurement methods and procedures to be applied:	calculated CO_2 Emission Co-efficient of natural gas is calculated as per equation number-2a of AM0029 Values of sub-variables: 1) Net Calorific Value of gas (NCV_y): 8,570 kcal/ m^3 2) CO_2 emission factor ($EF_{CO2,f,y}$): 0.0561 t CO_2/GJ 3) Oxidation factor of gas ($OXID_f$): 1 8,570 (kcal/ m^3) x 4.186 x 10^{-9} x 56.1 (t CO_2 / TJ) x 1 = 0.002013 Recording frequency: annual
QA/QC procedures to be applied:	Not applicable as it is a calculated value and also in line with the monitoring methodology AM0029
Any comment:	This value will be calculated ex-post in the monitoring period and archived electronically for crediting period + 2 years.

Data / Parameter:	$EF_{CO2,NG,y}$
Data unit:	$kgCO_2e/TJ$
Description:	Emission Factor of Natural Gas
Source of data used:	Table 1.4, Chapter 1, Volume 2, 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value applied:	56,100
Justification of the choice of data or description of measurement methods and procedures actually applied :	In absence of country specific data; IPCC default value used as recommended in methodology.
Any comment:	If IPCC publishes another version of this report, the same will be used. This value is used for estimation and will be monitored ex-post throughout the crediting period and archived electronically for crediting period + 2 years.

Data / Parameter:	$EF_{BL,\ Upstream,CH4}$
Data unit:	t CH_4/MWh
Description:	Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in terms of ton of methane per MWh
Source of data used:	Calculated as: $EF_{BL,upstream,CH4} = \frac{\sum_j FF_{j,k} \cdot EF_{k,upstream,CH4}}{\sum_j EG_j}$ $\Sigma FF_{j,k}$: Refer to "Fuel consumed by power sources included in BM from latest CEA or equivalent database for Indian Power Sector $EF_{k,upstream,CH4}$: Table 2 of AM0029. ΣEG_j : Refer to "Electricity delivered to grid by power sources included in BM" latest CEA or equivalent database for Indian Power Sector
Value applied:	16.03 CO_2/MU
Justification of the choice of data or description of measurement methods and procedures actually applied :	Wherever necessary default values suggested in the approved methodology AM0029 are used in the formula above to arrive at the above value.
Any comment:	Calculated using CEA CO_2 Baseline Database V. 3.0. As the parameter is to be calculated ex-post, latest available CEA dabatase/ power plants data (in case database is not updated in any year, but only data is published) will be used to get $\Sigma FF_{j,k}$, ΣEG_j

Data / Parameter:	**PEy**
Data unit:	tCO_2
Description:	Project emission due to combustion of fuel
Source of data to be used:	Calculated under project activity
Value of data	670,500
Description of measurement methods and procedures to be applied:	Please refer to Section B.6.3 of the PDD for step wise calculation procedure
QA/QC procedures to be applied:	Not applicable as it is a calculated value
Any comment:	This value will be calculated ex-post in the monitoring period.

Data / Parameter:	**$EF_{BL,CO2,y}$**
Data unit:	tCO_2/MWh
Description:	baseline CO_2 emission factor
Source of data to be used:	Calculated as per the monitoring methodology AM0029
Value of data	0.7054
Description of	Calculated as per monitoring methodology AM0029

measurement methods and procedures to be applied:	As the option 1 - build margin is chosen, this parameter will monitored ex-post and based on latest available database published from the CEA (CO_2 Baseline database for the Indian power sector). Recording frequency: annual
QA/QC procedures to be applied:	The database is Government of India's official publication based on the 'Tool to calculate the emission factor for an electricity system'. Thus, no QA/QC is required.
Any comment:	this value will be monitored ex-post as required by the monitoring methodology AM0029 and archived electronically for crediting period + 2 years.

Data / Parameter:	$OXID_{NG}$
Data unit:	Unit less factor
Description:	Oxidation Factor of NG
Source of data to be used:	Latest available version of IPCC Guidelines for National Greenhouse Gas Inventories
Value of data	1
Description of measurement methods and procedures to be applied:	In absence of country specific data; IPCC default value used as recommended in methodology. Recording frequency: annual
QA/QC procedures to be applied:	Not required as this is default value published by IPCC and latest available report (IPCC Guidelines for National Greenhouse Gas Inventories) will be referred
Any comment:	This value is used for estimation and will be monitored ex-post throughout the crediting period and archived electronically for crediting period + 2 years.

B.7.2. Description of the monitoring plan:

The project activity is operated and managed by the PP. The individual plants record data related to their respective project activity. The natural gas based power project abides and will abide by all regulatory and statutory requirements as prescribed under the state and central laws and regulations.

A CDM project team has been placed at the plant site. The project team has been 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 the plants performance requirement.

All the monitoring data will be stored, recorded and kept under safe custody of the Project Executor and Head (Power Plant and Utilities) at the plant site for a period of crediting period + 2 years. The data will be achieved in both hard copies and electronic format (excel sheets). Also, any change within the project boundary, such as change in spare and or equipments will be recorded and any change in the emission reduction due to such alteration will also be studied and recorded.

Emergency plan:

The electricity meters (both the main meter and the check meter) are calibrated annually. Also, there are quarterly checks for error and if any meter is found to give error more than permissible in the class of the

meter, it will be taken for the calibration. For the electricity measurement, the meter (from the main and check) that does not show the error will be used for the data recording. In case, both the meters have shown error more than the limit prescribed in the class, both the meters will be taken for the calibration and correction will be applied to the electricity generation recorded by the main meter.

