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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

"1147.5 MW Natural gas based grid connected Combined cycle power generation project".

Version: 2.

Date: 18th April, 2007.

A.2. Description of the project activity:

Purpose of the Project Activity

Due to the electricity supply deficit in the Western Regional Electricity Grid of India, Torrent Power Generation Limited (since amalgamated with Torrent Power Limited) (Torrent) proceeded to set up a new (i.e. Greenfield) grid connected power plant (comprising three blocks with a total capacity of 1147.5 MW). The plant is based on efficient combined cycle technology and can use natural gas or Re-gasified Liquefied Natural Gas (LNG) as fuel.

The Gas Turbines, Siemens V94.3A (lately renamed SGT5-4000F- equivalent to "F" Class) use several advanced technologies namely:

1) Special metallurgy of buckets and blades – capable of withstanding much higher Turbine Inlet Temperature (TIT around 1200 Celsius) of combusted gas at inlet to gas turbines as compared with those of matured class gas turbine (about 1060 Celsius), due to which the gas turbine requires relatively much stringent level of surveillance and very strict regime of inspections by OEM's specialists at regular intervals based on operating and loading pattern-unlike matured class gas turbines that can be inspected by third party service providers. Moreover due to this reason spare buckets and blades of the gas turbine are not available from third party manufacturers and one has to enter into a long term service agreement with the OEM (Siemens), at a substantial cost, for refurbishment of these parts and for providing the services for their repairs.

2) The Fuel Burners are of special advanced design due to which the fuel gas combustion takes place in "pre-mix" mode right from beginning rather than first combusting in "diffusion" mode (upto about 30-40% load) and then changing over to "pre-mix" mode thus helping the environment by limiting the NO_x emission right fom initial combustion unlike conventional DLN Burner technology that results into higher NO_x emission upto 30-40% load and limits NO_x only after the load increases above this threshold limit. These special technology gas burners have to be covered with OEM (Siemens) for necessary inspection and servicing since such services are not available from any third party provider due to technology restrictions.

3) The gas turbines are equipped with a special hydraulically controlled axial positioning device for axially positioning the gas turbine rotor so as to optimize radial clearances of rotor blades for the purpose of minimizing fuel gas consumption and CO_2 emissions for protecting environment – however, this advancement in technology has to be separately paid for and one

has to obtain the services of the OEM for its servicing and repairs since this technology is of proprietary nature and is not available from any third party.

The plant will predominantly operate in base load mode. The power generated from the project activity can be delivered to any utility in India subject to certain quantum being supplied on inter-state basis in accordance with the mega power project policy of the Government of India. 75% of the power generated is proposed to be supplied to the cities of Ahmedabad and Surat, which form part of the Western Regional Electricity Grid.

The status and schedule of the project activity is as follows:

- Host Country Approval has been obtained on 28th November, 2006.
- Main plant construction, i.e. project activity started on 17th June 2005 (i.e. project start date, on which date the Engineering Procurement and Construction contract for main plant construction was placed).
- The first block is expected to be installed and commissioned in fourth quarter of 2007.
- The commissioning of second and third blocks is expected in first quarter of 2008 .
- The entire project construction is expected to be completed by March 2008.

While planning to put up this project activity, Torrent faced substantial investment, technological and regulatory barriers in electricity generation using natural gas, e.g. due to higher cost of natural gas and unfamiliarity with the operation of highly advanced combined cycle power plant. Despite these barriers, the Board Members of Torrent decided to take up the project activity in view of the risk mitigation cover provided by revenues expected from Clean Development Mechanism (CDM) registration of the project activity.

How the project activity reduces greenhouse gas emissions

As per the baseline scenario analysis described under section B.4, in the absence of the project activity similar power would have been generated through a pit-head coal (non-coking) based power plant. As the typical new coal based power plant in India uses coal of a low quality and has sub-critical steam parameters, the project leads to substantial greenhouse gas emissions reductions due to the use of a less carbon intensive fuel and a much higher efficient power generation plant.

Views of the project participant on the contribution of the project activity to sustainable development

Ministry of Environment and Forests, Government of India has stipulated the four indicators - social well being, economic well being, environmental well being and technological well being - for assessment of the sustainable development benefits in the interim guidelines for CDM projects. The designated national authority (DNA) after examining the sustainable development contributions of this project activity has accorded it Host Country Approval.

In brief, the project activity fulfils these indicators as follows:

Social Well Being:

- The power plant contributes to empowerment of the vulnerable sections of the society including the scheduled caste and scheduled tribes through direct and indirect employment opportunities.

- Increased availability of electrical energy will in the long run reduce dependence on bio-mass based energy sources for domestic consumption. This improves the health of women in particular through reduction of indoor air pollution which currently kills 150,000 women in India every year.

- The development of a region from the Human Development perspective would result from improvements in life expectancy at birth, infant mortality, literacy/education, health, infrastructure, ability to cope with shocks and empowerment / having a voice in the institutions of state and society. It has been the experience of this country that industrial activity and income security often brings with it empowerment and allied infrastructure that benefit the peripheral areas. Increase in such industrial activity is facilitated by the electricity generated by the project activity.

- Promotes local skills, local entrepreneurship and community development.

Environmental Well Being:

- Adoption of combined cycle, an efficient technology as well as natural gas as a fuel with no ash and low sulphur content reduces local air pollution, water usage and generation of solid waste (fly ash) compared to the typical coal power plants in India. Usage of coal for power generation is not constrained by law but whose use is rather encouraged by the government policies in view of its availability and affordable prices is of particular importance.

- The dry low NOx type burner used in project activity reduces not only the NOx emissions but also water consumption.

- About 25 hectares of the total land area available (approximately 150 ha) for the project will be developed as greenbelt, lawns, horticulture and other forms of greenery, which is beyond statutory stipulation. The main objective of the green belt is not only to provide a barrier between the plant and the surrounding areas, but also be beneficial in many ways, such as retention of soil moisture, prevention of soil erosion, recharge of ground water and moderation of micro climate. Besides acting as a carbon sink, certain species of plant even absorb the pollutants while others can thrive in polluted atmosphere. A good part of the waste water shall be used in the project site for development and maintenance of this greenery. The trees that were uprooted while constructing the approach road etc were replanted in the green belt area.
- Drainage system of the project has been developed after considering the contour of the site and natural water courses. Hence, there is negligible impact on the natural drainage pattern in and around the project site.

Economic well being:

- Reduction of the electricity supply-deficit in the western region will inter-alia improve productivity of industry that is currently suffering from frequent power cuts and thereby enhance economic growth.

- Encourages developments in the local economy.

Technology well being:

- The combined cycle gas turbine applied is new, highly efficient (i.e. High temperature F class gas turbine having a higher fuel efficiency (i.e. 57% at 100% load) and less polluting and the demonstration effect could be important for diffusion of this technology in India (particularly in the context of high gas prices) instead of projects using higher GHG intensive fuels such as coal.
- Further the project activity has many features which increases the fuel efficiency (for details refer to section A.2 and A.4.3).

A.3. Project participants:

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Government of India (Host)	Torrent Power Limited	No

Torrent Power Limited shall be the lead and nodal entity for all communication with CDM – Executive Board and Secretariat. The contact information has been provided in Annex I. This project activity has been developed as a CDM project and would have other entities from Annex I countries to join as project participants at a later stage. The list of such participants shall be provided as and when identified.

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.:

Gujarat.

A.4.1.3. City/Town/Community etc:

Akhakhol (village) in Kamrej Taluka, Surat district.

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

The physical location for the power plant to be operated and constructed is at Akhakhol village in Kamrej taluka, which is about 28 km northeast of Surat city. The project site is located approximately at 72°59'E longitude and 21°21'N latitude. The approximate location of the site is shown below.

The land for the project including its approach road, housing colony and intake well comprises approximately 344.83 acres of land. The terrain of the proposed plant site is fairly flat and requires minimum grading.

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

The project activity falls in Scope Number 1; Sectoral Scope – Energy Industries (renewable - / non-renewable sources).

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

The natural gas-fired power plant consists of three blocks of 382.5 MW each. A block consists of advance class (F Class) gas turbine (GT), matching triple pressure heat recovery steam generator, steam turbine and generator. The hot exhaust from the gas combusted in the gas turbine enters the heat recovery steam generator (HRSG) and generates steam in the boiler pipes using demineralised water. The steam thus produced will be introduced into the steam turbine (ST) for

driving the electrical generator which will also simultaneously be driven by the GT for electricity generation. The generator's electrical output is at 20 kV. The evacuation to grid will be at the 220 and 400 kV switch-yard of the project activity. The auxiliary consumption for the plant is estimated to be around 2-3%.

The EPC contract for implementing the project activity has been awarded to a consortium of Siemens AG and Siemens India Ltd through an international competitive bidding process, which will be sourcing the technology as well as the main equipment i.e. the Gas Turbine, Steam Turbine and Generator from Europe and the USA, while supporting equipments viz. Heat Recovery Steam Generator and Transformer will be imported from Korea.

The project activity will adhere to many of the norms practiced in Europe which are more stringent than those in the host country, particularly as regards NOx emissions and thus requires higher investments.

Natural Gas (including LNG, the share of which is estimated to be 50% in energy terms for the purpose of this PDD) will be transported to the project site including through a spur pipeline tapped from the trunk gas line owned and operated by Gujarat State Petronet Ltd. (GSPL) currently. The Natural Gas from domestic sources is expected to have an average net calorific value of 8500 kCal/SCM (0.03558 Giga Joules/ SCM)[1] and LNG is expected to have an average calorific value of 8981 kCal/SCM (0.03759 Giga Joules/SCM) [1].

The plant contains several efficiency increasing properties:

- The plant will have a single shaft configuration which is more efficient than the multi shaft configuration due to lesser length of steam cycle piping and lesser number of major operating equipments.

- The project activity provides for usage of only clean fuel i.e. natural gas (including LNG). The project activity is not technically equipped to use naphtha or any other liquid fuel (as is commonly not the case in the case of other Combined Cycle Power Plants in India, who provide for the firing of such liquid fuel as a backup fuel or a main fuel), which feature is expected to increase the efficiency of the project activity.

- Also the project activity shall have two stage burner with diffusion plot instead of conventional burners (i.e. pre mix operation through out the entire load range), which reduces the NOx level right from start load instead of from 45% load. Also the efficiency of the gas turbine is also increased due to high combustion stability achieved by such burners. Also due to such burners the NOx emissions from project activity is 25ppm when loads are greater than 50% against the Euro norms being 26.6ppm (50Mg/NM^3) for loads greater than 70% and the Indian norm being 50ppm.

- Again the project activity shall have a device called "GT Rotor Axial Positioning Device", which is a hydraulic device for fixing the axial position of Gas Turbine Rotor. This device by

[1] NCV for ONGC is collected from agreement between ONGC and Gail. NCV of Petronet LNG Limited is collected from Petronet's "Price of R-LNG for year 2004- Tariff levelized over five years" document.- www.infraline.com

minimising the leakages of air between various stages of air compressor and by also minimising the leakage of gas combustion products from gas turbine blade tips, improves the efficiency of the gas turbine.

Due to above features of the project activity including transfer of advanced class power generation technology, the project activity causes use of an environmentally safe and sound technology that would reduce additional GHG emissions as well as mitigate to a great extent regulated emissions such as SPM, NOx and SO_2 from power generation.

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

Years	Annual estimation of emission reductions in tonnes of CO_2e
2008 (From 1st April)	2392278
2009	3189704
2010	3189704
2011	3189704
2012	3189704
2013	3189704
2014	3189704
2015	3189704
2016	3189704
2017	3189704
2018 (Until 31st March)	797426
Total estimated reductions (tonnes of CO_2e)	**31897040**
Total number of crediting years	**10 years**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**3189704**

A.4.5. Public funding of the project activity:

No public funding or Official Development Assistance will be used for the 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:

Title: "Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas" (based on new methodology NM 0080rev submitted by the project participant.)

Reference: AM0029 Version 01.1; Sectoral Scope: 01, 19th May 2006

Reference to other methodologies or tools:

- Version 02 of the "Tools for the demonstration and assessment of additionality".
- Version 06 of ACM0002.

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

The choice of AM0029 for application to this project activity has been justified below.

Sr. No.	Requirements as per Baseline Methodology	Why applicable to this Project Activity
Main Condition No.1.	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 (including LNG) fired combined cycle power plant (CCPP), of 1147.5 MW (i.e three blocks of 382.5MW each) for electricity generation. • The project activity will be connected to the Gujarat state grid at 220 kV Kim sub-station, which is ~6 km from the project site through two lines of 220 kV each having an evacuation capacity of 267 MVA each. It is also to be connected to the 400 kV national grid of Power Grid Corporation of India (PGCIL) through two LILO lines each having an evacuation capacity of 1,178 MVA, viz (i) Jhanor-Dahegam and (ii) Jhanor-Vapi lines. It shall also have connectivity with Surat city network (part of Western Regional Electricity Grid) through 3 nos 220kV double circuit lines (each having evacuation capacity of 534 MVA).
Main Condition No.2.	The geographical/ physical boundaries of the baseline grid can be clearly identified and information pertaining to the grid and	• As the project activity is expected to supply power to the states (including its various demand centers) forming part of the Western Regional Electricity Grid, the same has been chosen as the Baseline Grid. This choice on baseline grid selection is also in

Sr. No.	Requirements as per Baseline Methodology	Why applicable to this Project Activity
	estimating baseline emissions is publicly available.	compliance with the clarification on baseline grid determination provided by the CDM EB. Power transmission within the Western Regional Electricity Grid is made without significant transmission constraints, as Power Grid Corporation of India ltd. (State owned power transmission company) as well as the state transmission utilities operate a well connected power transmission system within the baseline grid. • The geographical/ physical boundaries of the Western Regional Electricity Grid are the boundaries of Gujarat, Madhya Pradesh, Maharashtra, Goa and Chattisgarh states and union territories of Daman & Diu and Dadra & Nagar Haveli. Information relating to the baseline grid is publicly available from Ministry of Power and its website (www.powermin.nic.in), Central Electricity Authority (Ministry of Power, Government of India) and its web site (www.cea.nic.in), infraline website (www.infraline.com-access available on subscription), western regional electricity grid load dispatch centre and its website (www.wrldc.com), Central electricity regulatory commission (www.cercind.org), etc. • Official information related to the baseline grid carbon emission factor are publicly available with CEA, Ministry of Power, Government of India (http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm). This information compiled by CEA, Ministry of Power, Government of India in technical cooperation with Indo-German Energy programme (GTZ) was presented and explained in a side event of COP/MOP2 recently held in Nigeria and was well received.
Main Condition No.3.	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.	• As gas imports are permitted freely and without restrictions from any part of the world, and as there are no restraints generally in the establishment and expansion of regasification terminals for processing such imports and as new explorers and developers are permitted to sell gas at market determined price, availability of natural gas (including LNG) in India by 2010/11 (i.e., within the first three/four years of the start of the crediting period of the project activity-

Sr. No.	Requirements as per Baseline Methodology	Why applicable to this Project Activity
		generally the time required for the establishment of necessary gas supply infrastructure) is expected to be sufficient (i.e., capable of firing more than 40 times the capacity of the project activity) as indicated in *Appendix 1* to this PDD. A major part of this gas is expected to be available in the states of Maharashtra and Gujarat (as stated in Appendix I), which form part of the baseline grid and in which (i.e. in Gujarat) the project activity is located. • At the time of initiation of real action on the project activity i.e. award of the EPC Contract in June 2005, natural gas was available for procurement and there have been no evidenced 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. There are several examples[2] of sufficient availability of natural gas in the open market in Gujarat, in which state the project activity is located. • Any new gas fired combined cycle power plant comparable in size to the project activity can catalyze the development of gas supply infrastructure (such as a re-gasification terminal and necessary pipeline connections without significant constraints) from the infrastructure planning perspective. Hence, gas sourcing for significant future power plants comparable in size to the project activity is generally sourced well in time to enable development of gas supply infrastructure before the commissioning of such large sized plants.– be it domestic or imported LNG (as Gas sourcing requires a long lead time). This supply infrastructure would be able to cover its costs through the revenues from

[2] In May 2004, NTPC was successful in sourcing Natural Gas for its 2,600 MW proposed gas based power capacity additions at Kawas and Gandhar in Gujarat through a global tender from two different sources, viz., Reliance Industries Ltd which won the bid and Petronas which lost out after providing a compliant bid. NTPC and Reliance Industries Ltd are in the process of negotiating and finalizing the definitive Gas Sales Agreement. In April-05, Shell commissioned its receipt and re-gasification terminal at Hazira in Gujarat with estimated capacity of 2.5 million tones per annum which is sufficient to support the generation of ~2,500MW. This terminal of Shell Hazira was not being utilized at high capacity due to the high gas prices, which are unaffordable in India in respect of new users of such gas. Therefore it can be said that a capacity of ~5,000 MW which is more than four times the capacity of the project activity has sourced gas/ could have sourced gas in Gujarat in the period before and immediately following the start of real action on the project activity.