An emergency plan is prepared to account for monitoring equipments failure and accidental release of GHGs in the project activity plant.

1) Both electricity meters (main and check) failure: As per PPA dt. June 2003, Article 4: Metering, clause 4.4 and 4.5, following provision are available and will be followed for the monitoring plan.
    (A) Errors in main meters – If main meter check indicates error beyond prescribed limit, but no such error is noticed in the check meter, billing for the month will be done on the basis of check meter. Also, the main meter will be calibrated or replaced immediately.
    (B) Errors in main meter and check meters: If both the main and check meter show error during quarterly check, both meters will be sent for calibration and replaced immediately with new meters for further monitoring. The error found in the main meter calibration will be applied to the electricity measurement values for the period from last check.
2) Failure of gas flow meter: In case gas flow meter of the supplier (GAIL) which is main meter is found to have error more than ±2% or if the meter is out of service, the gas quantity will be computed using (a) using check meter of the PP if installed and accurately registering (b) applying main meter error factor to readings from last calibration (c) estimating the volume of gas delivered by comparison with deliveries during the period under similar conditions when seller's meter was registering accurately (In same order of preference among a,b and c. Refer clause 8.04 of the gas supply agreement with GAIL).
3) Gas leakage detection: Emergency gas alarm system is installed at GAIL supply terminal near the project plant to detect gas in case of leakage.
4) Complete power failure scenario: In case of complete power failure, the GAIL terminal will get indication on the gas flow control panel and the gas flow valve will be shut when the power plant will have to be shut down. Thus, the accidental release of gas is avoided in any case.

The calculation of combine fugitive emission factor in the absence of project activity ($EF_{BL,upstream,CH4}$):

The latest available CEA CO_2 baseline database for the Indian Power Sector will be used and the plants commissioned in southern grid in the last five years from publication of database will be short listed. Fuel consumption as per category i.e. coal and lignite, natural gas, liquid fuels will be summarized. The electricity generation in those particular categories will also be summarized for the years and then default methane fugitive emission factors for each fuel type is applied to get combine fugitive emission factor in the absence of project activity.

As the project activity registration may not coincide with the JMR date (both monitoring period start and the end),

(1) the net electricity export for this period will be monitored from the main/ check meter readings (manual record daily by the PP).

OR (2) the crediting period will be taken from the subsequent JMR date after the registration date.

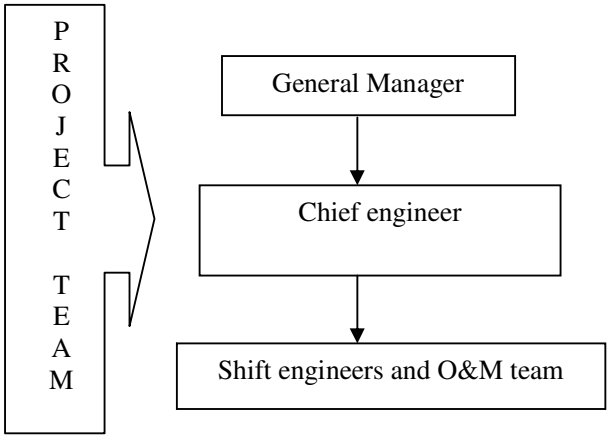
Similarly for the gas consumed and NCV readings, in case the monitoring period start/end not coincide with the gas invoice period (both at the monitoring period start and the end date), the daily joint ticket signed by both gas supplier and PP will be used as primary source.

INTERNAL AUDIT AND PERFORMANCE REVIEWS

Monitoring team will be responsible for the annual performance reviews. The monthly invoices from APTransco will be cross checked with the monthly export data. Any non-conformity if observed will be corrected.

The energy meter calibration due dates will be informed to the O&M team. In the review meeting, if the calibrations are found to be not done on due date, the meters will calibrated immediately and the correction factor will be applied to the monitored values.

Designation	**Responsibilities**
General Manager (Power plant)	• Registration • Project Execution
Chief engineer	• Operation • Verification of data Inspection of data whenever necessary to independently check the authenticity of data and take corrective actions wherever required. • Storage/ Achieving of data • Internal audit of monitored data and GHG reduction calculation
Shift engineer	• Operation, Monitoring and Verification of Data • Data Recording • Storage of data
Operation and Maintenance team/ Contractor	• Operation and Maintenance • Storage of data • Data Recording • Data Collection • Archiving of data



B.8. Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies):

The date of completion of the application of the methodology to the project activity study is 25/11/2011.

Entity responsible for application of the baseline and monitoring methodology:

GVK Industries Ltd. Hyderabad and their CDM Advisors – General Carbon (www.general-carbon.com).

GVKIL is the project participant and contact details are given in Annex 1.

SECTION C. Duration of the project activity / crediting period

C.1. Duration of the project activity:

C.1.1. Starting date of the project activity:

14/01/2004

The date[44] of Notice to Proceed to the EPC Contractor with disbursement of the first instalment towards the same for the Project Activity (first major irreversible expense on the project activity in accordance with CDM Guidelines – '*date on which the project participant has committed to expenditures related to the implementation or related to the construction of the project activity'*).

C.1.2. Expected operational lifetime of the project activity:

15 years 0 months[45]

[44] Notice to Proceed letter from PP to the EPC Contractor

[45] http://powermin.nic.in/acts_notification/generating_companies.htm

C.2. Choice of the crediting period and related information:

Fixed crediting period is chosen for the project activity.

C.2.1. Renewable crediting period:

C.2.1.1. Starting date of the first crediting period:

NA

C.2.1.2. Length of the first crediting period:

NA

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/02/2012 or a date not earlier than the date of registration of the CDM project activity.

C.2.2.2. Length:

10 years 0 months

SECTION D. Environmental impacts

D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

Rapid Environmental Impact Assessment has been conducted for the project activity by VIMTA Labs Ltd. and the environment management plan is prepared to minimize the potential environmental impacts arising out of the proposed project activity and plant operation must coexist satisfactorily with its surrounding environment by reducing its adverse impacts.

The proposed project activity would create impacts on environment in two distinct phases:

- During the construction phase which may be regarded as temporary or short term
- During the operation phase which would have long term effects

The plant is located in a notified industrial area and as the plant is proposed to be run on natural gas, a clean fuel. It is ensured that there are no major negative impacts envisaged on the air quality, water environment and land environment of the surrounding region[46]. Moreover the plant authorities have taken necessary care to see that all statutory regulations existing in the country are followed[47].

The following expected impact may occur as a result of the project activity during the construction phase:

[46] Rapid EIA Report by Vimta Labs Ltd., Hyderabad; Chapter 4: Impact Assessment

[47] The latest "Consent to Operate from APPCB, Hyderabad; Order No. APPCB/VSP/RJY/289/HO/2008 2565 dt. 23/02/2008"

1. Land use

The construction of the Combined Cycle Power Plant would bring in certain immediate changes in the land use pattern of the proposed area as well as in the vicinity. The likely changes would be:

- Construction activities would attract a sizable labour population and the influx of the population is likely to be associated with construction of labour colony within the plant premises. This would be temporary especially in the case of the proposed project activity as the gestation period is very small.

2. Air environment

Light negative impact on ambient air quality is envisaged due to the emission of suspended particles during the construction phase. The concentration of NOx and CO might also increase due to the vehicular movement. To mitigate these impacts regular sprinkling of water will be done at the construction site.

3. Noise environment

The major sources contributing to the noise pollution during the construction phase are vehicular traffic and construction equipment like dozers, scrappers, concrete mixers, cranes, generators etc. use of proper personal protective equipment will mitigate any significant impact of the noise generated by such equipment.

4. Terrestrial Ecology

The initial construction works at the project site involves no land clearance, cutting of trees, filing and levelling as the land is barren. So construction activity will not result in any loss of either vegetation or potential agricultural productive land.

The following impact may be expected to occur as a result of the operation of the project activity:

- *Soil*

The impact of power plant operated on Natural Gas on soil characteristics is insignificant as compared to the impact of coal based projects. Most of the impacts are restricted to the construction phase which will get stabilized during the operational phase.

- *Air Quality*

Natural Gas based power plant will have NOx as the major air pollutant. The emissions of the particulate matter will be insignificant. Adequate stacks will be provided to disperse the pollutant over a wide area.

- *Noise environment*

The major sources contributing to the noise pollution from the power plant are gas turbines, compressors, steam turbine, inlet and exhaust system. During their operation there would be increase in the ambient noise level and may affect occupational health and community

- *Ecology and biodiversity*

The activities of the power plant operations such as stack emission, waste water discharges and solid waste disposals have a potential to affect the ecology and biodiversity of this region.

Based on the third party rapid EIA done for getting the clearance from MoEF, there are no transboundary impacts due to the project activity. The project does not have any negative social impacts as found in the rapid EIA[48]. Also, as per the Host Government Approval Criteria, it meets the Social development clause.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

[48] Rapid EIA Report by Vimta Labs Ltd., Hyderabad; Chapter 4; page – C4-3 and C4-23

The project activity has obtained all the consents from the state pollution control board (Consent to Establish and Consent to Operate) and the clearance from the Ministry of Environment & Forests has also been obtained. The specific conditions from the 'Consent to Operate' are as summarized in the following table[49]

Table: Conditions from the APPCB 'Consent to Operate'

Sr. No.	Parameter	Limiting value	Unit	Point of discharge
Discharge of Effluents				
1	Cooling tower blow down, boiler blow down – after treatment	3541	KLPD	On land plantation and excess in irrigation drain
2	DM plant rejects after treatment	28	KLPD	
3	Domestic Effluents	61	KLPD	Septic Tank followed by Soak Pit
4	Tolerance Limits			
a	Temperature	Not more than 5°C than the intake		
b	pH	6.5 to 8.5		
c	Free available chlorine	0.50 mg/l		
d	Suspended solids	100 mg/l		
e	Oil and grease	10 mg/l		
f	Copper (Total)	1.0 mg/l		
g	Iron (Total)	1.0 mg/l		
h	Zinc	1.00 mg/l		
i	Chromium (Total)	0.20 mg/l		
j	Phosphate	5.00 mg/l		
k	BOD	30.0 mg/l		
Emissions from Chimneys				
5	Chimneys attached to 93 TPH Waste Heat Recovery Boiler 1,2 and 3	381600	Nm^3/hr	-
6	Chimneys attached to 93 TPH Waste Heat Recovery Boiler	748800	Nm^3/hr	-
7	Prescribed limits			
a	SPM	115 mg/Nm^3		
b	NOx	75 ppm		
8	Ambient Air quality standards			
a	TSPM	200 $\mu g/m^3$		
b	RSPM	100 $\mu g/m^3$		
c	SO_2	80 $\mu g/m^3$		
d	NOx	80 $\mu g/m^3$		
9	Noise Levels			
	75 dB (A)	Day time (6 am to 10 pm)		
	70 dB (A)	Night time (10 pm to 6 am)		

[49] Consent to Operate from APPCB, Hyderabad; Order No. APPCB/VSP/RJY/289/HO/2008 2565 dt. 23/02/2008

All these conditions are met by various environmental control equipments/ units for the treatment exhaust gas and the effluent water before the discharge.