Sr. No.	Requirements as per Baseline Methodology	Why applicable to this Project Activity
		the electricity generated using such infrastructure's natural gas (including LNG) supplies[3]. • Kogas (South Korea) has been successful in sourcing 17.2 mmscmd of gas in the last few years (6 mmcmd from Petronas, 5.2 mmcmd from Yemen LNG project and 6 mmscmd from Shell's East Russian Sakhalin Island Venture.[4] Recently the Shanghai (China) LNG regasification terminal has sourced three million tonnes per annum (approx. 12 mmscmd) of LNG from Petronas Malaysia[5]. The above sourcing in South East Asia (in the neighborhood of India) are capable of firing more than 7000 MW of gas based combined cycle power plants. • The project activity is located in the state of Gujarat where sufficient gas grid is available (see map at the end of this section B.2). In the context of the above, it can be concluded beyond any reasonable doubt that the availability of natural gas to any future gas based power capacity additions comparable in size to the project activity is not constrained by the use of natural gas (including LNG) in the project activity. **The constraint that is currently being faced by such projects is not the lack of natural gas availability but high prices of natural gas.**
Sub Condition No.1.	Natural gas should be primary fuel. Small amounts of other startup or auxiliary fuels should be used, but can comprise no more than 1% of total fuel use.	The project activity is designed for exclusive firing by Natural Gas (including LNG).
Sub Condition No.2.	In some situations, there could be price-inelastic supply constraints (e.g.,	• During the period 2008 (the beginning of the crediting period) to 2010/2011 and thereafter (during the balance period of the crediting period) there are

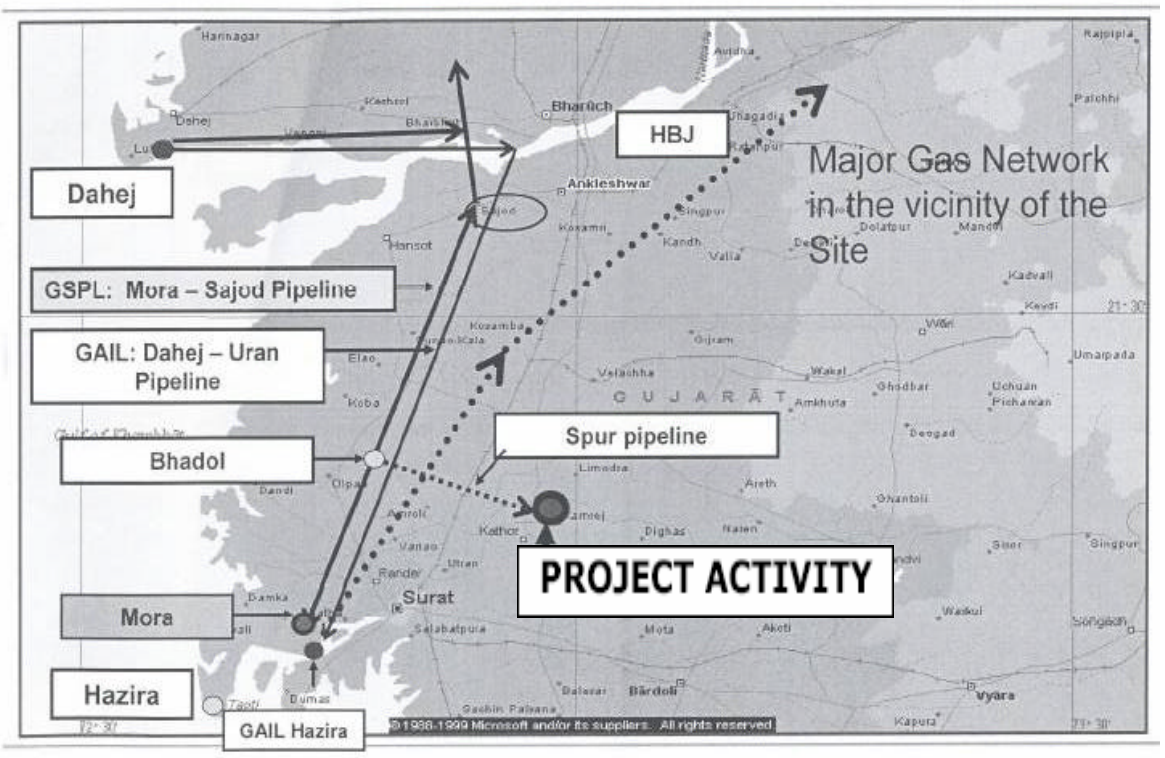
[3] For example, the cost of such gas supply infrastructure comprising the re-gasification terminal and the permissible 100 km pipeline connecting it to a power plant comparable in size to the project activity (allocable for such project activity based on re-gasification capacity required for the project activity) would be approximately 16% of the cost of such new gas fired combined cycle power plant.

[4] www.petroleumnews.net News dated 18th May, 2005, Nell Ritchie, New Zealand.

[5] http://thestar.com.my/news/story.asp?file=/2006/10/31/nation/15868615&sec=nation

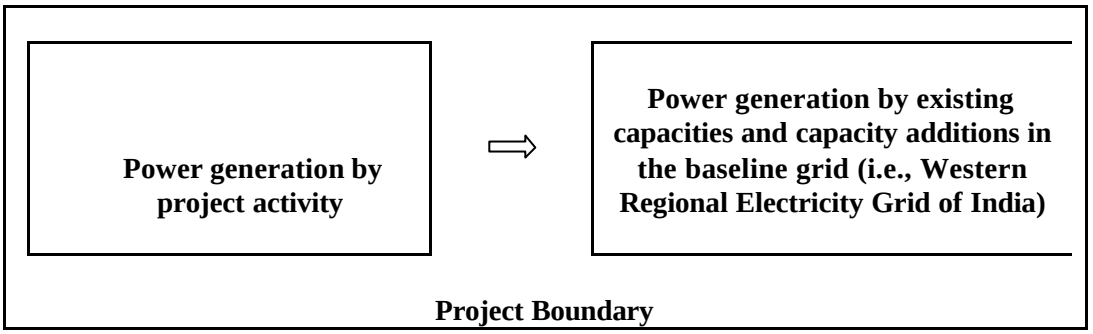
Sr. No.	Requirements as per Baseline Methodology	Why applicable to this Project Activity
	limited resources without possibility of expansion during the crediting period) that could mean that a project activity displaces natural gas that would otherwise be used elsewhere in an economy, thus leading to possible leakage. Hence it is important for the project proponent to document that supply limitations will not result in significant leakage as identified here.	definite as well as highly probable new facilities and expansion plans which would be capable of supplying more than 230 to 310 million m^3 per day of Natural Gas, which can fire more than 60,000 MW (*Refer Appendix 1 to this PDD*).Even today spot gas of more than 32 million m^3 per day is available at very high prices which can fire approximately 7,000 MW. • During the last few years, the Natural Gas (including LNG) prices have been fluctuating which in fact indicates that prices have not become inelastic (Refer Appendix II). • On the basis of the above it can be easily concluded that there are no price-inelastic supply constraints as far as natural gas (including LNG) is concerned during the crediting period and therefore there are no significant leakages.

Location - Fuel Gas Infrastructure



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

The spatial extent of the project boundary as indicated below comprise the project site (including its intake well site and approach road) and all power plants connected physically to the baseline grid that the CDM project power plant is connected to.



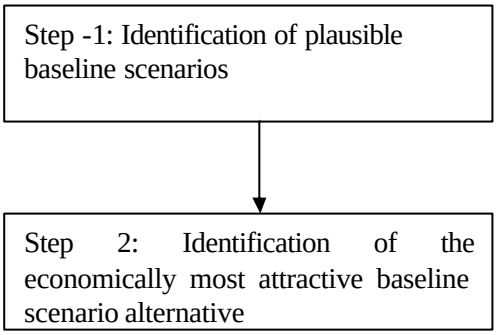
The GHG emission sources applicable to this project activity that are within the project boundary are mentioned below.

	Source	Gas	Included?	Justification / Explanation
Baseline	Power Generation in the Build Margin in the Western Regional Electricity Grid	CO_2	Yes	Main emission source.
		CH_4	No	Excluded for simplification in accordance with AM0029. This is conservative.
		N_2O	No	Excluded for simplification in accordance with AM0029. This is conservative.
Project Activity	On-site natural gas combustion in the three Blocks	CO_2	Yes	Main emission source.
		CH_4	No	Excluded for simplification in accordance with AM0029.
		N_2O	No	Excluded for simplification in accordance with AM0029.

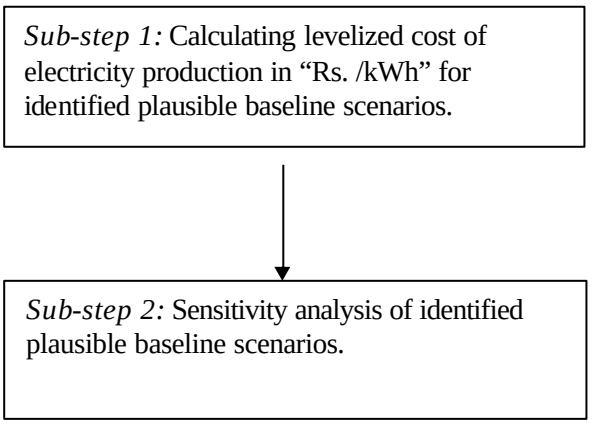
Gas transportation facility are not included within the project boundary and is covered under leakage calculations.

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

The following is a flow chart indicating the flow of various steps involved in identifying and describing baseline scenario in accordance with AM0029.



Further, for the purpose of identifying the economically most attractive baseline scenario alternative the following *sub-steps* are involved.



Baseline scenario identification as per the requirements of AM 0029 leads us to the following assessment at the start of the project activity (i.e. the awarding the Engineering Procurement and Construction Contract in June 2005 to the consortium of Siemens AG and Siemens India)

Step 1: Identification of plausible baseline scenarios

Table-1

Potential Baseline Scenario	Does it deliver outputs and services comparable to project activity?	Is it permitted by applicable regulations?	Is the alternative 'Realistic and Credible'?	Conclusion
A) Project activity not implemented as a CDM project, activity i.e., 1,147.5 MW gas based CCPP with 57% efficiency at 100% load under standard operating conditions) and lifetime of 15 years[6]	Yes	Yes	Yes	Plausible baseline scenario
B) Power generation using Natural Gas but technologies other than the project activity. i.e. 1050 MW gas based based combined cycle power plant with 52.5% efficiency (at 100% load factor under standard operating conditions) and lifetime of 15 years *(Sources: Same as above)*.	Yes	Yes	Yes	Plausible baseline scenario
C) Power generation technologies using energy sources other than Natural gas				

[6] Sources: 2004-05 GTW handbook and Appendix-II CERC guidelines for tariff calculations-www.cercind.org.

Potential Baseline Scenario	Does it deliver outputs and services comparable to project activity?	Is it permitted by applicable regulations?	Is the alternative 'Realistic and Credible'?	Conclusion
(1) Wind source (750 Nos. 1.5 MW wind turbines with a life of 20 years) - (Source: "Research made by the Canadian Energy Research Institute-Augest2005."	No • Cannot deliver base load power throughout the year on a continuous basis. • Capacity factor is very low. • Wind power delivers only 17% capacity factor on an average.	Yes	No • Wind flow is not available throughout the year. • Also wind based generation is possible only in a few places with wind potential. • Due to low and unpredictable capacity factor, wind based power is not a realistic and credible baseline scenario	Not a plausible baseline scenario.
C) Power generation technologies using energy sources other than Natural gas (2) 1147.5 MW solar thermal parabolic trough power plant	No • Cannot provide base load power throughout the year on continuous basis	Yes	No • Solar energy not available throughout the year • Cannot provide the quantum of power contemplated • Solar thermal plant construction in Rajasthan has been discussed for over 20 years without any outcome despite availability of concessional funds (www.infraline.com)	Not a plausible baseline scenario
C) Power generation technologies using				

Potential Baseline Scenario	Does it deliver outputs and services comparable to project activity?	Is it permitted by applicable regulations?	Is the alternative 'Realistic and Credible'?	Conclusion
energy sources other than Natural gas (3) Solid biomass fired power plant	No • Biomass is only seasonally available in the Western Region. This is mainly due to the seasonal nature of agriculture in Western region. • Monsoon is the major source of irrigation and monsoon season comprises of only three months viz. July, August and September. Even monsoon certainty is not assured due to vagaries of nature. • Even when adequate monsoon is available there is still a probability of crop failure, because of the inherent risks associated with agriculture in India. • To add to the difficulty, biomass has alternative uses viz. used as fertilizer, fodder for cattle.	Yes	No • Generally biomass plants are small scale plants and not comparable with large scale plants like that of project activity. With a total installed capacity of ~70 MW in western region, biomass represents only 0.2% of the total installed capacity in the western region (Table 2.3 and 2.4 of CEA General Review 2006, data for 2004-2005). • Out of the total installed capacity in the western region, approx 40 MW is in Maharashtra. 82% of biomass plants in Maharashtra are sugar mill based co-generation plants, i.e. bagasse is used as a fuel. Again the sugar mills do not operate throughout the year, because of the seasonal nature of molasses crop. • There has been significant increase in Biomass price in past couple of years. Prices	Not a plausible baseline scenario

[7] www.infraline.com, www.mnes.nic.in

Potential Baseline Scenario	Does it deliver outputs and services comparable to project activity?	Is it permitted by applicable regulations?	Is the alternative 'Realistic and Credible'?	Conclusion
	(www.teri.res.in/teriin/terragreen/issue14/essay.htm) • Also there doesn't exist any organised market like that of coal or gas, from where biomass can be sourced. • Biomass can not be stored for long time due to CH_4 generation and therefore it's not possible to hold ample stock of biomass. Hence on the basis of the above analysis it is crystal clear that basic availability and in particular continued availability of bio-mass is in question and power generation based on biomass cannot provide base load power throughout the year and therefore, the bio-mass scenario does not offer outputs and services comparable to the project activity		have risen from Rs.350/MT in 2004 to Rs.1150/MT in 2006. Such increase in prices indicates that supply is limited and there are competing uses for the biomass. With the price of Bio-mass touching heights, further fuel supply can only come from non-renewable source such as forests which raises the threats of deforestation, and loss of habitat and biodiversity. As biomass scenario cannot deliver outputs and services similar to the project activity neither in terms of baseload power nor in terms of size and as further supply can cause destruction of precious forests and due to reasons contained under this column as well as preceding column this scenario is not realistic and credible.[7]	

Potential Baseline Scenario	Does it deliver outputs and services comparable to project activity?	Is it permitted by applicable regulations?	Is the alternative 'Realistic and Credible'?	Conclusion
C) Power generation technologies using energy sources other than Natural gas (4) 1000 MW coal fired pit head based power plant using conventional technology with 35.1% efficiency (under site conditions) and lifetime of 25 years[8].	Yes	Yes	Yes	Plausible baseline scenario
C) Power generation technologies using energy sources other than Natural gas (5) 1015 MW coal (imported) fired port based power plant using conventional technology with 35.1% efficiency (under site conditions) and lifetime of 25 years[9].	Yes	Yes	Yes	Plausible baseline scenario

[8] Sources - Regulation 16 of CERC tariff guidelines " Gross Station Heat Rate for coal based thermal power stations with an installed capacity of more than 500MW and above" and appendix II to CERC guidelines for tariff calculations- www.cercind.org.

[9] Sources - Regulation 16 of CERC tariff guidelines " Gross Station Heat Rate for coal based thermal power stations with an installed capacity of more than 500MW and above" & appendix II to CERC guidelines for tariff calculations- www.cercind.org.

Potential Baseline Scenario	Does it deliver outputs and services comparable to project activity?	Is it permitted by applicable regulations?	Is the alternative 'Realistic and Credible'?	Conclusion
C) Power generation technologies using energy sources other than Natural gas (6) 1320 MW coal fired pit head based power plant using super critical boiler technology with 40% efficiency (at 100% load factor under standard operating conditions) and lifetime of 25 years[10].	Yes	Yes	Yes	Plausible baseline scenario
C) Power generation technologies using energy sources other than Natural gas (7) 1320 MW coal (imported) fired port based power plant using super critical boiler technology with 40% efficiency (at 100% load factor under standard operating conditions) and lifetime of 25 years[11].	Yes	Yes	Yes	Plausible baseline scenario

[10] Sources- Collected from the report of the committee to recommend next higher size of coal fired thermal power plant- issued by CEA, Ministry of Power, Government of India- www.cea.nic.in & appendix II to CERC guidelines – www.cercind.org.

[11] Sources- Collected from the report of the committee to recommend next higher size of coal fired thermal power plant- issued by CEA, Ministry of Power, Government of India- www.cea.nic.in & appendix II to CERC guidelines – www.cercind.org.

Potential Baseline Scenario	Does it deliver outputs and services comparable to project activity?	Is it permitted by applicable regulations?	Is the alternative 'Realistic and Credible'?	Conclusion
C) Power generation technologies using energy sources other than Natural gas (8) 1000 MW Lignite fired power generation plant with 32.80% efficiency (under site conditions) and life time of 25 years.[12]	Yes	Yes	Yes	Plausible baseline scenario.
C) Power generation technologies using energy sources other than Natural gas (9) 1147.5 MW reservoir based hydro power plant with a lifetime of 35 years[13].	No • Does not deliver base load power due to seasonal monsoon rainfall regime (See also note 1)	Yes	No • In the baseline grid almost all available sites for large scale reservoir based power plant have been taken up. Further site development is not possible due to public resistance mainly on account of rehabilitation and the resettlement of the affected people (e.g. Sardar Sarovar, Indrasagar, Bansagar dams, as per www.infraline.com).	Not a plausible baseline scenario.

[12] Note two to Regulation 16(iii) of the CERC tariff guidelines and Appendix II to CERC tariff guidelines.

[13] Ministry of Power- http://powermin.nic.in/generation/renovation_mordernization_hydel.htm.

[14] Hydro Sector Development in India (Growth & Investment Opportunities) –By R.V. Shahi, Secretary, Ministry of Power, Government of India.

Potential Baseline Scenario	Does it deliver outputs and services comparable to project activity?	Is it permitted by applicable regulations?	Is the alternative 'Realistic and Credible'?	Conclusion
			• Also repeated silt formation leads to reduced or nil power generation even in monsoon, where water supply is copious (www.infraline.com) • Hydro power is for meeting peak load requirement[14]. • Only 816MW of capacity were ranked under "A" category for development in the baseline grid by Ministry of Power, Govt. of India based on various parameters.(Source: http://www.powermin.nic.in/informationcenter/pdf/50000MWHydroelectricInitiatives.pdf)	

Potential Baseline Scenario	Does it deliver outputs and services comparable to project activity?	Is it permitted by applicable regulations?	Is the alternative 'Realistic and Credible'?	Conclusion
C) Power generation technologies using energy sources other than Natural gas (10) Cluster of 20 MW of run of river (ROR) hydro power plants with a lifetime of 35 years (Ministry of Power-http://powermin.nic.in/generation/renovation_mordernization_hydel.htm).	No • Does not generally deliver base load power due to seasonal monsoon rainfall regime (See note 1)	Yes	No • Hydro power is for meeting peak load requirement [15]. • Only 816MW of capacity were ranked under "A" category for development in the baseline grid by Ministry of Power, Govt. of India based on various parameters.(Source: http://www.powermin.nic.in/informationcenter/pdf/50000MWHydroelectricInitiatives.pdf)	Not a plausible baseline scenario
C) Power generation technologies using energy sources other than Natural gas (11) 2*540 MW Nuclear reactor based power plant with a lifetime of 40 years[16].	Yes	No for all Stakeholders including the Project Activity	No Due to almost full exhaustion of indigenous uranium sources and the impossibility of imports,	Not a plausible baseline scenario

[15] Hydro Sector Development in India (Growth & Investment Opportunities) – By R.V.Shahi, Secretary, Ministry of Power, Government of India July, 2003.