The mitigation measures that have been adopted are summarised below

A. Management during construction phase

The impact during the construction phase on the environment would be basically of transient nature and are expected to reduce gradually on completion of the construction activities. In order to mitigate them following measures are proposed:

1. Designation and demarcation of sites for construction camps and ensuring due provision of necessary infrastructural services.

a. During excavation and transportation over un-metalled roads near the proposed plant site, there is a scope of local dust emissions. Frequent water sprinkling in the vicinity of the construction activity should be done and it should be continued even after the completion of the plant construction, as there is scope for heavy truck mobility. The industry should make provision for water sprinklers.
b. Since there is likelihood of fugitive dust from the construction activity, material handling and from the truck movement in the premises of the proposed plant, the industry should go for green belt plantation programme along the boundaries of the proposed plant site.
c. The construction site should be provided with sufficient and suitable toilet facilities for workers to allow proper standards of hygiene. These facilities would be connected to septic tank and maintained to ensure minimum environmental impact.
d. Though the noise effect on the nearest inhabitants due to construction activity will be negligible it is advisable that onsite workers using high noise equipment adopt noise protection devices. Noise prone activities should be restricted to the extent possible during night particularly during the period 10:00 PM to 6:00 AM in order to have minimum environmental impact.
e. It should be ensured that both gasoline and diesel powered construction vehicles are properly maintained to minimize smoke in the exhaust emissions. The vehicle maintenance area should be located in such a manner to prevent contamination of surface and ground water sources by accidental spillages of oil. Unauthorized dumping of waste oil should be prohibited
f. As soon as construction is over, the surplus earth should be utilized to fill up low lying areas, the rubbish should be cleared and all un-built surfaces reinstated. Appropriate vegetation should be planned and all such areas should be landscaped. Hazardous materials (e.g. acids, paints, explosives) should be stored in proper and designated areas.

2. To prevent unauthorized felling of trees by construction workers for their fuel needs, it should be ensured that the contractor provides fuel to the construction workers

B. Management during the operational phase

a. Air pollution control system: The air pollution control measures proposed for the project are described below:
   i. 70 m tall stack should be provided to ensure wider dispersion of pollutants
   ii. Appropriate system to control NOx emissions to 75 ppm should be provided
   iii. Green belt development in and around the plant premises should be undertaken

iv. The proposed air pollution control equipment should be installed prior to commissioning of the plant
v. Monitoring of stack emissions for NOx and SO_2 should be carried out regularly to meet all statutory requirements
vi. All the internal roads should be asphalted to reduce the fugitive dust due to vehicle movement

b. Water pollution control system: The waste water will be originating from cooling system, plant service water system, filter backwash and sanitary effluents from plant. All these waste will be treated and discharged on the land to be utilized for green belt through a central monitoring basin.

Following effluent treatment and disposal systems are proposed to be installed:

i. Minimize quantity of effluents through reuse to the extent possible;
ii. Treatment of the DM plant waste through neutralization;
iii. Provision of oil separators; and
iv. Biological treatment for domestic waste from plant.

Effluent monitoring instruments namely pH meter, flow meter, etc., should be provided in the effluent discharge line. Flow integrators should be provided both at the plant intake and discharge point at central effluent holding pond

Apart from the proposed treatment schemes, some additional measures are given here under:

i. Minimize quality of effluents through reuse to the maximum extent feasible;
ii. The treatment scheme proposed should be constructed before the commissioning of the plant
iii. Sedimentation tanks should be cleaned regularly in order to avoid clogging. Sludge should be removed regularly and sufficient time should be given for proper settling of solids
iv. The treatment units viz., STP should be operated regularly
v. Monthly effluent samples should be collected and analysed at the inlet and outlet of the treatment plants to ascertain the efficiency of the treatment plants and to meet the statutory requirements.

c. Solid waste management plan: Solid wastes generated from the plant are basically from sedimentation tanks and sewage treatment plants. The solid waste does not contain any toxic matter and safe to dispose off on land.

The suitable landfill area should be identified taking in to consideration permeability of soil, distance from population area, etc. the collection, transport and disposal of solid wastes from different parts of the plant to the disposal area should be through sanitation contract package. The contractors deployed by the proponents are required to allow certain norms with respect to tools and safety equipments.

The waste brought to the landfill site would be unloaded immediately over the working face of the landfill and would be evenly separated and compacted by bulldozers/loaders. The top surface and the slopes of the refuse dumped would be covered progressively with a layer of soil or civil debris or any other sealing material. A daily inspection will be made for rodent burrows or insect infestations and appropriate control measures shall be taken.