[16] Uranium Information Centre–http://www.uic.au/nip19.htm

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

Potential Baseline Scenario	Does it deliver outputs and services comparable to project activity?	Is it permitted by applicable regulations?	Is the alternative 'Realistic and Credible'?	Conclusion
		except for Nuclear Power Corporation of India, an 100% Government owned company This scenario is available only to Nuclear Power Corporation of India Limited, a 100% Government of India owned Company[17]. whose capacity additions are driven by the Government of India initiatives based on its long term strategic programmes and not by the project activity. It may be pertinent to note here that Nuclear Power Corporation of India is under the administrative control of	expansion of nuclear power generation is not possible[18] and hence this scenario is not realistic and credible. The lead time for a nuclear power plant is very high at 8-10 years as against 3-4 years for a gas based or a coal based plant. Also such lead times face the risk of getting stretched due to possible public protests against the harm that may be caused by radiations. The lead times of a Nuclear Plant is almost more than double than that of gas based plants Hence for above reasons this alternative baseline scenario is not realistic and credible.	

[18] 1) www.uic.com,2) www.science.org.au/nova/002/002key.htm, 3) http://news.softpedia.com/news/australia-not-to-sell-uranium-to-india-19090.shtml, 4) www.hinduonnet.com, 5) www.wisconsinproject.org,6) www.npcil.nic.in

Potential Baseline Scenario	Does it deliver outputs and services comparable to project activity?	Is it permitted by applicable regulations?	Is the alternative 'Realistic and Credible'?	Conclusion
		Department of Atomic Energy, whereas the other Government of India owned companies in power sector are under the administrative control of Ministry of Power. Also Nuclear Power Corporation is not governed by the Indian Electricity Act, 2003 and is not subject to jurisdiction of Indian Electricity Regulatory Commissions. Hence the scenario is not legally available to any **stakeholder** including the project participant except for Nuclear Power Corporation of India		
C) Power generation technologies using				

Potential Baseline Scenario	Does it deliver outputs and services comparable to project activity?	Is it permitted by applicable regulations?	Is the alternative 'Realistic and Credible'?	Conclusion
energy sources other than Natural gas (12) Cluster of 20 power plants of 50 MW using diesel with 42% efficiency and lifetime of 15 years[19].	Yes	Yes	Yes	Plausible baseline scenario
C) Power generation technologies using energy sources other than Natural gas (13) Electricity Imports from Pakistan	Yes	No	No • Political conflict between India and Pakistan • Power shortage in Pakistan (Pakistan Business News- Pak Tribune- www.paktribune.com).	Not a plausible baseline scenario
C) Power generation technologies using energy sources other than Natural gas (14) Electricity Imports from other Indian grids	No • Electricity Import from other regional grids in India is not possible at all times as these grids are	Yes	No As this scenario does not deliver output and services comparable to the project activity and as there are significant	Not a plausible baseline scenario.

[19] Appendix –II CERC guidelines for tariff calculations and http://mnes.nic.in/baselinepdfs/annexure2c.pdf

.

Potential Baseline Scenario	Does it deliver outputs and services comparable to project activity?	Is it permitted by applicable regulations?	Is the alternative 'Realistic and Credible'?	Conclusion
	suffering from shortages to meet their energy demand and in particular the peak demand. The monthly average peak deficit for the year 2004-05 being (as contained in *Note-2*): 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 • Such peak deficits occur in all months of the year as is demonstrated in *Note-2* below. • Electricity Imports are possible only in periods of temporary surplus from these other regional grids and in particular from the Eastern Regional grid. • It can be concluded from the above that Imports do not deliver base-load power and therefore there is no denying the fact		transmission constraints, this scenario is not realistic and credible.	

Potential Baseline Scenario	Does it deliver outputs and services comparable to project activity?	Is it permitted by applicable regulations?	Is the alternative 'Realistic and Credible'?	Conclusion
	that Imports do not deliver the output and services comparable to the project activity.			

Note 1: The details of hydro power projects and their Plant Load Factor are as follows:

Particulars	2002-03	2003-04	2004-05
No. of projects in western region (Annex- 2.1 to "Performance Review of Hydro Power stations in 2004-05 and 2003-04, & www.infraline.com)	40	42	46
Installed capacity.(Annex- 2.1 to "Performance Review of Hydro Power stations in 2004-05 and 2003-04, & www.infraline.com)	4386.30	4899.80	5757.80
Avg. Plant Load Factor (%) (Annex- 2.1 to "Performance Review of Hydro Power stations in 2004-05 and 2003-04, &www.Infraline.com).	22	22	21
Projects having Plant Load Factor>50%	2 (99 MW)	1 (90 MW)	1 (90 MW)

The hydro plants cannot be considered as base load plants for the following reasons:-

a) The average Plant Load Factor of the hydro plants in western region in 2002-03, 2003-04 and 2004-05 was only 22%, 22% and 21% respectively.

b) The installed capacity of projects achieving at least 50% Plant Load Factor in a year (base load plants are expected to achieve a Plant Load Factor of above 60%) is only approx. 2 % of the entire hydro capacity in western region.

c) An analysis of the projects having over 50% Plant Load Factor in either of the three years i.e.2002-03, 2003-04 and 2004-05 (which are two projects having an aggregate capacity of 99MW), shows that there is a wide divergence in the monthly plant load factor over different months of the same year i.e. around 50%. This shows that monthly Plant Load Factor in hydro projects depends on seasonal factors viz. monsoon during which time there are copious

water flows. The logical inference is that even those hydro projects having average Plant Load Factor above 50% cannot be considered as those providing base load electricity.

Note 2 - Peak Demand / Peak Met by Different Regions during the year 2004-05

Month / Region	Apr-04	May-04	Jun-04	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04	Jan-05	Feb-05	Mar-05	Average
Northern Region													
Peak Demand	23466	24247	25654	26834	24757	26829	24457	25015	25373	25095	24407	23180	24943
Peak Met	22014	22729	23952	24125	22971	23752	21325	22890	22764	22316	21731	21583	22679
Surplus/(Deficit) (MW)	(1452)	(1518)	(1702)	(2709)	(1786)	(3077)	(3132)	(2125)	(2609)	(2779)	(2676)	(1597)	(2264)
Surplus/(Deficit) (%)	**(6.2)**	**(6.3)**	**(6.6)**	**(10.1)**	**(7.2)**	**(11.5)**	**(12.8)**	**(8.5)**	**(10.3)**	**(11.1)**	**(11.0)**	**(6.9)**	**(9.1)**
Western Region													
Peak Demand	29859	27835	26589	26650	25090	28904	28834	30414	31085	30084	30361	30732	28870
Peak Met	23380	22681	21316	21560	20809	24049	23834	24005	23400	23096	23868	24128	23011
Surplus/(Deficit) (MW)	(6479)	(5154)	(5273)	(5090)	(4281)	(4855)	(5000)	(6409)	(7685)	(6988)	(6493)	(6604)	(5859)
Surplus/(Deficit) (%)	**(21.7)**	**(18.5)**	**(19.8)**	**(19.1)**	**(17.1)**	**(16.8)**	**(17.3)**	**(21.1)**	**(24.7)**	**(23.2)**	**(21.4)**	**(21.5)**	**(20.3)**
Southern Region													
Peak Demand	23075	19236	21607	20934	21026	20564	20577	20431	21842	21506	22528	22809	21345
Peak Met	21928	18904	20483	20861	20673	20299	20331	20184	20622	20954	22051	22364	20805
Surplus/(Deficit) (MW)	(1147)	(332)	(1124)	(73)	(353)	(265)	(246)	(247)	(1220)	(552)	(477)	(445)	(540)
Surplus/(Deficit) (%)	**(5.0)**	**(1.7)**	**(5.2)**	**(0.3)**	**(1.7)**	**(1.3)**	**(1.2)**	**(1.2)**	**(5.6)**	**(2.6)**	**(2.1)**	**(2.0)**	**(2.5)**
Eastern Region													
Peak Demand	8286	8224	8027	7993	8148	8123	8340	8231	8445	8489	8480	8816	8300
Peak Met	7895	7606	7765	7837	8071	8099	8320	8046	8250	8371	8310	8533	8092
Surplus/(Deficit) (MW)	(391)	(618)	(262)	(156)	(77)	(24)	(20)	(185)	(195)	(118)	(170)	(283)	(208)
Surplus/(Deficit) (%)	**(4.7)**	**(7.5)**	**(3.3)**	**(2.0)**	**(0.9)**	**(0.3)**	**(0.2)**	**(2.2)**	**(2.3)**	**(1.4)**	**(2.0)**	**(3.2)**	**(2.5)**
North-Eastern Region													
Peak Demand	1225	1211	1231	1247	1221	1195	1211	1221	1161	1272	1226	1263	1224
Peak Met	1029	1022	1082	1068	1104	1082	1128	1087	1045	995	995	1044	1057
Surplus/(Deficit) (MW)	(196)	(189)	(149)	(179)	(117)	(113)	(83)	(134)	(116)	(277)	(231)	(219)	(167)
Surplus/(Deficit) (%)	**(16.0)**	**(15.6)**	**(12.1)**	**(14.4)**	**(9.6)**	**(9.5)**	**(6.9)**	**(11.0)**	**(10.0)**	**(21.8)**	**(18.8)**	**(17.3)**	**(13.6)**

Month / Region	Apr-04	May-04	Jun-04	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04	Jan-05	Feb-05	Mar-05	Average
All India													
Peak Demand	85911	80753	83108	83658	80242	85615	83419	85312	87906	86446	87002	86800	84681
Peak Met	76246	72942	74598	75451	73628	77281	74938	76212	76081	75732	76955	77652	75643
Surplus/(Deficit) (MW)	(9665)	(7811)	(8510)	(8207)	(6614)	(8334)	(8481)	(9100)	(11825)	(10714)	(10047)	(9148)	(9038)
Surplus / (Deficit) (%)	**(11.3)**	**(9.7)**	**(10.2)**	**(9.8)**	**(8.2)**	**(9.7)**	**(10.2)**	**(10.7)**	**(13.5)**	**(12.4)**	**(11.5)**	**(10.5)**	**(10.7)**

(Source: Central Electricity Authority India)

Step 2: Identify the economically most attractive baseline scenario alternative

Sub Step -1: Calculating levelized cost of electricity production in "Rs./kWh" for identified plausible baseline scenarios.

From the discussions above it is found that the following are the plausible baseline scenarios.

A. Project activity not implemented as a CDM project, i.e. 1147.5 MW gas based combined cycle power plant with advance class gas turbine.

B. Power Generation using natural gas but technology other than the project activity (i.e. 1050 MW gas based CCPP)

C. Power generation technologies using energy sources other than Natural Gas:

1. 1,000MW coal fired pit head based power plant using conventional technology.
2. 1015 MW coal (imported) fired port based power plant using conventional technology.
3. 1,320 MW coal fired pit based power plant using super critical boiler technology.
4. 1,320 MW coal (imported) fired port based power plant using super critical boiler technology.
5. Cluster of 20 power plants of 50 MW each, using diesel.
6. 1000 MW Lignite fired power generation plant.

These plausible baseline scenarios are evaluated on the basis of economic attractiveness using levelized cost of electricity production in Rs./kWh. Table 2 below shows the assumptions for calculating levelized cost of the identified plausible baseline options:

Table 2:

A. General Assumptions for all types of projects:

Sr.No.	Particulars	Detail	Source
1	Debt : Equity ratio	70:30	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2004 (www.**cerc**ind.org)
2	Plant Load Factor	80%	
3	Incentive payable for generation above normative level	0.25 Rs./ kWh	
4	Permissible increase in O & M	4% p.a.	
5	Return on Equity allowed	14% p.a.	
6	Advance against Depreciation limited to years	10	
7	Deprecation limited to	90%	

Sr.No.	Particulars	Detail	Source
8	Depreciation Rate	Straight line method of depreciation, 6% for gas and diesel and 3.6% for coal.	
9	Rate of interest on working capital borrowing	10.25%	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2004 (www.**cerc**ind.org)
10	Corporate Tax Rate (including surcharge)	33.66%	Income Tax Act, 1961 for assessment year 2006-07 (as stipulated for the accounting year 2005-06)
11	Minimum Alternate Tax (including surcharge)	8.415%	
12	Tax Holiday benefits (Sec.80 IA)	100% deduction of profits derived for any consecutive 10 years out of first 15 year period.	
13	Tax Depreciation Rate	35% for 1st year & 15 % thereafter (WDV Basis)	
14	Tenure and Interest rate on long term loan	Project period +12 years, 7.25 % Interest Rate	As offered by Power Finance Corporation
15	USD Exchange rate on 8th June, 2005.	43.53 Rs/USD	RBI website (http://www.rbi.org.in/scripts/ReferenceRateArchive.aspx)
16	Rate of Depreciation of Rupees against USD	3.0% p.a.	Based on period over 10 years (http://www.oanda.com/convert/fxhistory)

B General assumptions for Gas Based Projects

Sr.No.	Particulars	Detail	Source
1	Auxiliary consumption	3%	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2004 (www.**cerc**ind.org)
2	Heat Rate	1,850 kCal (7.7441 Mega Joules) /kWh- for combined cycle (Advance class) 1,950 kCal (8.163 Mega Joules)/kWh- for combined cycle (E class etc)	
3	O & M charges	0.877 million Rs/ MW for year 2007-08 with 4 % p.a. escalation	

Sr.No.	Particulars	Detail	Source
4	Working Capital – Receivable Fuel O & M Maintenance spare Escalation of maintenance spare	 2 months 1 month 1 month 1% of historical cost 6% p.a.	
5	Ex-terminal price of gas	> 5 $/mmbtu (>4.74$/ GJ)[20]	Calculation of Ex terminal price of LNG at Dahej based on 12 month average of Henry Hub prices (July 2004-June 2005) (http://www.neo.negov/statshml/124_2004.hmt and Press Release made by Business line www.thehindubusinessline.com)
6	Sales Tax	12%	Gujarat Sales tax Act for the year 2004-05.
7	Calorific value on GHV basis	9615 kCal(40.248 Mega Joules)/scm	Calculated as Weighted average GCV of PLL and ONGC, weights applied are 0.5 and 0.5 respectively.
8	Gas Transmission charges in 1st year	561 Rs/1000 scm	The price break-up for Dahej LNG. (www.infraline.com)
9	Discounting Rate	7.50%	Average of 10 and 20 years government bond rate (www.rbi.org.in)

C General assumptions for Coal Based Project

Sr.No.	Particulars	Detail	Source
1	Auxiliary consumption (Unit with cooling tower)	7.5%	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2004 (www.**cerc**ind.org)
2	Secondary Fuel oil consumption	2.0 ml/kWh	
3	Loss in transit and handling	0.80%- for non pit head 0.30% -for pit head	

[20] Exact figures are confidential and enclosed in Appendix-4.

Sr.No.	Particulars	Detail	Source
4	O & M charges (applicable to units with installed capacity of more than 500MW)	Rs. 1.052 million/ MW- for year 2007-08 with 4 % p.a. escalation	
5	Working Capital - Receivable Fuel O & M Maintenance spare Escalation of maintenance spare Secondary fuel	 2 months 1.5 month 1 month 1% of historical cost 6% p.a. 2 months	
6	Heat Rate	2450 kCal (10.255 Mega Joules) /kWh- for coal based thermal plant with installed capacity of more than 500MW 2155 kCal (9.020 Mega Joules)/kWh for supercritical technology based plant	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2004 (www.**cerc**ind.org) Based on efficiency (39.91%) given in "Report of the Committee to Recommend Next Higher Size of Coal Fired Thermal Power Stations" by CEA (Ministry of Power, Government of India), in November 2003. (Table-3)
7	Landed cost of diesel	32.83Rs./ litre	IOC website: Diesel prices in Mumbai (http://www.iocl.com/Diesel_prices.aspx)
8	Gross Calorific value of fuel oil	10100 kCal (42.28 Mega Joules)/kg	C02 baseline Database for Indian Power Sector, December 2006. issued by Central Electricity Authority, Ministry of Power, Government of India.
9	Discounting Rate	7.64%	Average of 20 years and 30 years Government Bond Rate (www.rbi.org.in)

D Specific assumptions for CCPP comprising advance class gas turbine:

Sr.No.	Particulars	Detail	Source
1.	Project Capacity	1147.50 MW	EPC Contract placed in June, 2005 for the project activity.
2.	Project cost	Rs. 30960 million	Press Release during securitisation dated 23rd September, 2004.
3.	Cost/MW	Rs.27 million /MW	Derived based on Sr.No. 1 & 2 of this table

E Specific assumptions for Imported Coal using conventional technology:

Sr.No.	Particulars	Detail	Source
1.	Project Capacity	1,015 MW	Tariff petition for Nagarjuna power project dated 11th April, 2005. Thermal project of over 1,000 MWh, as mega projects, have to approach to the Central electricity Regulatory Commission (CERC) for project cost approval. In compliance with this requirement Nagarjuna Power Project has filed a tariff petition on 11 April 2005 with CERC.
2	Project cost	Rs. 43036 million	
3	Cost/MW	Rs. 42.4 million /MW	
4	Landed cost of coal per mt	Dollar component: $ 47.63 INR component: ➢ custom duty @5.2% ➢ other charges -210 Rs/mt	
5	Gross Calorific value	6200 kCal (25.95 Mega Joules)/kg	

F Specific assumptions for Indigenous Coal using conventional technology

Sr.No.	Particulars	Detail	Source
1	Project Capacity	1000 MW	Project Monitoring Report of CEA(Ministry of Power, Government Of India)-NTPC- Vindhyachal Plant
2	Project cost	Rs. 42015 million	
3	Cost/MW	Rs. 42 million /MW	
4	Landed cost of coal per mt	Rs.1150 per MT (Break Up- Ex-terminal price of ROM coal : 720Rs/Mt Additional charges to make it steam coal : 165 Rs/Mt Royalty and Excise duty: 125Rs/Mt Sales tax @ 4% on above: 40 Rs/Mt Transmission cost: 100Rs/Mt)	Price Notification No. CIL: GM (F): Pricing: 289 dated 15.06.04 by Coal India Limited ('E' grade coal) plus royalty, transmission cost & Taxes
5	Gross Calorific value	3755 kCal (15.71Mega Joules)/kg	CO_2 Baseline Database for the Indian Power Sector, December 2006, issued by Central Electricity Authority, Ministry of Power, Government of India

Sr.No.	Particulars	Detail	Source
			(http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm).