The generating of leachate from the landfill area should not be a common phenomenon under Indian conditions. The compaction and provision of proper slope would prevent stagnation of water inside the landfill area, thereby minimizing leachates. In addition, a drainage system should be constructed around the landfill area. However two wells should be monitored near the landfill area.

d. Noise level management: The predominant noise levels will be confined to the work zones in the plant. The noise levels at the entire sources will not exceed 85 dB(A). Community noise levels are not likely to be affected because of proposed vegetation and attenuation due to the physical barriers.

i. The use of damping materials such as thin rubber/lead sheet for wrapping the work places like turbine halls, compressor rooms, DG sets, etc.;
ii. Shock absorbing techniques should be adopted to reduce impact;
iii. Efficient low techniques for noise associated with high fluid velocities and turbulence should be used;
iv. All the openings like covers, partitions should be acoustically sealed;
v. Inlet and outlet mufflers should be provided which are easy to design and construct;
vi. Reflected noise should be reduced by the use of absorbing material on roofs walls and floors;
vii. Ear plugs should be provided to the workers, and it should be enforced to be used by the workers;
viii. Increase the distance between source and receiver and by altering the relative orientation of the source and receiver;
ix. Provision of the separate cabins for workers and operators
x. The industrial compound should be thickly vegetated with species of rich canopy

e. Measures for improvement of ecology

i. Clearing of existing vegetation should be kept to minimum and should be done only when absolutely necessary. Even then clear felling of big trees should be kept to bare minimum.
ii. Plantation programme should be undertaken in all areas. This should include plantation in the proposed plant premises, along the internal and external roads
iii. Use of biogas, solar energy, etc. should be encouraged both at individual and at society levels
iv. People should be educated and trained in social forestry activities by local governmental and nongovernmental organizations

f. Socio-economic development activities: GVK has created economic and social benefits to the people of areas surrounding the Jegurupadu power project. Some of the socio economic projects undertaken and developed by GVK are:

i. Supply of drinking water to the villages of Kadiyarn mandal
ii. Built bus shelters in Jegurupadu and Kadiyapu village for the benefit of the travellers using the bus shelters
iii. The school building was built in Jegurupadu village by GVK to provide a high school facilities to benefit the 12000 population of the village
iv. Undertook the responsibility to repair the state highway from Dowleshwaram and Kesawaram villages which has benefited over a lakh of people living in the vicinity
v. GVK has sponsored the construction of about 25 school buildings in the district of Nellore around the Krishnapatnam project site
vi. GVK has developed a green landscape along some of the Hyderabad city roads, which have been appreciated by number of visitors to Hyderabad as well.

GVK has always undertaken the responsibility of improving the quality of life in and around the vicinity of their project sites. GVK now has its future agenda health care facilities, education and better sanitation for the rural people living around its project sites.

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

A local stakeholders' consultation meeting was organized on 01/12/2007 at GVK Power Plant Jegurupadu. GVK Industries Limited identified local villagers, local NGO, employees of GVK Power Plant, government officials as the most important stakeholders, with an interest in the CDM activities. Accordingly the stakeholders were duly informed of the consultation meeting through written invitations. A record of these invitations is available with the PP. For the stakeholders that could not come for the meeting, another 15 days time was given to contact the Director Technical to inform about their concerns and opinions.

Comments of stakeholders were recorded during the stakeholder meeting.

The stakeholders meeting process was followed in the following sequence

- Welcome Address
- Election of the Chair of the meeting and approval of the proposed Agenda
- Presentation of the CDM-Kyoto Protocol and role of local stake holder
- Presentation of the Projects undertaken by GVK Group.
- Discussion and Articulation of concerns
- Chair summarizing the local stake holder concerns
- Vote of Thanks followed by Tea

Mr. G Satyanarayana, Advisor – Tech, GVKIL welcomed all the stakeholders to the consultation meeting. Mr. John Fernandes, Vice President, GVKPIL proposed Dr. Ramana Murthy to chair the meeting and Mr. Zakir Hussain supported him. Mr. Ramesh Babu, Manager (E&C) gave a brief presentation on the plant, configuration and power generation and gas supply, water supply and power evacuation system in the vernacular language (Telugu). The representative from CantorCO2e gave a presentation in the vernacular language (Telugu) on global warming, Kyoto protocol and proposed CDM Project activity. He provided a brief on the CDM project process and the role of the local stakeholders in the CDM project. He also explained that the purpose of the meeting is to internalise the local stakeholders concern for the project activity.

The summary of the meeting was recorded - copy of which will be made available to Designated Operating Entity during validation process. The list of participants with their signature is kept for record and photographs of the event were also taken. After the presentation, chairman invited the stakeholders to raise their queries.

In summarizing the discussion, Dr. Ramana Murthy (chairman of the meeting) appreciated the greenery development in the plant area and the social activities of GVK Group. He also commended GVK group for the natural gas based power project activity as it is a cleaner source of energy.

For any further queries, another 15 days time was given to stakeholders for contacting GVK Industries Ltd. Mr. Ramalingeswara Rao thanked all the stakeholders for attending the local stakeholders' consultation meeting.

E.2. Summary of the comments received:

The specific concerns expressed by the participants are summarized below along with clarifications provided on such concerns:

Stakeholder concerns / question / comment	Answer / clarifications
Dr. P. Syam Prasah What are the possible leakages expected and how they will be controlled?	The possible gas leakages are Natural gas and chlorine. In case of natural gas leakage the control vales automatically shutoff and thereby the gas supply to terminal station will be stopped. In case of chlorine gas leakages the control valves will close automatically. In case of chlorine spillages occur it will be absorbed by sodium hydroxide tower and neutralized. This has been included in emergency plan and mock drills are conducted.
Dr. DV Ramana Murthy What is the basis of emission reduction calculations?	In the absence of this project activity the PP or any other players would have constructed more carbon emissive power plant like the coal based power plant. That power plant would have produced equivalent power similar to GVK power plant and would have emitted more amount of CO_2 in to the atmosphere per unit of electricity generation. The project activity will emit less amount of CO_2 per unit of electricity generation. This is called emission reduction per unit of electricity generation. This will be multiplied with the total amount of electricity generation and the total figure will give total amount of CO_2 emission reduction per annum.
The stakeholders appreciated the social activities like Construction of School buildings, conducting health camps and providing water supplies to neighbouring villages undertaken by GVK Group. They further suggested the following: 1. To create environmental awareness in the nearby villages especially in the school going children / college going students to neighbouring towns. 2. To adopt some villages and support panchayats in improvement of sanitation. 3. Create health observatory, to observe new diseases coming in the surrounding areas.	As GVK is committed to the society towards sustainable development, it has taken many social initiatives in the area of education, health care and poverty eradication. As a part of corporate policy on continuous basis GVK is involved in various social activities and will be involved in the local areas and similar kind of activities. Neighbouring engineering colleges are being given training (as part of the curriculum). Also plant visits from neighbouring colleges are encouraged. The suggestion is under consideration and once the plant is operational, the implementation will be considered. It was explained that all the pollution norms are met and rapid EIA confirms that there are no major health impacts due to the project activity. However, a health observatory to study the impact specifically due to project activity is out of the scope of PP. However, the workers in the plant and their families staying in the adjacent residential colony (who are likely to be affected in the first place) are continuous monitored by medical

	officer.
4. To provide tree guards being planned in the local gram panchayat of Jegurupadu village.	The suggestion is under consideration and once the plant is operational, the implementation will be considered.

E.3. Report on how due account was taken of any comments received:

The stakeholders were given clarification on the issues raised as above to their satisfaction by providing relevant evidence of the project claims. No negative comments were received that required follow up action on the project activity side.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	GVK Industries Ltd.
Street/P.O.Box:	156-159, Sardar Patel Road
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E-Mail:	Issac@gvk.com
URL:	www.gvk.com
Represented by:	
Title:	Director (Finance)
Salutation:	Mr.
Last Name:	George
Middle Name:	Issac
First Name:	A.
Department:	Finance
Mobile:	-
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Personal E-Mail:	-

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Public funding from Annex I and diversion of official development assistance (ODA) is not involved in this project activity. The project cost is met by the PP by the debt financing.

Annex 3

BASELINE INFORMATION

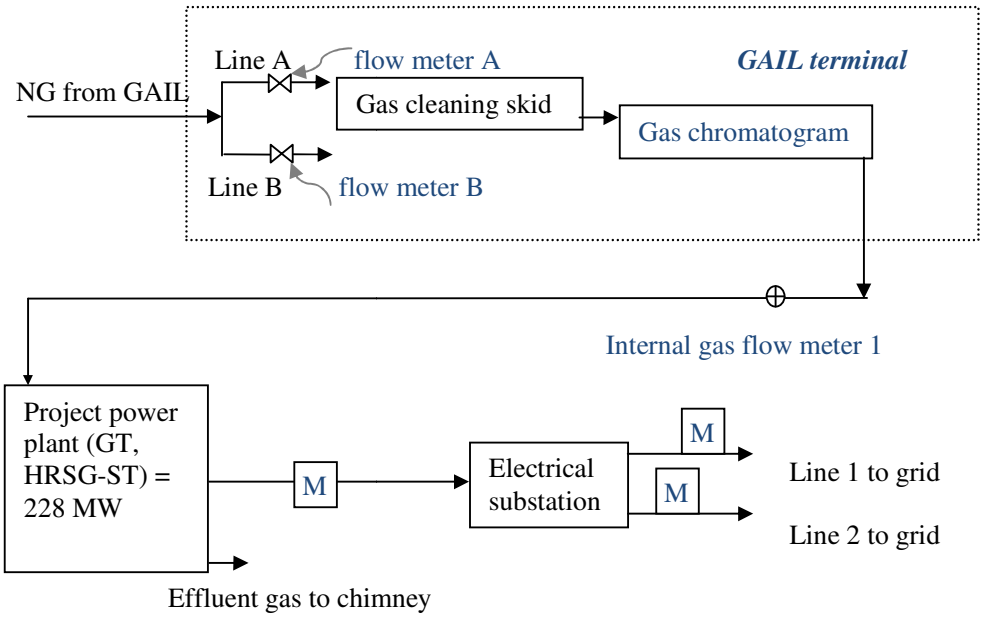
Please refer Section B.6.3.