G Specific assumptions for Indigenous Coal using Super critical boiler technology:

Sr.No.	Particulars	Detail	Source
1	Project Capacity	1320 MW	Standard sizes
2	Project cost	Rs.73920 million	Derived based on Sr. No. (1) and (3)
3	Cost/MW	56 million Rs./MW	Vijayawada Stage IV quoted cost per MW (Online edition of Indian National papers including the Hindu, 2005).
4	Landed cost of coal	Rs.1150/MT (Break Up- Ex-terminal price of ROM coal : 720 Rs/Mt Additional charges to make it steam coal : 165 Rs/Mt Royalty and Excise duty : 125Rs/Mt Sales tax @ 4% on above: 40 Rs/Mt Transmission cost : 100Rs/Mt)	Price Notification No. CIL: GM (F): Pricing: 289 dated 15.06.04 by Coal India Limited ('E' grade coal) plus royalty, transmission cost & Taxes.
5	Gross Calorific value	3755 kCal (15.72Mega Joules)/kg	CO_2 Baseline Database for the Indian Power Sector, December 2006, issued by Central Electricity Authority, Ministry of Power, Government of India (http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm).

H Specific assumptions for Imported Coal using Super critical boiler technology:

Sr.No.	Particulars	Detail	Source
1	Project Capacity	1320 MW	To make it comparable with project activity
2	Project cost	Rs.73920 million	Derived based on Sr. No. (1) and (3)
3	Cost/MW	Rs.56 million /MW	Vijayawada Stage IV quoted cost per MW (Online edition of Indian National papers including the Hindu, 2005).
4	Landed cost of coal/ mt	Dollar component: $ 47.63	Tariff petition for Nagarjuna power

Sr.No.	Particulars	Detail	Source
		INR component: ➢ custom duty @5.2% ➢ other charges -210 Rs/mt	project dated 11th April, 2005 (http://cercind.gov.in/261005/40-2005.pdf)
5	Gross Calorific value	6200 kCal(25.9532 Mega Joules)/kg	

I Specific assumptions for CCPP comprising E class & its variations:

Sr.No.	Particulars	Detail	Source
1	Project Capacity	1050 MW	To make it comparable with project activity
2	Project cost	Rs. 26250 million	Derived based on Sr.No. 1 and 3.
3	Cost/MW	Rs. 25 million /MW	Based on a CCPP- Promoted by GVK Power Pvt. Ltd) in Andhra Pradesh (source – Ministry of Power/ Central Electricity Authority, Ministry of Power, Government of India)

J. Assumptions for Diesel fired power generating units.

Sr. No.	Particulars	Details	Source
1	Total Capacity of the plant	1000 MW (Cluster of 20 Nos. of 50 MW each)	To make it comparable to our project
2	Cost per MW	Rs. 37.839 Million	Basin Bridge DGPP- M/s GMR Vasai Power Corp. Ltd.- comprising 4 numbers 50 MW DGCC Private Sector Thermal Schemes Cleared/Appraised By CEA (Ministry of Power Government of India), under the provisions of repealed E (S) Act, 1948. (http://www.cea.nic.in/Thermal/Project%20Appraisal/private-thermal.pdf).
3	Total Project Cost	Rs. 37839.9 Million	Obtained from above two items
4	Landed Cost of Diesel	32.83 Rs./litre	IOC Website: Diesel Price in Mumbai (http://www.iocl.com/Diesel_prices.aspx).
5	Gross Calorific value of Diesel	10500 kCal (43.95 Mega Joules) / Kg.	C02 Baseline Database for Indian Power Sector issued, December 2006 by Central Electricity Authority, Ministry of Power, Government Of

Sr. No.	Particulars	Details	Source
			India
6	Gross Heat Rate	2165.1 kCal (9.063 Mega Joules)/KWh	Ministry of Non-Conventional Energy Sources. (based on 1.05 * net heat rate) http://mnes.nic.in/baselinepdfs/annexure2c.pdf Grossing factor provided by:CO2 Baseline Database for Indian Power Sector, December 2006, issued by Central Electricity Authority, Ministry of Power Government of India,
7	Operating and Maintenance exp.	2.5% of the Project Cost.	As per earlier norms stipulated by the Government of India in 1990.
8	Expected Life of the Project	15 years	Appendix II to CERC guidelines for Tariff calculations, 2004 (www.cercind.org)
9	Working Capital Information.	**a) Receivables**: 2 Months. **b) Fuel**: 1 Month. **c) O& M Exp.**: 1 Month **d) Maintenance Exp**: 1 % of the historical cost, to be appreciated @6% p.a.	CERC Guidelines for Tariff calculations as is applicable in case of Gas Fired Power Generating Units. (www.cercind.org)
10	Auxiliary consumption	2%	Based on expert opinion.
11	Discounting rate	7.5	Average of 10 and 20 years government bond rate (www.rbi.org.in)

K. Specific assumptions for Lignite fired power generation plant

Sr. No.	Particulars	Details	Source
1	Project capacity	1000MW	To make it comparable with the project activity.
2	Cost Per Mega Watt	Rupees 50 Million per MW	Akrimota Lignite based TPP, Kutch (www.infraline.com)
3	Lignite cost	Rs.678/mt	Weighted average price (weight applied is the quantity supplied from different lignite extraction sites by Gujarat Minerals Development Corporation) at which Gujarat Minerals Development Corporation sold lignite in 2004-05 (www.gmdc.com)
4	Gross calorific value of Lignite	2724 Kcal/Kg (11.402 Mega joules per Kg)	General Review 2006, for year 2004-05 by Central Electricity Authority,

Sr. No.	Particulars	Details	Source
			Ministry of Power, Government of India (table 6.3).
5	Loss in transit and handling	0.80%- for non pit head 0.30% -for pit head	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2004 (www.cercind.org) Assumed similar to that of Coal based plant.
6	O&M cost for lignite based plants of capacity more than 500MW	For the year 2008-09: Rs.10.95 lacs (Rs.1.095 Million) per MW escalated @ 4% per annum there after.	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2004 (www.cercind.org) Assumed similar to that of coal as CERC guidelines don't provide for "allowable O&M expenditure" for lignite plants exceeding 250MW.
7	Rate of Depreciation	3.6%	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2004 (www.**cerc**ind.org)
8	Oil consumption	3 ml/kWh	
9	Gross heat rate.	2621.5 Kcal/kWh (i.e 2450Kcal/kWh for coal multiply by factor of 1.07)	
10	Auxiliary consumption	8%	
11	Working Capital - Receivable Fuel O & M Maintenance spare Escalation of maintenance spare Secondary fuel	 2 months 1.5 month 1 month 1% of historical cost 6% p.a. 2 months	
12	Landed cost of diesel	32.83Rs./ litre	IOC website: Diesel prices in Mumbai (http://www.iocl.com/Diesel_prices.aspx)
13	Gross Calorific value of fuel oil	10100 kCal (42.28 Mega Joules)/kg	CO2 Baseline Database for Indian Power Sector, December,2006 issued by Central Electricity Authority, Ministry of Power, Government Of India.
14	Discounting Rate	7.64%	Average of 20 years and 30 years Government Bond Rate (www.rbi.org.in)

On the basis of plausible baseline scenarios identified in table 1 and assumptions detailed in table 2, table 3 represents evaluation of alternatives based on economic attractiveness:

Table 3:

Sr.No.	Alternative	Levelised Cost (Rs/kWh)[21]
A	Project activity not implemented as a CDM project, i.e. 1147.5 MW gas based combined cycle power plant with advance class gas turbine.	>Rs.3
B	Power Generation using natural gas but technology other than the project activity (i.e. 1050 MW gas based CCPP)	>Rs.3
C	Power generation technologies using energy sources other than Natural gas.	
1.	**1000MW coal fired pit head based power plant using conventional technology**	**1.94**
2.	1015 MW coal (imported) fired port based power plant using conventional technology.	2.60
3.	1320 MW coal fired pit based power plant using super critical boiler technology.	2.11
4.	1320 MW coal (imported) fired port based power plant using super critical boiler technology.	2.68
5.	Cluster of 20 diesel fired power plants of 50 MW.	More than Rs. 7**
6.	1000 MW Lignite fired power generation plant	2.14

** as the cost per unit of power is very high in diesel fired power plants, no sensitivity analysis has been carried out for such power plant.

Thus, it can be seen that coal fired pit head based power plant using conventional i.e. sub-critical technology is economically the most attractive baseline scenario.

Sub Step -2: *Sensitivity analysis of identified plausible baseline scenarios.*

The sensitivity analysis was conducted for the above alternatives to confirm that the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions i.e. fuel prices and the load factor. Table 4 below shows the economic evaluation of the sensitivity analysis on identified plausible baseline options:

Table-4:

Parameter	Alternative	Variation	Levelised cost (Rs/kWh)[22]

[21] Exact figures of levelized cost (where not indicated) and excel sheets containing the workings for arriving at the levelized cost are confidential and enclosed as Appendix-4.

[22] Exact figures of levelized cost (where not indicated) are confidential and enclosed as part of Appendix 4.

Parameter	Alternative	Variation	Levelised cost (Rs/kWh)[22]
Fuel Price	Project activity not implemented as a CDM project, i.e. 1147.5 MW gas based combined cycle power plant with advance class gas turbine.	+/-5 +/-10	> Rs.3 in all cases
	Power Generation using natural gas but technology other than the project activity (i.e. 1050 MW gas based CCPP)	+/-5 +/-10	> Rs.3 in all cases
	1000MW coal fired pit head based power plant using conventional technology	+/-5 +/-10	**1.97/1.92** **2.00/1.89**
	1015 MW coal (imported) fired port based power plant using conventional technology.	+/-5 +/-10	2.67/2.53 2.74/2.46
	1320 MW coal fired pit based power plant using super critical boiler technology	+/-5 +/-10	2.13/2.08 2.15/2.06
	1320 MW coal (imported) fired port based power plant using super critical boiler technology	+/-5 +/-10	2.74/2.62 2.80/2.56
	1000 MW Lignite fired power generation plant	+/-5 +/-10	2.17/2.10 2.21/2.06
Load Factor	Project activity not implemented as a CDM project, i.e. 1147.5 MW gas based combined cycle power plant with advance class gas turbine.	+/-5 +/-10	> Rs.3 in all cases
	Power Generation using natural gas but technology other than the project activity (i.e. 1050 MW gas based CCPP)	+/-5 +/-10	> Rs.3 in all cases
	1000MW coal fired pit head based power plant using conventional technology	+/-5 +/-10	**1.89/2.00** **1.85/2.06**
	1015 MW coal (imported) fired port based power plant using conventional technology.	+/-5 +/-10	2.55/2.66 2.50/2.72
	1320 MW coal fired pit based power plant using super critical boiler technology.	+/-5 +/-10	2.04/2.18 1.99/2.25
	1320 MW coal (imported) fired port based power plant using super critical boiler technology.	+/-5 +/-10	2.62/2.75 2.56/2.83
	1000 MW Lignite fired power generation plant	+/-5 +/-10	2.08/2.20 2.03/2.27

The sensitivity analysis also confirms the conclusion that the economically most attractive baseline scenario identified in sub step -1 is robust to reasonable variations in the critical assumptions.

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 project's additionality has been assessed and demonstrated according to the following three steps specified in AM0029.

Step 1: Benchmark investment analysis

According to the additionality tool, levelized cost of electricity generation can be used as financial indicator for the Benchmark Investment Analysis. This parameter is appropriate for this project activity, as all thermal electricity generation projects in the baseline grid are allowed return of 14% on equity investment in determining their cost for tariff purposes. The following levelized costs were compared:

- Cost per kWh for the *existing power plants* and
- Cost per kWh for new *power plants*

Cost per kWh for existing power plants

National Thermal Power Corporation (NTPC) is the major electricity generator in the baseline grid (i.e. western regional electricity grid) as well as in India. While there are no calculations of levelized cost publicly available for NTPC's power plants, data for weighted average cost per kWh of NTPC's four plants connected to the baseline grid for the past 3 years viz. 2001-02, 2003-04 and 2004-05 (authentic and reliable data for the year 2002-03 is not available and hence not considered) as well as its average for such three years (which serves as a good proxy for levelized cost as it is based on 12 values) are available. This has been reproduced below:

Weighted average cost per kWh of NTPC power stations connected to Western Regional Electricity Grid in Rs/kWh:				
Year	Financial Year 2001-2002	Financial Year 2003-2004	Financial year 2004-05	Simple average cost for three years.
Rupees per kWh.	1.45*	1.34*	1.46*	1.42

* Has been derived by taking weighted average of cost per kWh for the above four plants in each of the three years[23], weights applied being the power generated (in kWh) by the respective plants in the corresponding year.[24]

Cost per kWh for new power plants

[23] http:// www.Infraline.com /power, Year wise weighted Average Tariff for NTPC station(June 2006),

[24] NTPC's 29th annual report (www.ntpc.co.in)

Jindal Power Limited is setting up a 1000MW (Phase I -2*275MW and phase II- 450MW) coal based power plant "Raigarh TTP" in Raigarh. The tariff contracted for supplies from this plant to Power Trading Corporation (PTC), for a ten year period is Rs.2.21/kWh without any escalation which in fact is equivalent to levelized tariff. (www.infraline.com)

Calculation and comparison of financial indicators:

The levelized cost per kWh for the project activity and the benchmark values are tabulated below.

	i)Existing Power plants (NTPC, Western Regional Electricity Grid)	ii) New power plants-	Project Activity
Levelized cost per kWh	1.42	2.21	> Rs.3[25]

It is clear from the above analysis that the cost per kWh for the project activity is significantly higher than both benchmark values. Therefore the CDM project activity cannot be considered financially attractive.

Sensitivity Analysis:
The sensitivity analysis was conducted by varying the benchmark values as well as the levelized cost perk kWh of the project activity as the constituents of such cost in the case of benchmark values are not available. Conducting a sensitivity analysis on the total levelized cost instead of on any of its constituent one at a time is more conservative. The results of the same are presented in the following table.

Particulars	Existing power plants (Rs./kWh)	Upcoming Power plants (Rs./kWh)	Project Activity (Rs./kWh)[26]
Normal case	1.42	2.21	> Rs.3
Cost increases by 5%	1.49	2.32	> Rs.3
Cost increases by 10%	1.56	2.43	> Rs.3
Cost decreases by 5%	1.35	2.10	> Rs.3
Cost decreases by 10%	1.28	1.99	> Rs.3

It can be observed that this CDM project activity is financially unattractive not only in the normal situation but also in the varying scenarios and therefore the project activity is additional.

Step 2: Common Practice Analysis

[25] Exact figures of levelized cost (where not indicated) and excel sheets containing the workings for arriving at the levelized cost are confidential and enclosed as Appendix-5.

[26] Exact figures of levelized cost (where not indicated) are confidential and enclosed as part of Appendix 5.

Under this step, it is being demonstrated that the project activity is not a common practice[27] in India by applying Step 4 of the latest version of the "Tool for demonstration assessment and of additionality" (Additionality Tool) agreed by the CDM Executive Board at the time of start of the project activity. As per Sub-step 4a of this Additionality Tool, an analysis of other activities similar to the proposed project activity is presented below.

- ✓ In terms of scale, there are no combined cycle power plants of a similar scale (i.e. 1,000 MW and above in a single location) implemented previously or currently underway at the time of start of this project activity.

- ✓ In terms of technology, the project activity is the first combined cycle power plant in India possessing a combination of environment friendly features hitherto not used in any other combined cycle power plant in India (though a few out of 38 combined cycle power plants have one or other such feature) (source CEA 2003-04, Ministry of Power, Government of India & www.infraline.com). Such features include:

  (a). The project activity is the first and the only project amongst those in operation and in construction to have a single shaft configuration instead of a multiple shaft configuration. In view of better fuel efficiency in a single shaft configuration, the project proponent has gone for this in compliance with its objective of reducing GHG emissions per GWh.

  (b). Also the project activity is the first and the only project in India to have two stage burner with diffusion pilot (i.e. pre mix operation through out the entire load range) instead of conventional burners , which reduces the NOx level right from start load instead of from around 45% load. Further the efficiency of the gas turbine is also increased due to high combustion stability achieved by such burners. Also due to such burners the NOx emissions from project activity is 25ppm when loads are greater than 50% against a Euro norm of 26.6ppm ($50Mg/NM^3$) for loads greater than 70% and the Indian norm of 50ppm.

  (c) Again the project activity is the first and the only project in India to have a device called " GT Rotor Axial Positioning Device" , which is a hydraulic device for fixing the axial position of Gas Turbine Rotor. This device by minimising the leakages of air between various stages of air compressor and by also minimising the leakage of gas combustion products from gas turbine blade tips, improves the efficiency of the gas turbine.

  (d) A normal feature in most of the combined cycle gas based plants in India and in all the combined cycle gas based plants in the western region is that, there is a special provision of bypass stack which enables these plants to operate in open cycle mode. However no such special provision has been made by the project activity, thus substantiating the fact that the project activity is not common practice. The operations when in open cycle mode leads to more t CO_2 emissions per GWh".

[27] Dabhol power plant comprising three phase of 714 MW each has been abandoned and not revived as of project start date and hence not considered for this analysis. Attempts have been made subsequently by Government of India to revive this project by various means including provision of tax concessions specifically for this project activity.

(e) High temperature F class gas turbines have higher fuel efficiency (i.e. 57% at 100% load) than the standard E class turbines. Only three out of 38 combined cycle power plants (i.e. 8%) in India use such advanced class gas turbines.

✓ The project activity is among the few gas based combined cycle plants in India (i.e. two out of thirty four gas fired combined cycle power plants-5.88%) to be conceived on the basis of Natural Gas to be sourced from the market (including thru imports) at market determined price. Most of the other gas based combined cycle plants were allotted Natural Gas by the *"Gas Linkage Committee"* under the Administered Price Mechanism, which enabled the implementation of such projects. Such allocated gas is priced under the Administered Pricing Mechanism at a lower level i.e. around 3.3$ per mmbtu as against the market determined price of over $6 per mmbtu.

✓ Also of the recent capacity additions contributing to 20% of the generation in 2004-05, there is no power plant in operation comparable to the project activity in terms of size, scale, fuel and technology.

✓ Also the National Electricity policy favours coal and lignite based projects and states that "Gas a source for Power Generation is dependent on its price".

As there are no similar activities observed, Sub step 4(b) of "Tools for Demonstration and Assessment of additionality" needs no detailed elaboration.

Thus the above substantiate the claim that the project activity is not a widely observed and commonly carried out practice. Therefore, this project is additional.