Annex 4

MONITORING INFORMATION

Please Refer to Section B.7.2

Metering diagram



M: electricity meter
Both line meters are substation are trivector meters (to monitor both import and export)

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Appendix –1

Natural gas availability in India and the project activity location/ region

The spirit of emphasizing "sufficient availability" of NG in the methodology as an applicability criterion is:

(a) to ensure that NG from other users are not diverted and
(b) to ensure future power generation facilities of comparable size are not deprived due to NG being taken up by the project activity [Ref: footnote No. 2 of the AM0029, Version 3]

The points (a) and (b) above are borne out by the clarification [Ref: F-CDM-AM-Clar_Resp_ver 01.1 - AM_CLA_0091] issued by EB in response to a DOE query. In the response, EB also clearly mentions how the applicability condition pertaining to availability is to be implemented. In EB's view, a project activity to demonstrate that it meets the applicability condition will need to do so by resorting to appropriate monitoring. The relevant excerpt from EB's clarification– "*the monitoring should show that satisfying the project activity's demand for natural gas will not lead to shortages in supplies of the gas to other projects within the country*".

In other similar examples, recently registered projects from China in the applicable methodology AM0029, have shown 'LNG import agreements from other countries like Malaysia' (Project reference No.s 1381, 1343, 1344) in support of the NG availability. Thus, NG availability in the project activity region alone is not the applicability of methodology here. The same spirit of applicability allows new power plant even with imported NG to qualify for AM0029.

In this project we demonstrate that:
1) NG was sufficiently available in the source of supply so that other NG based projects do not get deprived and leakage does not occur.
2) Also future natural gas based power capacity addition also not constrained

The applicability condition in the methodology aims to avoid the diversion of natural gas from other future and existing users. It is evident from the AM0029 applicability condition on sufficient availability 'future natural gas based power capacity additions, comparable in size to the project activity, are not constrained by the use of natural gas in the project activity'.

India has about 0.4% of World's natural gas reserves[50]. Almost 70% of India's natural gas reserves are found in the Bombay High basin and the state of Gujarat[51]. Off shore reserves are also located in Andhra Pradesh coast (Krishna Godavari Basin) and Tamil Nadu coast (Cauvery Basin). Onshore reserves are located in Gujarat and the North Eastern states.

At the time of initiation of the project activity i.e. award of the EPC Contract, Natural gas was available for procurement and there have been no evident restrictions caused by the project activity's choice of natural gas as the fuel, on significant future capacity additions to the baseline grid comparable in size to the project activity, in choosing natural gas as fuel. The abundant 'availability' of NG in the KG basin

[50] http://planningcommission.nic.in/plans/planrel/fiveyr/10th/volume2/v2_ch7_3.pdf

[51] http://www.eai.in/ref/fe/nag/nag.html

from where the gas is proposed (and secured by a fuel supply agreement with the Gas Authority of India Ltd. -GAIL) is established as noted in APERC orders on the PPA[52]. The agreement for the supply of 1.1 MCMD gas (more than that required for the operation) is signed before the financial closure (the project start date). The project activity is slated to draw NG coming out from a new source (not a source which was earlier supplying NG elsewhere). The project activity has contracted NG supply for more than that required at the design PLF not from an existing gas source but from a new gas source i.e. KG Basin. The NG to be used in this project is therefore not a result of diversion of NG destined for other projects in any region. For the purpose of gas supply a priority list for allocation has been created by Gas allocation committee of MoP&NG[53]. The fact that this project activity figures in the allocation list of NG supply, proves that the planned gas consumption of this project activity, will be met by the NG available from the new sources.

Reliance Industries Limited (RIL) in October, 2002 found 9 Trillion cubic Feet (tcft ~ 254.88 TCM)[54] of gas reserves, the biggest gas find in India in three decades, in the exploration block called KGBDW-6 (renamed as KG-DWN-98/3) in deep waters, 150 km off the Andhra Pradesh Coast near Kakinada. Cairn Energy also announced discovery of about 1 tcft of gas in Krishna Godavari Basin. ONGC, Gujarat State Petroleum Corpn. Ltd. and Reliance Industries Limited are further intensifying exploration for gas, both onshore and offshore in Krishna Godavari Basin and this is expected to result in considerable additions to gas availability[55]. Further planned projects and national NG grid and trans-national pipelines will make gas availability possible[56]. Further, the announcement of consideration of Lanco's Kondapalli[57] and NTPC's Ratnagiri Power[58] projects by Ministry of Petroleum (Government of India) for NG allocation, after NG allocation was committed to this project activity, prove that the project in question is not depriving any other future user. The fact that the two projects mentioned above are of comparable capacity to the concerned power project, proves that future power projects of same scale have not been negatively affected by the NG to be used in VPGL.

In the state of Andhra Pradesh, during 2003, projected availability by ONGC is about 8 to 9 MCMD of Natural Gas and the current supply is about 7 MCMD. It is also indicated that private agencies like CAIRN are expected to develop 3 to 4 MCMD from 2004-05[52]. Thus, there was surplus gas available with one of the major suppliers of gas.

The demand supply data of India available from[59] Ministry of Petroleum and Natural gas shows that the country's natural gas consumption has been less than the gross production as presented below:

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[52] http://www.aperc.gov.in/OtherOrders/Amendment_PPA_GVK.html

[53] http://www.iemr.in/userfiles/Pricing%20of%20Natural%20Gas%20in%20India.pdf

[54] calculated from http://www.natgas.info/html/natgasunitscalculator.html)

[55] Department of Industries, Govt. of AP; http://www.apind.gov.in/indussectors.html

[56]http://www.pwc.com/extweb/pwcpublications.nsf/docid/5EBE732379E5428ECA257184005E7A2B/$file/oil_gas.pdf

[57] http://petroleum.nic.in/clip4151206.pdf

[58] News Article in The Economic Times (copy submitted to the DOE)

[59] A report on OIL & GAS by PricewaterhouseCoopers.