Step 3 Impact of CDM registration

The approval and registration of the project activity as a CDM activity besides reducing anthropogenic greenhouse gas emissions would have the following impacts on the project activity, which were envisaged at the time of start of the project activity.

- Revenue from the CDM funds are important for the project activity's success. Amongst many risks facing the project activity, the high cost of Natural gas is a significant risk. In many situations such high cost can result in nil or reduced deliveries of power from the project activity exposing it to the risk of paying for natural gas not taken pursuant to stringent take or pay clauses in the gas purchase contracts.

- The registration of the project activity would encourage other prospective developers to develop gas based advance class combined cycle power plants, which in effect would lead to further reduction in GHG emissions from power generation through adoption of a new and fuel efficient technology.

It can, thus, be seen that the project activity satisfies each of the steps 1 to 3 and therefore the project activity is not the base line scenario and is additional.

The starting date of the project activity (i.e., awarding of EPC contract) was on 17th June 2005, which is before the date of starting the validation process. The evidence that the incentive from CDM was

seriously considered in the decisions to proceed with the project activity are available and include inter-alia, the decision of the Board of Directors and submission of new methodology *"NM0080"*.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

>>

The procedure followed for estimating the emissions reductions from this project activity during the crediting period are as per the following four steps which correspond with AM0029.

Steps	Description	Equation Used	Methodological choices
A.	**Procedure followed for estimating emissions in the project scenario (PE_y)**	The CO_2 emissions from on site combustion of natural gas in the project activity (PE_y) are calculated in accordance with and as per equation no 2 of AM0029.The sub variable $COEF_{f,y}$ to be calculated in accordance with and as per equation no. (2a) of AM0029	The design of the project power plant is to use gas as the primary and only fuel for power generation.
B	**Procedure followed for estimating emissions in the baseline scenario (BE_y)**	Baseline emissions are calculated in accordance with and as per equation no 3 of AM 0029	The ex ante assessment in accordance with and as per AM0029 under options 1, 2 & 3 of AM0029 in section B.6.3 results in lowest emission factor for option 1 (i.e. The Build Margin calculated according to ACM0002), and therefore the Build Margin as per ACM0002 define $EF_{BL,\ CO2,y}$. As Option 1 is selected, it will be estimated ex-post as described in ACM0002 during the crediting period. Under option 1 for calculating baseline emissions (i.e. the build margin), the sample group for the purpose of Section B.6.3 shall be the recently built power plant capacity additions (75 Nos.) in the baseline grid in accordance with ACM0002 (i.e. the western regional electricity grid) that comprise 20% of the generation in the baseline grid as in the context of the baseline grid the most recent five power plants have a smaller annual generation (i.e. 1.47% of the generation in baseline grid). Under option 2, (a) the simple OM methodology as

Steps	Description	Equation Used	Methodological choices
			per ACM0002 has been used as the low cost and must run resources has a share lower than 50% as demonstrated in Annex 3 and as the baseline grid is not operated through a merit order-despatch system For option 3, coal fired pit head based 1000MW 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.
C	**Procedure followed for estimating leakages (LE_y)**	Leakage emissions are calculated in accordance with and as per equation no 5 of AM0029	
C.1	**Procedure followed for estimating fugitive methane emissions ($LE_{CH4,y}$)**	Fugitive methane emissions are to be calculated in accordance with and as per equation no 6 of AM0029.	As the baseline emissions are calculated based on option 1, the emission factor for upstream fugitive CH4 emissions occurring in the absence of the project activity is derived using the equation given at the end of page 6 of AM0029. Thus, the emission factor for upstream fugitive CH4 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 are to be 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 US/Canada values for NG as (a) gas processing facilities in Rasgas (Qatar) , Petronet LNG (India), Hazira LNG (India) and Panna-Mukta and Tapti (India) etc and (b) gas transportation and distribution facilities of Gujarat State Petronet Ltd. are predominantly of recent vintage and are built and operated to international standards such as API, ASMI, ASTM (supporting proof has been provided to the validation team). The details justifying such a claim include the

Steps	Description	Equation Used	Methodological choices
			following: **<u>Gas Processing system</u>** **RasGas (Qatar):** The LNG that is sourced by Petronet LNG Ltd. from Rasgas comes from its Liquefaction Trains No. 3 and 4. These trains are owned by Ras Laffan Liquefied Natural Gas Company Limited (II) (RasGas II), a joint venture company established in 2001 by Qatar Petroleum and an Oil Major, Exxon Mobil. ExxonMobil holds 29% of shareholding in Train No. 3 and 30% of shareholding in Train No. 4. The commercially proven technology for construction of liquefaction of terminals is currently of US origin and as these trains have been built recently under the guidance of this leading Oil Major located in United States, it can be concluded that these liquefaction trains are of recent vintage and are built and operated to international standards. **Petronet LNG Ltd. – Dahej LNG Terminal:** GAZ de France (GdF), the French national company that has been the largest importer of LNG in Europe for the last 30 years is Petronet LNG Ltd's strategic partner and holds 10% equity in Petronet LNG Ltd. GdF, whose business covers every aspect of the gas supply chain, is recognized as a world leader. It has developed expertise in natural gas production, supply, transmission, liquefied natural gas (LNG), storage and distribution, and other applications. GdF's vast experience has been of immense value while setting up Dahej LNG Terminal. Petronet LNG Ltd. – Dahej Terminal had awarded the Engineering Procurement and Construction Contract in respect of the subject Terminal to the Consortium led by M/s Ishikawajima Harima Heavy Industries Company Ltd. (IHI), Japan. The other members of the consortium were M/s Ballast Nedam International BV-Netherlands, M/s Toyo Engineering India Limited, M/s Itochu Corporation, M/s Mitsui Company Limited, Japan and M/s Toyo Engineering Corporation. The Consortium Leader M/s IHI is one of the most reputed construction companies in the field of LNG regasification terminals. This terminal was commissioned in the first quarter of 2004. Thus it can be seen that the Dahej LNG Terminal of

Steps	Description	Equation Used	Methodological choices
			Petronet LNG Ltd. is of recent vintage and is built and operated to international standards. **ONGC:** ONGC Hazira Plant is processing around 42 MMSCMD of gas and associated condensate. The processing includes sweetening (H2S removal), dehydration, hydrocarbon dew point depression, and condensate fractionation and sulphur recovery. The plant is built and commissioned by builders of international fame like KIT USA, KHIC South Korea and HYUNDAI South Korea which are considered to be one of the best in the world. The technology adopted for processing has been provided by the reputed international technology provider like SNEA (P) France, (Now called Prosernat) and ARI (Now called Merrichem). The process control is carried out with DIDC (Distributed Digital Control System) system, which has been, further upgraded to latest state of art with full redundant feature based on industrial IT technology by ABB. Advance process control (APC) technology is also being implemented for the finest control of the system. The Digital Control System (DCS) is based on open standard protocol for ease of integration. The process operation and control at ONGC Hazira is unique in India with integrated safety system; such as H2S detection and hydrocarbon detection. ONGC Gas Processing Complex - Hazira where Bombay High Gas and Panna-Mukta Tapti Gas are processed is working on various schemes to achieve zero hydrocarbon emissions including zero flares. Such schemes include the following: a) Flare gas recovery project at Hazira Gas Processing Complex (HGPC), Hazira Plant, ONGC Ltd. (for which PDD has been submitted on 2nd June, 2006 using AM0009 version 2) b) Flare gas recovery project at Hazira Gas Processing Complex (HGPC), Hazira Plant, ONGC Ltd. (for which PDD has been submitted on 21st February, 2007 using AMS-III D version 9). c) Zero hydrocarbon (HC) emission from Glycol Dehydrating Unit (GDU) at Hazira Gas Processing Complex of ONGC (for which PDD has been submitted on 16th June, 2006 using AM0037).

Steps	Description	Equation Used	Methodological choices
			Thus it can be observed that the Gas Processing Complex of ONGC at Hazira has been built by leaders of international fame and is currently being modernized through latest technology and are therefore is predominantly of recent vintage and built and operated to international standards. **<u>Gas Transportation and Distribution</u>** Gas Transportation and Distribution facilities of Gujarat State Petronet Ltd. for transportation of Gas to the site of the project activity are predominantly of recent vintage and are built and operated to international standard. This has been demonstrated in the letter (vide reference GSPL/TS/Torrent/513 dated 2nd February 2007) addressed by Gujarat State Petronet Ltd. The emission factor for fugitive upstream emissions of coal is based on surface mining which is currently predominant in India.. Fugitive upstream emissions occurring in Annex 1 countries shall be excluded in leakage calculations in accordance with AM0029.
C.2	**Procedure followed for estimating CO_2 emissions from LNG ($LE_{LNG, CO2,y}$)**	CO_2 emissions from LNG are calculated in accordance with and as per the equation contained in AM0029.	In relation to the emission factor for such emissions the default factor of 6 tCO_2 /TJ shall be used.
D	**Estimation of emissions reduction (ER_y)**	The emissions reduction ER_y due to project activity during a given year "y" is calculated in accordance with and as per equation no 8 of AM0029.	

The data choices, where applicable, in relation to parameters not covered above are dealt with in Sections 6.2 and 7.1

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

A. Margin Emission Factors (ex-ante)

A.1

Data / Parameter:	$EF_{BM,y}$
Data unit:	tCO_2/ GWh
Description:	Build margin emission factor of the baseline grid (Western Regional Electricity grid) in tonnes of CO_2 per GWh.
Source of data used:	Table S-1 of "CO_2 Baseline Database" for the "Indian Power Sector" provided by Central Electricity Authority (CEA) Ministry of Power ,Government of India, (http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm)
Value applied:	780
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:	Nil

A.2

Data / Parameter:	$EF_{CM,y}$
Data unit:	t CO_2/ GWh
Description:	Combined margin emission factor of the baseline grid is (Western regional electricity grid)in tonnes of CO_2 per GWh.
Source of data used:	Table S-1 of "CO_2 Baseline Database" for the "Indian Power Sector" provided by Central Electricity Authority (CEA, Ministry of Power ,Government of India) http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm
Value applied:	890 t CO_2/GWh
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:	Nil

B. Emission factor of the most likely baseline scenario ($EF_{BL, CO2}$)

B.1

Data / Parameter:	**NCV_{coal}**
Data unit:	KCal/ Kg (to be converted into GJ/tonne)
Description:	Net calorific value for non-coking coal for pit-head power generation.
Source of data	GCV and conversion factor (GCV to NCV) sourced from "CO_2 Baseline Database

used:	of the Indian Power Sector, December 2006, issued by Central Electricity Authority, Ministry of Power, Government of India" (http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm).
Value applied:	3624.5
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:	Nil

B.2

Data / Parameter:	$EF_{CO2,coal}$
Data unit:	gCO_2/MJ to be converted to t CO_2 /TJ
Description:	Carbon emission factor of coal.
Source of data used:	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/planning/c%20and%20e/Government%20of%20India%20website.htm)
Value applied:	95.8 gCO_2/MJ * 10^6 / 10^6 = 95.8 tCO_2/TJ
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:	Nil

B.3

Data / Parameter:	$OXID_{coal}$
Data unit:	Nil
Description:	Oxidation factor of coal.

Source of data used:	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/planning/c%20and%20e/Government%20of%20India%20website.htm)
Value applied:	0.98.
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:	Nil

B.4

Data / Parameter:	η_{BL}
Data unit:	% (expressed in decimals e.g. 40% is expressed as 0.40)
Description:	The energy efficiency of technology in the most likely baseline scenario.
Source of data used:	Specification of sub critical coal-fired power plant according to the heat rate (10.255 MJ/kWh) applied by Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2004 (www.cercind.org)
Value applied:	35.1%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data has been collected from official source.
Any comment:	Nil.

C. Leakages

C.1

Data / Parameter:	$EF_{NG, upstream, CH4}$
Data unit:	t CH_4 / GJ
Description:	Emission factor for upstream fugitive methane emissions of natural gas from production, transportation, distribution, and, in the case of LNG, liquefaction, transportation, re-gasification and compression into a transmission or distribution system, in tCH_4 per GJ fuel supplied to final consumers.
Source of data used:	Table - 2 of AM0029.
Value applied:	0.00016 t CH_4/ GJ
Justification of	Data has been collected from official sources. US/Canada values have been chosen.

the choice of data or description of measurement methods and procedures actually applied :	The justification for the same in given in section 6.1 (C-1).
Any comment:	Nil.

C.2

Data / Parameter:	$EF_{BL,upstream,CH4}$
Data unit:	tCH_4/MWh
Description:	Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in terms of tonnes of methane per MWh.
Source of data used:	Calculated as: $\frac{\sum_j FF_{j,k} * EF_{k,upstream,CH4}}{\sum_j EG_j}$ $\sum FF_{j,k}$: Refer to table A.2 "Fuel consumed by power sources" under sub section A " Monitoring parameters for Build Margin emission factor" of section B.7.1. $EF_{k,upstream,CH4}$: Table 2 of AM0029. $\sum EG_j$: Refer to table A.3 "Electricity delivered to grid " under sub section A " Monitoring parameters for Build Margin emission factor" of section B.7.1
Value applied:	**0.000647141** $t CH_4/ MWh$
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data has been collected from official sources.
Any comment:	Default emission factor for fugitive upstream CH_4 emissions for coal has been considered as 0.8 $t CH_4$ / Kt Coal, as surface mining is predominant in India. This leads to conservative estimation of leakages.

B.6.3 Ex-ante calculation of emission reductions:

>>

The following section presents the ex-ante emission estimations up to the calculation of emission reductions by applying the procedures and data mentioned under sections B.6.1 and B.6.2.

(Note: m^3 i.e. Standard Cubic Metre or "SCM" in this PDD means one (1) standard cubic meter of Gas, at a temperature of fifteen decimal five six (15.56) degrees Celsius and at an absolute pressure of one decimal zero one three two five (1.01325) Bar(a)).

1. Calculation of baseline emissions

The elements of the baseline emission calculation are described below. First, for determination of the baseline emission factor $EF_{BL,CO2,y}$ three emissions factors are calculated, of which the lowest is chosen:

A.) Build margin

Source: Table S-1 under CEA report (Ministry of Power, Government of India) called "CO_2 Baseline Database for the Indian Power Sector" for Western Regional Electricity Grid

Result: **780** t CO_2/GWh (for the year 2004-05)

B. Combined margin

Source: Table S-1 under CEA report (Ministry of Power, Government of India) called "CO2 Baseline Database for the Indian Power Sector" for Western Regional Electricity Grid

Result: **890** t CO_2/GWh (For the year, 2004-05)

C) Emission factor of the most likely baseline scenario.

Calculated as per equation number- 4 of AM 0029 as contained in part B (Procedure followed for estimating emissions in the baseline scenario) of section B.6.1 "Explanation of Methodological Choices".

Sources:
See B.6.2. and table M.1 "Calculation of emission factor of the most likely baseline scenario" as contained in annexure-3 "Baseline Information".

Values of sub-variables:
Fuel CO_2 emission co-efficient ($COEF_{BL}$): 0.093884 t CO_2e/GJ
Energy Efficiency of technology (η_{BL}): 35.10%

$$= \frac{0.093884 \text{ t } CO_2e/GJ}{0.3510} * 3.6 \text{ GJ/MWh} * 1000 = \mathbf{962.91} \text{ t } CO_2/GWh$$

Therefore, according to AM 0029, **780** 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) EG_y is estimated as **9067.9994** GWh per year.

Therefore, the estimated annual baseline emissions (BE_y) will be (as per equation 3 of AM0029)

= 9067.9994 GWh * 780 tCO_2/GWh = **7073039.54** tCO_2.

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 **3581398.206** t CO_2

Values of sub-variables:
Volume of fuel combusted in project plant ($FC_{f,y}$) : 1744834538.12 m^3
CO_2 emission coefficient of fuel ($COEF_{f,y}$) : 0.00205257 t CO_2/ m^3 of natural gas

Data Sources:
Refer to table P.1 "Calculation of Project Emissions" as contained in annexure-3 "Baseline Information".

Based on the above, the estimated annual project emissions (PE_y) will be

= 0.00205257 tCO2/m^3 * 1744834538.12 m^3= **3581398.206** tCO_2.

Sub-variables are calculated as follows

2A) Calculation of CO_2 Emission Co-efficient of natural gas ($COEF_{f,y}$)

Calculated as:

CO_2 Emission Co-efficient of natural gas is calculated as per equation number-2a 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".

Values of sub-variables:
1) Net Calorific Value of gas (NCV_y): 0.037 GJ/ m^3
2) CO2 emission factor ($EF_{CO2,f,y}$): 0.0561 t CO_2/GJ
3) Oxidation factor of gas ($OXID_f$): 1

0.037 GJ/ m^3 * 0.0561 t CO_2 / GJ* 1 = **0.00205257 t CO_2/ m^3**

Data Sources:
Refer to table P.1 "Calculation of Project Emissions" as contained in annexure-3 "Baseline Information".

3) Calculation of Leakages (LE_y)

Calculated as:

Leakages are calculated as per equation number-5 of AM 0029 as contained in part C (Procedure followed for estimating Leakages) of section B.6.1 "Explanation of Methodological Choices", which is **301937.6101** t CO_2e

Values of sub-variables:
1) Leakage emission due to fugitive upstream CH_4 emissions ($LE_{CH4,y}$): 91267.1274t CO_2 e.
2) Leakage emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system ($LE_{LNG,CO2,y}$) : 210670.4827 t CO_2 e

Data Sources:
Refer to table L.1 "Calculation of Leakages" as contained in annexure-3 "Baseline Information".

Based on the above, the estimated annual leakages (LE_y) will be

= 91267.1274 t CO_2 e + 210670.4827 t CO_2 e = **301937.6101** t CO_2 e

3A) Calculation of leakage emissions due to fugitive upstream CH4 emissions ($LE_{CH4,y}$)

Calculated as:
Leakage emissions due to fugitive upstream CH_4 emissions are calculated as per equation number-6 of AM 0029 as contained in part C (Procedure followed for estimating Leakages) of section B.6.1 "Explanation of Methodological Choices".

Values of sub-variables:
Quantity of natural gas combusted in the project plant (FC_y): 1744834538.12 m^3

Average net calorific value of natural gas ($NCV_{NG,y}$): 0.036587733 GJ/m^3

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 CH4 per GJ fuel supplied to final consumers
($EF_{NG, upstream,CH4}$) : 0.00016 t CH_4/ GJ

Electricity generated in the project plant ($EG_{PJ,y}$) : 9067999.4 MWh

Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in t CH4 per MWh electricity generation in the project plant ($EF_{BL, upstream, CH4}$) : 0.00064714 t CH_4/ MWh (*Refer note below*)

Global warming potential of methane valid for the relevant commitment
Period (GWP_{CH4}) :21

Data Sources:
Refer to table L.1 "Calculation of Leakages" as contained in annexure-3 "Baseline Information".

Based on the above, the estimated leakage emissions due to fugitive upstream CH4 emissions ($LE_{CH4,y}$) will be:

= [(1744834538.12 m^3 * 0.036587733 GJ/m^3 * 0.00016 tCH_4/GJ) – (9067999.4 MWh * .00064714 tCH_4/MWh)] * 21 = 91267.1274 tCO_2e.

Note:
Calculation of 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 ($EF_{BL,upstream,CH4}$)

Calculated as per equation at the end of page 6 of AM 0029 as contained in part C (Procedure followed for estimating Leakages) of section B.6.1 "Explanation of Methodological Choices".

Value of sub-variables:
Refer to annexure-3 "Baseline Information"

Data Sources:
Refer to table L.1 "Calculation of Leakages" as contained in annexure-3 "Baseline Information").

3B) Leakage emissions due to fossil fuel combustion / electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system ($LE_{LNG,CO2,y}$)

Calculated as per the methodology, AM 0029 as contained in part C (Procedure followed for estimating Leakages) of section B.6.1 "Explanation of Methodological Choices".

Value of sub-variables:

Quantity of natural gas combusted in the project plant ($FC_{LNG\ y}$) (For CO_2 emissions from LNG): 35111.74712 TJ

Emission factor for upstream CO_2 emissions due to fossil fuel combustion / electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system ($EF_{CO2,\ upstream,LNG}$) : 6 t CO_2/ TJ

Data Sources:
Refer to table L.1 "Calculation of Leakages" as contained in annexure-3 "Baseline Information".
Based on the above, the estimated Leakage emissions due to fossil fuel combustion / electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system ($LE_{LNG,CO2,y}$) will be:

= 35111.74712 TJ * 6 t CO_2/ TJ = **210670.4827** t CO_2

4. Emissions Reduction (ER_y)

Calculated as:
Emissions reduction are calculated as per equation number-8 of AM 0029 as contained in section B.6.1 "Explanation of Methodological Choices"

Values of sub-variables:
1) Emissions in the baseline scenario (BE_y): 7073039.54 t CO_2 e.
2) Emissions in the project scenario (PE_y): **3581398.206** t CO_2 e
3) Leakages (LE_y): **301937.6101** t CO_2 e

Data Sources:
Refer to table E.1 "Calculation of Emissions reduction" as contained in annexure-3 "Baseline Information".

Based on the above, the estimated emissions reduction will be:

= 7073040 t CO_2 e.- **3581398** t CO_2 e - **301938** t CO_2 e = **3189704** t CO_2 e

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

>>

Year	**Estimation of project activity emissions (tonnes CO_2e)**	**Estimation of Baseline emissions (tonnes CO_2e)**	**Estimations of Leakages (tonnes CO_2e)**	**Estimation of overall emissions reductions (tonnes CO_2e)**
2008 (From 1st April, 2008)	2686049	5304780	226454	2392278
2009	**3581398**	7073040	**301938**	**3189704**
2010	**3581398**	7073040	**301938**	**3189704**
2011	**3581398**	7073040	**301938**	**3189704**
2012	**3581398**	7073040	**301938**	**3189704**
2013	**3581398**	7073040	**301938**	**3189704**
2014	**3581398**	7073040	**301938**	**3189704**
2015	**3581398**	7073040	**301938**	**3189704**
2016	**3581398**	7073040	**301938**	**3189704**
2017	**3581398**	7073040	**301938**	**3189704**
2018 (Until 31st March, 2018)	895349	1768260	75484	797426
Total (tonnes of CO_2e)	35813980	70730400	3019380	31897040

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

The following two sections (B.7.1 and B.7.2) provides a detailed description of the application of the monitoring methodology and description of the monitoring plan, including an identification of the data to be monitored and the procedures that will be applied during monitoring.

Please note that data monitored and required for verification and issuance are to be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, which ever occurs later.

B.7.1 Data and parameters monitored:

A - Monitoring parameters for the Build margin emission factor:
A1:

Data / Parameter:	Build Margin emission factor ($EF_{BM,y}$ or $EF_{BL,CO2,Y}$)
Data unit:	t CO_2/ GWh
Description:	Build Margin emission factor of the grid in tonnes of CO_2 per GWh.
Source of data to be used:	Central Electricity Authority, Ministry of Power, Government of India (CEA) has developed a "CO_2 Baseline Database" for the "Indian Power Sector" wherein relevant figure for Build Margin Emission factor ($EF_{BM,y}$) for the Baseline Grid has been provided. These estimates provided by CEA (Ministry of Power, Government of India), have been thoroughly checked and have been compiled in the best possible manner and therefore are considered to be a reliable source of data. Such data if available in a timely manner, shall be used. Otherwise, this parameter shall be calculated as provided below, using parameters A.2 to A.6: Calculated as $$\frac{\sum_{i,m} F_{i,m,y} * COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$ where $F_{i,m,y}$ is the amount of fuel *i* (in metric tonnes) consumed by relevant power sources *m* in year(s) *y*, *m* refers to the power sources delivering electricity to the grid, $COEF_{i,m}$ is the CO_2 emission coefficient of fuel *i* (tCO_2 / metric tonnes of the fuel), taking into account the carbon content of the fuels used by relevant power sources *m* and the percent oxidation of the fuel in year(s) y i.e $NCV_i * EF_{CO2,i} * OXID_i$, and $GEN_{m,y}$ is the electricity (GWh) delivered to the grid by source m.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	780 t CO2/GWh
Description of	Not Applicable

measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	The uncertainty level of this data is low. This is calculated based on data collected from official/ reliable data sources. No additional QA/QC procedures may need to be planned.
Any comment:	Data will be recorded as per Monitoring Plan. Data will be archived electronically/ paper as available. Archived data will be stored as per Monitoring Plan.

A.2

Data / Parameter:	$F_{i,m,y}$ (as per ACM0002)
Data unit:	Metric tonnes/ Year
Description:	Amount of fuel 'i' in metric tonnes consumed by relevant power sources 'm' in year(s) 'y'.
Source of data to be used:	Fuel used in Build Margin sample "m" plants (i.e. plant name/power source) to be estimated based on the ratio of "Σ GEN m,y" to the total generation in the baseline grid (a),applied to the fuel consumption in the baseline grid, separately for steam plants and gas plants (b), based on availability of data. a) Generation data for baseline grid will be calculated from data collected from table 6.1 (Gross Generation) and 5.5 (Auxiliary consumption) CEA General Review(Ministry of Power, Government of India), as follows: (Gross Generation – Auxiliary Consumption). b) Fuel consumption data for the baseline grid will be collected from table 6-1, CEA General review (Ministry of Power, Government of India) of the corresponding year.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not Applicable as value of A.1 is available.
Description of measurement methods and procedures to be applied:	Not Applicable.
QA/QC procedures to be applied:	The uncertainty level of this data is low. This is collected from official sources. No additional QA/QC procedures may need to be planned.
Any comment:	Data will be recorded as required for Build Margin Emission Factor in Monitoring Plan. Proportion of data monitored will be 100%. Data will be archived electronically/ paper as available. Archived data will be stored as required for Build Margin Emission Factor in Monitoring Plan.

A.3

Data / Parameter:	$GEN_{m,y}$ (as per ACM0002)
Data unit:	GWh
Description:	Electricity (GWh) delivered to the baseline grid by source 'm' in years "y"
Source of data to be	Electricity delivered to baseline grid by sample group "m" is represented by power

used:	generation by plant name/power source. .The generation data for sample group "m" to be collected from "CO_2 Baseline data base for the Indian Power Sector" issued by CEA, Ministry of Power, Government of India for the corresponding year (provided that the said data is available). In the absence of above source, generation data for sample group "m" to be collected from "CEA General Review"(Ministry of Power, Government of India) for the corresponding years.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not Applicable as value of A.1 is available.
Description of measurement methods and procedures to be applied:	Not Applicable.
QA/QC procedures to be applied:	The uncertainty level of this data is low. This is collected from official data sources. No additional QA/QC procedures may need to be planned.
Any comment:	Data will be recorded as required for Build Margin Emission Factor in the Monitoring Plan. Proportion of data monitored will be 100%. Data will be archived electronically/ paper as available. Archived data will be stored as required for Build Margin Emission Factor in Monitoring Plan.

A.4

Data / Parameter:	NCV_i (as per ACM0002)
Data unit:	MJ/kg
Description:	Net Calorific value (energy content) in MJ per Kilogram of fuel "i".
Source of data to be used:	a) Coal, HSD/Light Diesel, LSHS, Furnace Oil, Lignite: Collected from table 6-3 of the CEA General Review (Ministry of Power, Government of India) of corresponding year, based on availability of data. b) Naphtha: Collected from table 1-2 of 2006 IPCC Guidelines for National Greenhouse Gas Inventory, based on availability of data. c) Gas: Calculated based on availability of data, as weighted average Net Calorific value of Petronet LNG Ltd. and ONGC Ltd., based on the gas supply made by the two companies in the corresponding years.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not Applicable, as value for A.1 is available.
Description of measurement methods and procedures to be applied:	Not Applicable
QA/QC procedures to be applied:	The uncertainty level of this data is low. This is collected from official/ reliable data sources. No additional QA/QC procedures may need to be planned.
Any comment:	Data will be recorded as required for Build Margin Emission Factor in Monitoring

	Plan. Proportion of data monitored will be 100%. Data will be archived electronically/ paper as available. Archived data will be stored as required for Build Margin Emission Factor in Monitoring Plan.

A.5

Data / Parameter:	$EF_{CO2,i}$ (as per ACM0002)
Data unit:	Kg C/GJ to be converted into tCO_2 /TJ by multiplying with (44000/12000)
Description:	CO_2 emission factor in tonnes per Tera Joule of the fuel "i"
Source of data to be used:	Collected from table 1-3 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, based on availability of data.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not Applicable, as value for A.1 is available.
Description of measurement methods and procedures to be applied:	Not Applicable
QA/QC procedures to be applied:	The uncertainty level of this data is low. This is collected from reliable data sources. No additional QA/QC procedures may need to be planned.
Any comment:	Data will be recorded as required for Build Margin Emission Factor in Monitoring Plan. Proportion of data monitored will be 100%. Data will be archived electronically/ paper as available. Archived data will be stored as required for Build Margin Emission Factor in Monitoring Plan.

A.6

Data / Parameter:	$OXID_i$ (as per ACM0002)
Data unit:	Number
Description:	Oxidation factor of the fuel "i"
Source of data to be used:	IPCC Guidelines for default values in accordance with ACM0002.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not Applicable, as value for A.1 is available.
Description of measurement methods and procedures to be applied:	Not Applicable
QA/QC procedures to be applied:	The uncertainty level of this data is low. This is collected from reliable data sources. No additional QA/QC procedures may need to be planned.
Any comment:	Data will be recorded as required for Build Margin Emission Factor in Monitoring Plan. Proportion of data monitored will be 100%. Data will be archived electronically/ paper as available. Archived data will be stored as required for Build Margin Emission Factor in Monitoring Plan.

A.7

Data / Parameter:	Plant name/ Power source.(i.e. sample group "m" as per ACM0002 Build Margin)
Data unit:	Text
Description:	Identification of power source/plant for the Build Margin Calculation
Source of data to be used:	For monitoring during crediting period: Sample "m" plants and generation data thereof shall be collected from "CO_2 Baseline data base for the Indian Power Sector" issued by CEA (Ministry of Power, Government of India) for the corresponding year (provided that the said data is available). In the absence of the above source of data for any corresponding year, (a) the baseline grid generation (MWh) will be calculated from data collected from table 6.1 (Gross Generation) and 5.5 (Auxiliary consumption) CEA General Review (Ministry of Power, Government of India), as follows: (Gross Generation – Auxiliary Consumption) and (b) the data regarding capacity additions (i.e. recently built plants) made to the baseline grid will be collected from table 2.7 of CEA General Review (Ministry of Power, Government of India), of the corresponding year.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not Applicable as value for A.1 is available.
Description of measurement methods and procedures to be applied:	Not Applicable
QA/QC procedures to be applied:	The uncertainty level of this data is low. This is collected from official data sources. No additional QA/QC procedures may need to be planned.
Any comment:	Data will be recorded as required for Build Margin Emission Factor in Monitoring Plan. Proportion of data monitored will be 100% of set of plants. Data will be archived electronically/ paper as available. Archived data will be stored as required for Build Margin Emission Factor in Monitoring Plan.

B: Monitoring parameters for Project Activity:

B1:

Data / Parameter:	$FC_{f,y}$
Data unit:	m^3
Description:	Annual quantity of fuel "f" to be consumed in the project activity. In case, monitoring and verification are planned to be completed for lesser or greater duration than a year, this parameter will be actual natural gas consumption value for such period.
Source of data to be used:	For the purpose of Section B5 and B6.3 : Calculated on the basis of a) Net electricity evacuated to the grid by the project plant , b) Gross Calorific value of

	fuel "f" and c) Gross station heat rate of Advanced Class Combined Cycle technology, as follows: $\Sigma FC_{f,y}$ (m^3)= $EG_{pj,y}$ (GWh) * 10^6* Gross heat rate (kCal/kWh)*/ GCV (kCal/m^3) {i.e. (a) * (c) / (b)} For monitoring during crediting period: Fuel flow meter reading at the project boundary. The consumption of natural gas will be metered daily using the turbine flow meter of the project activity which is located within the project boundary. The metering records will be maintained electronically. The metered readings will be cross-verified with the Natural Gas supplier(s)/ Natural Gas Transporter(s) bills. In case of any significant difference in the monthly consumption figures, the higher of the two readings (project-end and Natural Gas Supplier's/ Natural Gas Transporter's end) would be used.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1744834538.12 m^3
Description of measurement methods and procedures to be applied:	For: For the purpose of Section B5 and B 6.3- Not Applicable. b) For monitoring during crediting period:-: The flow meter shall be used for the measurement of volume of fuel consumed. The total accuracy of turbine flow meter shall be at least +/- 0.5%.. The measurement shall be taken online by the mass flow meter and the same shall be recorded in the flow computer. All the measurement methods and procedure adopted shall be as per the industry practice.
QA/QC procedures to be applied:	Natural gas supply metering to the project will be subject to regular maintenance and testing in accordance with stipulation of the meter supplier, applicable industry and national standards and relevant agreements to ensure accuracy. These readings will be double checked (cross-verified) with the measurement provided by the gas supplier's/ transporters . The flow meter shall be supplied by M/S Siemens and the calibration certificate shall be valid in accordance with the German Metering Calibration Rules, 1988
Any comment:	Data will be recorded as per Monitoring Plan. Proportion of data monitored will be 100%. Data will be archived electronically/ paper as available. Archived data will be stored as per Monitoring Plan.

B2:

Data / Parameter:	$NCV_{f,y}$
Data unit:	kCal/m^3 (this will be converted to GJ/m^3 by multiplying with (4.186/10^6), since 1 Cal = 4.186 J).
Description:	This is the average 'Net Calorific Value' of natural gas to be consumed in the project activity. In case, Gross Calorific Value (GCV) is available instead of

	NCV, then GCV to NCV conversion will be completed using standard ASTM conversion procedures. These values will be obtained fort-nightly.
Source of data to be used:	For the purpose of Section B5 and B6.3 – a) Gas: Collected as weighted average Net Calorific value of Petronet LNG Ltd. and ONGC Ltd., weights applied are .5 and .5 respectively (Gross calorific value is converted into Net calorific value by dividing the GCV by a factor 1.10). b) For monitoring during crediting period – The data for NCV (GCV if available instead) will be provided by the gas supplier(s)/ gas transporter(s). In case GCV is available, then gas characteristics required for conversion of GCV to NCV will be obtained from the gas supplier(s)/ gas transporter(s).
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.036587733 GJ/m^3
Description of measurement methods and procedures to be applied:	For: a) the purpose of Section B5 and B6.3- Not Applicable. b) monitoring during crediting period: - Not Applicable.
QA/QC procedures to be applied:	The uncertainty level of this data is low. No additional QA/QC procedures may need to be planned.
Any comment:	Data will be recorded as per Monitoring Plan. Proportion of data monitored will be 100%. Data will be archived electronically/ paper as available. Archived data will be stored as per Monitoring Plan..

B3:

Data / Parameter: Data unit:	$EF_{CO2, f,y}$ Kg C/GJ to be converted into tCO_2 /GJ
Description:	Emission factor for fuel "f" in tonnes of carbon dioxide per Giga Joule.
Source of data to be used:	For the purpose of Section B5 and B6.3: Estimated on the basis of data collected from table 1-3 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, based on availability of data. For monitoring during crediting period: Use supplier(s)/ transporter(s)-provided data, local data, country-specific/IPCC values, in that order of preference.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	15.30 Kg C/ GJ /1000 *(44/12) =0.0561 t CO_2/GJ
Description of measurement methods and procedures to be applied:	Not Applicable
QA/QC procedures to be applied:	The uncertainty level of this data is low. No additional QA/QC procedures may need to be planned.

Any comment:	Data will be recorded as per Monitoring Plan. Proportion of data monitored will be 100%. Data will be archived electronically/ paper as available. Archived data will be stored as per Monitoring Plan.

B.4

Data / Parameter:	$OXID_f$
Data unit:	Nil
Description:	Oxidation factor of Natural Gas
Source of data to be used:	IPCC current default value.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**1**
Description of measurement methods and procedures to be applied:	Not Applicable.
QA/QC procedures to be applied:	The uncertainty level of this data is low. No additional QA/QC procedures may need to be planned.
Any comment:	Data will be recorded as per Monitoring Plan. Proportion of data monitored will be 100%. Data will be archived electronically/ paper as available. Archived data will be stored as per Monitoring Plan.