Table 1: Natural Gas Consumption & Production (Billion Cubic Meters - BCM)

	99-00	00-01	01-02	02-03	03-04	04-05	CAGR
Consumption	26.88	27.68	28.03	29.96	30.90	30.77	2.74%
Gross Production	28.45	29.48	29.71	31.40	31.96	31.80	2.25%

Source: MoPNG

On 17/06/2005, GSPC discovered India's largest gas reserve[60] in its KG # 8 well. Estimated at 20 TCF, it was expected to double the country's gas production. At investment decision (2003), it was estimated[61] that the total domestic production of natural gas would go up from the current 70 mscmd to 142 mscmd in 2006–7, with the Krishna–Godavari basin contributing a major part. Compared to this the domestic gas demand in 2006–7 could be around 135–150 mscmd.

The demand supply scenario the XI Five Year Plan where project activity started operations is presented below[62].

S.N.	Year	2007-08	2008-09	2009*-10	2010-11	2011-12
1	Total supply –Optimistic (BCM)	40.51	56.06	88.50	97.49	104.18
2	Total demand (BCM)	65.40	71.77	82.31	95.66	101.99
3	Demand supply gap (optimistic)	24.89	15.72	-6.19	-1.83	-2.19

As can be seen from the table above, from 2009-10 (where project activity plant was commissioned), the gas supply was expected to be surplus. This is further evident from a press release[63] by RIL on 22/01/2010. Here, RIL informed that they have capacity to produce 80 MCMD and have agreements for supply of 61 MCMD i.e. surplus gas availability.

- **Present Scenario:**

A new fuel supply term sheet was signed by PP with Reliance Industries Ltd. (RIL) on 09/06/2007 for supply of NG from new discovery in KG basin[64] (KG—DWN-98/3). The project activity power plant started commercial operations on 14/03/2009[65]. The project activity power plant is currently receiving uninterrupted natural gas supply from this new source.

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http://www.pwc.com/extweb/pwcpublications.nsf/docid/5EBE732379E5428ECA257184005E7A2B/$file/oil_gas.pdf

[60] http://www.kgbasin.in/gspc-discoveries/

[61] The Infrastructure Sector in India, 2002–3, pg. 31 (10 of file) http://www.iitk.ac.in/3inetwork/html/reports/IIR-2004/Chap%202%202003.pdf

[62] Report of Infraline – copy given to DOE (Note - this report has given values in MMSCMD, here converted in BCM by multiplying with 365 (No. of days/ year) and dividing with 1000 (conversion factor million to billion)

[63] Copy of press release provided to the DOE

[64] Gas sale term sheet between PP and RIL, pg. 3

[65] Andhra Pradesh Power Coordination Committee Consent for COD letter after performance acceptance tests as per PPA

Appendix –2

EIA of the project activity

Parameter	Potential impact without mitigating measures	Probable Source	Mitigating measures	Overall impact	Responsible entities
Impacts during Construction Phase					
Air environment	• Increase in dust and NOx concentration	• Heavy Vehicular traffic	• Regular sprinkling of water in the construction area.	Low significance	Management personnel of GVK
Noise environment	• Increase in ambient noise level	• Construction Equipment	• Equipment will be kept in good condition to keep the noise level within 85 dB(A). • Workers will be provided the necessary Personal Protective Equipment.		Management personnel of GVK
Water environment	• Increase in suspended solids due to soil erosion	Soil Erosion	• Construction of Temporary Sedimentation Tank.	Short Term Impact	Management personnel of GVK
Ecology and biodiversity	• Clearing of Vegetation		Plantation will be done during the start of the project	Insignificant impact	Management personnel of GVK
Impacts during Operation Phase					
Air environment	• Increase in NOX levels in ambient air • Increased SPM in ambient air	• Power Plant • Vehicular traffic	• Gas turbines would be designed to keep the NOx emission level to 75 ppm. A 70 m stack would be provided to ensure wider dispersion of pollutants • Steam Injection will be used	Long term negative	Management personnel of GVK

			• All motorable roads in the plant area will be paved to reduce the dust emissions.		
Noise environment	• Increase in ambient noise level • Impact on occupational health	• Equipment in main plant and auxiliaries	• Equipment will be designed to conform to noise levels prescribed by the regulatory agencies. • Acoustic enclosure would be provided to gas turbine generator		Management personnel of GVK
Water environment	• Discharge of effluents into surface water bodies	HRSG blow down, cooling tower blow down, filter backwash, service water, DM regeneration waste and sanitary effluents	• Adequate treatment facilities like neutralization pit, settling ponds, biological treatment system etc. will be provided so that the treated effluents conform to the regulatory standards.		Management personnel of GVK
Land environment	• Land use and terrestrial life • Soil quality • Agriculture • Forests and wild life	• Solid waste from the auxiliary units of plant • Application of the treated affluent on land	• ETP sludge can be used as manure if found suitable • Raw water treatment plant sludge to be disposed off in controlled dumping sites within in the plant premises • Emphasis to be laid on green belt development and its maintenance • Use of dry and fallow land for the plant operation		Management personnel of GVK
Ecology and biodiversity	• Impact on plant species	• Stack emission	Emissions will be controlled as well as dispersed through appropriate design	Insignificant impact	Management personnel of GVK