B.5

Data / Parameter:	$COEF_{f,y}$
Data unit:	$t\ CO_2 / m^3$
Description:	CO_2 emission coefficient of fuel (f),
Source of data to be used:	Calculated as : $COEF_{f,y} = \Sigma\ NCV_{f,y} * EF_{CO2,f,y} * OXID_f$ Where, $\Sigma\ NCV_{f,y}$ is as per B.2 of section B.7.1 $EF_{CO2,f,y}$ is as per B.3 of section B.7.1 $OXID_f$ is as per B.4 of section B.7.1
Value of data applied for the purpose of calculating expected emission reductions in section B.5	$0.00205257\ t\ CO_2 / m^3$
Description of measurement methods	Not Applicable.

and procedures to be applied:	
QA/QC procedures to be applied:	The uncertainty level of this data is low. No additional QA/QC procedures may need to be planned.
Any comment:	Data will be calculated and recorded as per Monitoring Plan. Proportion of data monitored will be 100%. Data will be archived electronically/ paper as available. Archived data will be stored as per Monitoring Plan.

B.6

Data / Parameter:	PE_y
Data unit:	t CO_2
Description:	Project emissions due to combustion of fuel in tonnes of CO_2
Source of data to be used:	Calculated under project activity as per equation no-2 of AM00029.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**3581398.206** t CO_2
Description of measurement methods and procedures to be applied:	Not Applicable.
QA/QC procedures to be applied:	The uncertainty level of this data is low. No additional QA/QC procedures may need to be planned.
Any comment:	Data will be calculated and recorded as per Monitoring Plan. Proportion of data monitored will be 100%. Data will be archived electronically/ paper as available. Archived data will be stored as per Monitoring Plan.

C: Monitoring parameters for Leakages:

C-1:

Data / Parameter:	FC_y
Data unit:	m^3
Description:	Quantity of natural gas combusted in the project plant during the year "y" in cubic meters.
Source of data to be used:	Refer to table B.1 "fuel consumption for the project activity" under sub section B " Monitoring parameters for project activity" of section B.7.1
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1744834538.12 m^3
Description of measurement methods and procedures to be applied:	Refer to table B.1 "fuel consumption for the project activity" under sub section B "Monitoring parameters for project activity" of section B.7.1.

QA/QC procedures to be applied:	Refer to table B.1 "fuel consumption for the project activity" under sub section B " Monitoring parameters for project activity" of section B.7.1
Any comment:	Refer to table B.1 "fuel consumption for the project activity" under sub section B " Monitoring parameters for project activity" of section B.7.1

C.2 :

Data / Parameter:	$NCV_{NG,y}$, NCV_y
Data unit:	GJ/ m^3
Description:	Average net Calorific value of natural gas combusted in the project plant during the year "y" in Giga joules per cubic meter.
Source of data to be used:	Refer to table B.2 "Net calorific value of fuel used in project activity" under sub section B " Monitoring parameters for project activity" of section B.7.1
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.036587733 GJ/m^3
Description of measurement methods and procedures to be applied:	Refer to table B.2 "Net calorific value of fuel used in project activity" under sub section B " Monitoring parameters for project activity" of section B.7.1
QA/QC procedures to be applied:	Refer to table B.2 "Net calorific value of fuel used in project activity" under sub section B " Monitoring parameters for project activity" of section B.7.1
Any comment:	Refer to table B.2 "Net calorific value of fuel used in project activity" under sub section B " Monitoring parameters for project activity" of section B.7.1

C.3:

Data / Parameter:	$EG_{PJ,y}$
Data unit:	MWh
Description:	Net annual electricity generated in the project plant (delivered to the grid) during any year 'y'. In case the monitoring and verification period selected is different from a full 12 month period, actual net electricity delivered to the grid will be used.
Source of data to be used:	a) For the purposes of Section B5 and B6.3- Estimated based on 1) Capacity of the project plant 2) EPC Contractor's guarantee of an equivalent availability factor at 93 % and 3) Auxiliary consumption (AUX) which is estimated at 3% and is based on note V to regulation 16 of Central Electricity Regulation Commission (CERC) guideline for tariff calculation. For monitoring during crediting period- Measured and recorded by the online energy meter installed in the plant. Data will be recorded and archived in the power plant.
Value of data applied for the purpose of calculating expected emission reductions in	9067999.4 MWh

section B.5	
Description of measurement methods and procedures to be applied:	For the purpose of Section B5 and B6.3 - Not Applicable. b) For ex- post calculations- The electricity meter to be installed on-site will be used for the measurement of net electricity generated from the project activity and delivered to the grid. In case, gross electricity generated and auxiliary consumption meters are available, the difference between the two could also be used to cross-check the net electricity export meter. The data will be cross-verified with data recorded by the grid/ recipient.
QA/QC procedures to be applied:	The accuracy level of all the electricity meters under the control of the project participant is of accuracy class 0.2 . The measurement and calibration procedure shall be done as specified in the CEA (Government/Regulatory authority) regulations. The measurement equipments shall be 'Availability Based Tariff compliant' as specified in the CEA regulations(Ministry of Power, Government of India). The measurement will be done on-line and the data is recorded in the control system. Thus, the uncertainty level of this data is low, and no additional QA/QC procedures will be applied.
Any comment:	Data will be recorded as per Monitoring Plan. Proportion of data monitored will be 100%. Data will be archived electronically/ paper as available. Archived data will be stored as per Monitoring Plan.

C.4:

Data / Parameter:	$FC_{LNG,y}$ (for CO_2 emissions from LNG)
Data unit:	m^3 (which is to be converted in terms of Tara Joules on the basis of a) GCV of Gas provided by fuel supplier(s) and b) 1 calories =4.186 joules)
Description:	Quantity of LNG purchased during the year "y" in terms of cubic meters
Source of data to be used:	For the purposes of Section B5 and B6.3: 50% of the power evacuated to the grid is expected to be generated using LNG. GCV is 9879.1 Kcal/ m^3 based on Petronet LNG Ltd. supplies. For monitoring during crediting period: On daily basis based on readings provided by fuel suppliers during the year "y" The daily readings shall be cross checked with the fortnightly invoices from the fuel suppliers.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	**849055020.6** m^3 or **35111.74712** TJ
Description of measurement methods and procedures to be applied:	Not applicable
QA/QC procedures to be applied:	The uncertainty level of this data is low. This is collected from daily "LNG consumption readings" and cross checked with fortnightly invoices which are processed for payment.. No additional QA/QC procedures may need to be planned.
Any comment:	1) Data will be recorded as per Monitoring Plan. Proportion of data monitored

	will be 100%. Data will be archived electronically/ paper as available. Archived data will be stored as per Monitoring Plan. The daily data shall be cross checked with the fortnightly invoices from the fuel supplier. 2) The reason for including this as a parameter for monitoring is that this data varies and is required for calculating $LE_{LNG,CO2,y}$.

B.7.2 Description of the monitoring plan:

>>

The monitoring plan for this project activity includes details of the operational and management structure that Torrent Power Limited is developing to monitor emission reductions during the crediting period, including measurement of those parameters in baseline, project and leakage emission scenarios that will be used to calculate actual emission reductions. It also identifies the team and responsibilities for monitoring the relevant parameters, data archiving and calibration of equipment and procedures.

The monitoring plan is organized as per information provided below, and the detailed background information are included under Annex 4.

- Introduction about the monitoring plan
- Obligations of CDM Manager
- Description of data required to be monitored
- Approach used in the monitoring plan
- Organizational structures & procedures for collection, processing, review, storage and reporting of data
- Description of workbook for emission reduction calculations
- Organizational structures & procedures during project implementation.

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)

>>

(1) The details of baseline information are included in Annex 3.

(2)The date of completion of the application of the methodology to the project activity is 09.12.2006.

(3) Mr. Deepak Dalal of Torrent Power Ltd. is responsible for the application of the baseline and monitoring methodology to the project activity and the entity (viz. Torrent Power Ltd) is also a project participant listed in Annexure-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:

>>

17th June 2005.

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

>>

The project activity is expected to be operational for a period of 15 years from the date of commencement of operations.

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

C.2.1. Renewable crediting period

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

>>

Not opted for in this project activity

C.2.1.2. Length of the first crediting period:

>>

Not applicable.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

1st April,2008 or a date not earlier than the date of registration..

C.2.2.2. Length:

>>

10 years from the start of crediting period.

SECTION D. Environmental impacts

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

To predict the cause-condition-effect-relationship on the environment, an Environmental Impact Assessment (EIA) study was conducted for the project activity. The EIA study helps in justifying a project's sustainability plus provides with mitigation and management plan to abate the negative impact and enhance the positive ones. Thus EIA study is obligatory under Indian government policy under the Environmental (Protection) Act 1986 and the notification promulgated under it on 27 January 1994

(amended on 04/05/1994, 10/04/1997, 27/1/2000 and 13/12/2000). The EIA report can be verified by the Designated Operational Entity.

After conducting the EIA study it was found that the project activity benefits the local, regional and global environment in various ways. Reduced additional GHG emission in relation to the baseline emissions which includes huge emissions of carbon dioxide, sulphur dioxide, oxides of nitrogen, and particulate matter that would have occurred in absence of this project in Business-as-usual case. Another redeeming feature is that the project reduced adverse impacts related to air emission at coal mines, as well as elimination of fuel required for transportation of coal that would have been required to meet the additional capacity requirement of coal based thermal power stations.

Also, it may be noted that there are no trans-boundary impacts due to this project activity.

A summary the findings from the EIA report and an action plan for mitigation of negative environmental impact are provided in *appendix-3*.

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:

>>

The Environment Impact Assessment study did not indicate any significant environmental impacts. However, mitigative measures have been taken up for lesser impacts also, as per details provided in D.1.

Regular monitoring of all significant environmental parameters is essential to check the compliance status vis-à-vis the environmental laws and regulations. The objectives of the monitoring will be as follows:

- To verify the results of the impact assessment study with respect to the proposed project.
- To study the trend of concentration values of the parameters, which have been, identified as critical and planning the mitigative measures.
- To check and assess the efficacy of pollution control equipment.
- To ensure that any additional parameters, other than those identified in the impact, do not become critical after the commissioning of the project activity.

All necessary steps will be taken to monitor the efficiency of pollution control equipment on regular basis. Regular monitoring and vigilance of the surrounding environmental quality will be done. All necessary stipulations and legal requirements of Gujarat Pollution Control Board and Ministry of Environment & Forests will be fully complied.

Though this project may have insignificant adverse impact on the biological environment, if all the recommended mitigative measures are followed, then the impacts will be manageable and, affect a very limited area. The adverse impact will be greatly offset by the many positive socio-economic impacts that will flow directly from the project.

The project is likely to have impacts on the community lifestyle (day to day activity of the people living near the plant). Torrent is committed to develop the surrounding area in a manner that balances consistently the societal & environmental requirements while safeguarding the environmental and social

features. Implementing a public relations strategy; employing locals; buying local goods and services; encouraging local entrepreneurship, involving women participation in conservation efforts and creating awareness about environmental health and pollution and encouraging respect for local traditions and religious beliefs (all of them on reasonable endeavour basis) will offset the negative environmental impacts

SECTION E. Stakeholders' comments

>>

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

>>

Torrent identified local communities, NGOs, state government and governmental agencies, employees, contractors and consultants/ advisors as the most important stakeholders with an interest in the proposed CDM project activity. Accordingly, Torrent sent out a notice on 11th August,2004 to representatives of various stakeholder groups viz Government of Gujarat, Gujarat Control Pollution Board, 5 NGOs, representatives of 4 surrounding villages, 4 contractors, 20 employees of Torrent and 3 consultants, with a brief on the project, informing them of the proposed meeting on 26th August 2004 at Uma Mangal Hall, Kamrej Char Rasta, Kamrej, Surat District (in which district the project activity is located at Akhakhol Village) and requesting each stakeholder group to send representatives to the said meeting at the appointed hour. Also the aforesaid notice was placed at the Mamlatdar Office, Kamrej on 11th August, 2004. This notice also gave time for the various stakeholders to file their observations by 6th September, 2004 in writing.

There were 42 participants representing various parties including from local communities, NGOs, state government, employees, and contractors who attended the meeting on 26th August 2004. Villagers from the vicinity also showed interest in the project and related social and environmental development activities.

The meeting agenda was as follows:

a) Welcome address to the representatives by Mr. Dipen Chauhan of Torrent
b) Election of a Chairperson for the meeting by the stakeholder group representatives from amongst themselves.
c) Introduction of the project by Mr. Deepak Dalal, Executive Director Torrent, on request from the Chair.
d) Open house discussion on the merits of the project with permission of the Chair.

e) Summation of the concerns expressed by the stakeholder groups and the commitments to address the concerns made by Torrent by the Chairperson.
f) Preparation and circulation of draft Minutes of the Meeting and signing of the MOM.

E.2. Summary of the comments received:

>>

After a brief discussion regarding the pros and cons of this project the chair person interacted with the participants to clarify their doubts and concerns regarding the likely impacts of the project. The stakeholders viewed Torrent Group as a reputed group of companies contributing to the local economy. The participants sought clarifications on Kyoto Protocol and Clean Development Mechanism processes. Overall there was agreement that the proposed project had nil or negligible effect on people or their livelihood and that the project activity is a beneficial project. .Detailed comments and responses are shown in the table in section E.3.

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

>>

Torrent clarified all the stake holder's concerns by providing relevant evidence of the project claims and answered all question to the satisfaction of the participants. Detailed MOM delineating the above concerns and Torrents responses has been recorded and appended hereunder

Summary Record of the proceedings of Stakeholder Consultation meeting held at Uma Mangal Hall, Kamrej Char Rasta, Kamrej, Dist. Surat, Gujarat, India on 26.08.2004, 11.30 am

Local stakeholder consultation meeting to discuss stakeholder concerns on proposed Clean Development Mechanism (CDM) project – Natural Gas based Combined Cycle Power Plant of capacity 1050 (+10%) MW by Torrent Power Generation Ltd. (TPGL) (which has since merged into Torrent Power Limited).

Date and Venue: 26.08.2004, 11.30 am at Uma Mangal Hall, Kamrej Char Rasta, Kamrej, Dist. Surat, Gujarat, India

Mr. Dipen Chauhan of TGPL introduced the objective of the meeting. He further suggested the participants to elect a chairman to conduct the meeting. Mr. Dinesh Mehta had proposed the name of Mr. Dhiraj Sanghani, Mamlatdar and Executive Magistrate Kamrej, and Mr. Bharatbhai Patel seconded the proposal. Accordingly, Mr. Dhiraj Sanghani, as a chairman, further conducted the meeting.

Agenda set in the notification for the meeting by TORRENT was approved by Mr. Dhiraj Sanghani and obtained the consent of the participants to the agenda. Subsequently, Mr. Deepak Dalal was invited to provide a brief on the CDM project cycle and the role of local stakeholders in the project. He briefed the participants about the Kyoto Protocol and clean development mechanisms there in and elaborated the need for the project under this mechanism to catalyze sustainable development. He also outlined that the local stakeholders concern are to be internalized in any project under clean development mechanism of the Kyoto Protocol. Brief understanding of the project, elucidating the likely environmental and social impacts of the project, followed by the salient technical and environmental features of the project and how the proposed Natural Gas based Combine Cycle Power Plant of 1050 MW (±10%) would reduce GHG emissions was also mentioned.

The Chairman called upon the participants to seek clarifications and express their concerns on the likely impacts of the project, and it being structured as clean development mechanisms project under Kyoto Protocol. Participants were also given further time to go through the project documents that are made available at the site of the meeting.

The stakeholders viewed Torrent Group as a reputed group of companies contributing to local economy. The participants sought clarifications on Kyoto Protocol and Clean Development Mechanisms process. Overall there was agreement that the proposed project was a beneficial project from sustainability viewpoint. Specific concerns and questions and the answers are delineated in the table below.

Stakeholder concern / question / comment	Answer / outcome
Public Concern	
Does this project lead to increase in discharge of gaseous, liquid and/or solid wastes? If yes, what are the impacts?	No. Instead the project by avoiding use of conventional fuel that is coal, reduces emission of CO2, and avoids emission of SO2 and SPM. It also avoids generation of fly ash and other problems associated with handling coal such as excess land requirement for storage and usage of coal, land degradation and effluents. The project also avoids emission of excessive NOx unlike many similar power projects in India by using an advanced technology. No industrial effluents with pollution potential will be discharged from the project.

Stakeholder concern / question / comment	Answer / outcome
What technology to be employed?	The project utilizes a technology that aims at maximizing efficiency of production and reducing emission of NOx.
What are the socio-economic and welfare development programs be initiated for the area?	Community development plan will be introduced, which will encourage local entrepreneurship, provide employment to locals. Training programs for developing self-sufficiency among the local youth will be organized. Programs like tree planting, free health check-ups and medicines, donation of building materials and furniture, local school building renovation, are also included in the socio-economic development plan. Locally available service of farmers, plumbers, electricians, vehicle repair shops, shopkeepers and traders, hotels and eateries will be utilized to be maximum.
Does the project increase employment opportunities in the area?	The project requires labour during construction phase and operation phase (at designated areas of operation and utilities, such as green-belt maintenance, house-keeping, etc).
What are the contributions of the project activity to the sustainable development of around the project area?	The project will lead to sustainable development around the project area by contributing to the development of local economy and create jobs and employment in and around the project site. The project will use clean fuel and better technology that helps in minimizing pollution potential that is usually associated with other power generators in India.
What is the role of Torrent in CDM and Kyoto Protocol?	Torrent as a responsible corporate citizen volunteers to support the cause behind Kyoto Protocol. The group believes that all developmental projects should be evaluated against their potential for emission/discharge/disturbance reduction and

Stakeholder concern / question / comment	Answer / outcome
	environment restoration opportunities. Such projects, often require overcoming some barriers which are institutional, technological, organizational but can be financially feasible.
NGO's Concerns	
Will the emissions from the project affect the life of flora in the region?	No. The project emissions CO2 and some NOx are very less compared to conventional projects and no impacts are expected.
How do CO_2 emissions contribute to global warming?	CO2 emissions when present in the atmosphere prevent escape of solar heat energy from the earth's surface, resulting in heat build-up and global warming.
What are the safety practices to be adopted for this project?	Fire fighting facilities with water reservoir reservoirs, pumps and hydrant networks, detailed and documented on-site and off-site emergency procedures, active and passive accident control equipment and risk mitigation measures will be implemented. Formation of safety department of TORRENT will also be taken up. Continuous preventive measures, training and mock-drills will be implemented as per disaster management plan for the project.
What other socio-economic development can be availed from the project?	The project will bring many other indirect employment opportunities in the region due to development of infrastructure (roads), TORRENT housing colony, and other banking and co-operative societies around the project site.
Contractor's Concerns	
What is the cost of the project?	Rs. 3,256 Crore (US$ 723.56 Mn)
What is the projected timeline?	Above 15 years.
Employee's Concerns	
How many CDM projects have happened in India so far?	Around 50 projects in various stages of development.
Does this project require new skills and how are you going to provide them?	The engineers and technicians to be employed for the project will undergo enhancement of skill through appropriate training as required for the type of activity to be performed.

Stakeholder concern / question / comment	Answer / outcome
Are there any occupational health impacts from this project?	No. Every employee will be regularly covered under mandatory health check-up as per requirements of Factories Act. Additionally the low noise turbine will be installed and personal protective equipments will be provided to the employment working in noise prone zone.
Does this project lead to cost savings in energy production as compared to conventional fossil fuel projects?	Marginally higher operational costs are expected due to higher environmental benefits from the project due to use of a better technology and a cleaner fuel. CDM benefits are expected to offset partially this disadvantage.

Subsequent to questions and answers, chairman summarized the concerns articulated and clarifications provided.
Further, Mr. Dipen Chauhan from TORRENT thanked the chair and also all the participants.
Signed by Chairman of the meeting

TORRENT also informed the stakeholders that the project activity would contribute to the sustainable development of the region and country by facilitating and catalyzing local and regional opportunities, thereby creating sustainable economic, social and environmental value.

No comments were received in writing from the various stakeholders in response to the notice dated 11th August, 2004 by 6th September, 2004 the date stipulated in the notice.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Torrent Power Limited
Street/P.O.Box:	Ashram Road,
Building:	Torrent House
City:	Ahmedabad
State/Region:	Gujarat
Postfix/ZIP:	380009
Country:	India
Telephone:	+91-92742 10100
FAX:	+91-92742 10199
E-Mail:	ddalal@torrentpower.com
URL:	www.torrentpower.com
Represented by:	
Title:	Executive Director
Salutation:	Mr.
Last Name:	Dalal
Middle Name:	
First Name:	Deepak
Department: Mobile:	Site +91-9227433549
Direct FAX:	+91-92742 10199
Direct tel:	+91-9274210101
Personal E-Mail:	ddalal@torrentpower.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding or Official Development Assistance is involved.

Annex 3

BASELINE INFORMATION

A. Calculation of Baseline emission factor, Project Emissions, Leakages enclosed as spreadsheet calculations.

Table -1 : Low Cost / Must Run Plants (% of net generation)					
Year	**2000-01**	**2001-02**	**2002-03**	**2003-04**	**2004-05**
Low Cost % of Total Generation in the Western Regional Grid i.e. Baseline Grid	**8.2%**	**8.5%**	**8.2%**	**9.1%**	**8.8%**
Average Of Low Cost % For Past 5 Years	**8.56%**				

Data Source: CO_2 Baseline Database for the Indian Power Sector issued by Central Electricity Authority, Ministry Of Power, Government of India December, 2006.) (http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm)

B. Emission Reduction Calculations:

Calculation of Emission factor of technology, identified as the most likely Baseline Scenario ($EF_{BL,CO2}$)

Table M.1- Calculation of Emission factor of technology, identified as the most likely Baseline Scenario		
Particulars	Value	Unit
CO_2 Emission Co-efficient ($COEF_{BL}$) (note-1)	0.093884	t CO_2e/ GJ
Energy Efficiency (η_{BL}) (note-2)	35.10%	%
Emission factor of technology, identified as the most likely Baseline Scenario ($EF_{BL,CO2}$)	**962.91282**	**t CO_2/ GWh**

Data Sources

note 1) Refer to "Working note-1:Calculation of CO_2 Emission Co-efficient ($COEF_{BL}$)"

note 2) Collected from official source i.e., Note iii to Regulation 16 (Gross Station Heat rate for coal based thermal power stations, installed capacity 500MW and above) of tariff regulations issued by CERC- www.cercind.org

Working note-1: Calculation of CO_2 Emission Co-efficient ($COEF_{BL}$)		
Particulars	Value	Unit
Net Calorific value (note-3)	3625	Kcal/Kg
CO_2 Emission Factor (note-3)	95.80	t CO_2/ TJ
Oxidation factor (note-3)	0.98	
CO_2 Emission Co-efficient ($COEF_{BL}$) (note-4)	1.42442962	t CO_2e/ tonne

Net Calorific value	15.17222973	GJ/tonne
CO_2 Emission Co-efficient ($COEF_{BL}$)	**0.093884**	**t CO_2e/ GJ**

Data Sources

note 3) GCV, conversion factor (from GCV to NCV) and others collected from, CO_2 Baseline Database for the Indian Power Sector, December 2006, issued by Central Electricity Authority, Ministry of Power, Government of India.

note 4) $COEF_{BL}$ = NCV * EF_{CO2} * OXID

Table BE-1- Identifying the Baseline Scenario Emission Factor ($EF_{BL, CO2, y}$)

Particulars	Value	Unit
Build Margin Emission factor ($EF_{BM,y}$) (note-1)	780	t CO_2/ GWh
Combined Margin Emission factor (note-1)	890	t CO_2/ GWh
Emission Factor of the most likely Baseline Scenario (note-2)	962.91	t CO_2/ GWh
Baseline Scenario Emission Factor ($EF_{BL, CO2, y}$)	**780**	**t CO_2/ GWh**
(least of the Above 3 options)		

Data Source

note 1) CO_2 Baseline Database for Indian Power Sector , December 2006, Issued by Central Electricity Authority, Ministry Of Power, Government Of India.

Note 2) Table M.1- Calculation of Emission factor of technology, identified as the most likely Baseline Scenario.

Calculation Of Project Emissions

Table P1- Calculation of Project Emissions (PE_y)

Particular	Value	Unit
Net electricity evacuated to grid (note-1)	9067.99941	GWh
Annual gas requirement(note-2) $FC_{f,y}$	1744834538.12	m^3
Emission Co-efficient for Gas(note-3) $COEF_{f,y}$	0.00205257	tCO_2/m^3
Project Emissions (PE_y) (as per equation no-2 of AM0029)	**3581398.206**	**t CO_2**

Data Sources

note 1) Refer to table 1-1 "Net electricity evacuated to grid"

note 2) Refer to table 1-2 "Annual gas requirement "

note 3) Refer to table 1-3 " Emission Co-efficient for Gas "

Table 1-1 Net electricity evacuated to grid

Particular	Value	Unit
Capacity of the Power Plant (note-4)	1147.5	MWh
Load Hours per annum (note-5)	8146.80	Hours
Average annual electricity production	9348	GWh
Auxiliary Consumption (note-6)	3	%
Auxiliary Consumption	280.45359	GWh
Net electricity evacuated to grid	**9068.00**	**GWh**

Data Source

note 4) Collected from the letter from Ministry of Environment and Forest

note 5) Based on EPC Contractor's guarantee for an availability factor of 93%

note 6) Collected from official source i.e. Note V to Regulation 16 (Auxiliary consumption for Gas based Combined Cycle Generating Stations) of tariff regulations issued by Central Electricity Regulatory Commission-www.cercind.org

Table 1-2 Annual gas requirement ($FC_{f,y}$)		
Particular	**Value**	**Unit**
Gross Heat Rate(note 7)	1850	kCal/kWh
GCV of Gas (note 8)	9614.550	(kcal / m^3)
Net electricity evacuated to grid (from Table 1-1)	9068.00	GWh
Annual gas requirement ($FC_{f,y}$)	**1744834538.12**	**m^3**

Data Source

note 7) Collected from official source i.e. note iii to Regulation 16 (Gross Station Heat Rate for Advance Class combined cycle machines) of tariff regulations issued by Central Electricity Regulatory Commission-www.cercind.org

note 8) Calculated as weighted average NCV of Petronet LNG Ltd and ONGC India Ltd. weights applied are 0.5 and 0.5 respectively

Particulars	Weights	NCV (Kcal/m^3)
ONGC	0.5	8500
PLL	0.5	8981
Weighted Average NCV (Kcal/m^3)		**8740.5**

Grossing factor of 1.1 for conversion into GCV is provided by CO_2 Baseline Database for Indian Power Sector, December 2006, published by Central Electricity Authority, Ministry of Power, Government of India..

Table 1-3 Emission Co-efficient for Gas ($COEF_{f,y}$)		
NCV of Gas (note-8)	8740.50	Kcal/ m^3
NCV of Gas (NCV_y)	0.03658773300	GJ/m^3
CO_2 Emission factor ($EF_{CO2,f,y}$) (note-9)	0.0561	t CO_2/GJ
Oxidation factor for Gas ($OXID_f$) (note-10)	1.000	

Emission Co-efficient for Gas (COEF $_{f,y}$)	**0.00205257**	**tCO2/m^3**

COEF $_{f,y}$ = NCV* EF*OXID

Data Source

note 9) Collected from table 1-3 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
note 10) IPCC current default values.

Calculation of Leakages (LE $_y$)

Table L.1- Calculation of leakages		
Particulars	**Value**	**Unit**
Leakage Emissions due to fugitive upstream CH_4 emissions (LE $_{CH4,y}$) (note-1)	91267.1274	t CO_2 e
Leakage Emissions due to fossil fuel combustion/ electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution System (LE $_{LNG, CO2, y}$) (note-2)	210670.4827	t CO_2 e
Leakage Emissions (LE $_y$) (Equation no-5 of AM0029)	**301937.6101**	**t CO_2 e**

Data Sources

note 1) Refer to table 1-1 "Leakage Emissions due to fugitive upstream CH_4 emissions (LE $_{CH4,y}$)"

note 2) Refer to table 1-2 "Leakage Emissions due to fossil fuel combustion/ electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system (LE $_{LNG, CO2, y}$)"

Table 1-1 Leakage Emissions due to fugitive upstream CH_4 emissions (LE $_{CH4,y}$)		
Particulars	**Value**	**Unit**
Quantity of natural gas combusted in project plant (FC $_y$) (note-3)	1744834538.12	M ^{3}
Net Calorific Value of natural gas combusted (NCV $_y$) (note-4)	0.036587733	GJ/ M^3
Emission factor for upstream fugitive methane emissions of natural gas(EF $_{NG, upstream, CH4}$) (note-5)	0.00016	t CH_4/ GJ
Electricity generation in project plant (EG $_{PJ,y}$) (note-6)	9067999.4	MWh
Emission factor for upstream fugitive methane emissions occurring in the absence of project activity (EF $_{BL, upstream, CH4}$) (note-7)	0.00064714	t CH_4/ MWh

Global Warming potential of methane (GWP_{CH4}) (note-8)	21.0000	
Leakage Emissions due to fugitive upstream CH_4 emissions ($LE_{CH4,y}$) (Equation no-6 of AM0029)	**91267.1274**	**t CO_2 e**

Data Sources

note 3) Refer to "Working notes for calculating Leakages" Section -1

note 4) Refer to "Working notes for calculating Leakages" Section -2

note 5) Refer to "Working notes for calculating Leakages" Section -3

note 6) Refer to "Working notes for calculating Leakages" Section -4

note 7) Refer to "Working notes for calculating Leakages" Section -5

note 8) Data collected from publicly available sources, published by "U.S Greenhouse Gas Inventory Program, Office of Atmospheric Programs, U.S Environmental Protection Agency."

Table 1-2 Leakage Emissions due to fossil fuel combustion/ electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution System ($LE_{LNG, CO2, y}$)

Particulars	Value	Unit
Quantity of natural gas combusted in project plant ($FC_{LNG, y}$) (for CO_2 emissions from LNG) (note-9)	35111.74712	TJ
Emission factor for upstream CO2 emissions associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution System ($EF_{CO2,upstream,LNG}$) (note-10)	6	t CO_2/ TJ
Leakage Emissions due to fossil fuel combustion/ electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution System ($LE_{LNG, CO2, y}$)	**210670.4827**	**t CO_2 e**

Data Sources

note 9) Refer to "Working notes for calculating Leakages" Section -6

note 10) Collected from AM0029

Working notes for calculation of Leakages		
Particulars	**Value**	**Unit**
Section 1:Quantity of natural gas combusted in project plant (FC_y)		
Natural gas combusted in project plant (note-1)	1744834538.12	m^3

Quantity of natural gas combusted in project plant (FC_y)	1744834538.12	**M^3**
Section-2:Net Calorific Value of natural gas (NCV_y)		
Net calorific value of natural gas (note-1)	8740.500	$Kcal/m^3$
Net Calorific Value of natural gas (NCV_y)	**0.036587733**	**GJ/ M^3**
Section-3:Emission factor for upstream fugitive methane emissions of natural gas ($EF_{NG, upstream, CH4}$)		
Emission factor for fugitive methane emissions due to **Gas Production** (note -2)	72	t CH_4/ PJ
Emission factor for fugitive methane emissions due to **Gas Processing, transport and distribution** (note-2)	88	t CH_4/ PJ
Emission factor for upstream fugitive methane emissions of natural gas (addition of above two figures)	160	t CH_4/ PJ
Emission factor for upstream fugitive methane emissions of natural gas($EF_{NG, upstream, CH4}$)	**0.00016**	**t CH_4/ GJ**
Section-4: Electricity generation in project plant ($EG_{PJ,y}$)		
Electricity generation in project plant (note 1)	9067.9994	GWh
Electricity generation in project plant ($EG_{PJ,y}$)	**9067999.41**	**MWh**
Section:6-Quantity of natural gas combusted in project plant ($FC_{LNG, y}$) (For CO_2 emissions from LNG)		
Net Electricity evacuated to the grid (note-1)	9067.9941	GWh
50% of the Electricity evacuated to the grid*	4533.999705	GWh
GCV of LNG (note-3)	9879.1	$Kcal/m^3$
Gross Station Heat rate (note-1)	1850	Kcal/ KWh
Total LNG requirement	**849055020.6**	**m^3**
Gross Calorific value of Gas (note-3)	9879.1	Kcal/ m^3

Total LNG requirement	8387899454	Kcal *10^3
Quantity of natural gas (i.e. re-gasified LNG) combusted in project plant ($FC_{LNG,\ y}$) (For CO_2 emissions from LNG)"*"	**35111.74712**	**TJ**

"*" 50% of the power evacuated to the grid is expected to be generated using LNG

Data Sources

note 1) Collected from project emissions calculations
note 2) Collected from AM0029.
note 3) GCV of Gas supplied by Petronet LNG Ltd.

Section 5:Emission factor for upstream fugitive methane emissions occurring in the absence of project activity ($EF_{BL,\ upstream,\ CH4}$) (t CH_4/ MWh)

Particulars	Fuel (MT) (note-A)	NCV (TJ/tonne) (note-B)	Fuel (GJ) ($FF_{i,k}$)	Emission factor (t CH_4/GJ) $EF_{k,\ upstream,\ CH4}$ (note-C)	Emissions (t CH_4)
	(a)	(b)	(c) =(a)*(b)*1000	(d)	(e) = (c)*(d)
For Steam Stations					
Coal	14906372.8	0.01517	226162912.5	0.0000527279	11925.09824
Furnace Oil	160417.2725	0.04026	6459222.972	0.0000041	26.48281419
Light Diesel	1318.161537	0.04186	55178.24193	0.0000041	0.226230792
LSHS	84576.7698	0.04026	3405494.969	0.0000041	13.96252937
Gas	6178.377396	0.047865	295728.0341	0.00016	47.31676028
Lignite	413190.4703	0.01100	4547158.646	0.0000527279	239.7621827
	15572053.85		**240925697.1**		**12252.84876**
For Gas Stations					
Natural Gas	1317579.602	0.047865	63066313.97	0.00016	10090.61024
HSD	507.7024465	0.04186	21252.42441	0.0000041	0.08713494
Naphtha	210561.9473	0.04504	9485759.297	0.0000041	38.89161312
	1528649.252		**72573325.69**		**10129.58898**
For Diesel Stations					
LSHS	0	0.04026	0	0.0000041	0
Diesel Oil	0	0.04186	0	0.0000041	0
	0		**0**		**0**

Gross upstream fugitive methane emissions from production of the fuel type "K "(t CH_4) (Sum of the above) 22382.43774

Electricity generation in the plant "J" included in build margin (MWh) (note-E)	34,586,656
Emission factor for upstream fugitive methane emissions occurring in the absence of project activity ($EF_{BL, upstream, CH4}$) (t CH_4/ MWh)	**0.000647141**

Table 1-1 Working notes for calculating fugitive CH_4 emission factor from production of fuel "k"

A. Coal

Particulars	Value	Unit
Emission factor for fugitive CH_4 upstream emissions (for surface mining) (note-D)	0.8	t CH_4/ Kt coal
NCV of Coal (note-B)	0.01517223	TJ/ tonne
NCV of Coal	15172229.73	MJ/ Kt coal
Emission factor for upstream methane emissions from production of the Coal ($EF_{k, upstream, CH4}$)	**0.000052728**	**t CH_4/ GJ**

B. Gas

Particulars	Value	Unit
Emission factor for fugitive methane emissions due to **Gas Production** (note-D)	72	t CH_4/ PJ
Emission factor for fugitive methane emissions due to **Gas Processing, transport and distribution** (note-D)	88	t CH_4/ PJ
Emission factor for upstream fugitive methane emissions of natural gas	160	t CH_4/ PJ
Emission factor for upstream methane emissions from production of the Gas ($EF_{k, upstream, CH4}$)	**0.00016**	**t CH_4/ GJ**

C. Oil

Particulars	Value	Unit
Emission factor for fugitive methane emissions due to **Oil Production** (note-D)	2.5	t CH_4/ PJ
Emission factor for fugitive methane emissions due to **Oil transport, refining and storage** (note -D)	1.6	t CH_4/ PJ

Emission factor for upstream fugitive methane emissions of oil	4.1	t CH_4/ PJ
Emission factor for upstream methane emissions from production of the oil ($EF_{k, upstream, CH4}$)	**0.0000041**	**t CH_4/ GJ**

Data Sources

note A) Calculated based on data sourced from CEA, Ministry Of Commerce, Government of India, calculations are annex hereto.{Working note-F 1:Calculation of Fuel consumption ($F_{i,m,y}$)}

note B) Net Calorific Value of:

Coal, HSD, LSHS, Furnace Oil, Naphtha : Collected from CO2 Baseline Database For Indian Power Sector, December 2006, Issued by Central Electricity Authority, Ministry Of Power, Government Of India

Lignite: Collected from table 6.3 CEA General Review, data for 2004-2005, GCV converted into NCV using conversion factor provided by "CO2 Baseline Database For Indian Power Sector, December 2006, Issued by Central Electricity Authority, Ministry Of Power, Government Of India" .

Gas: Calculated as weighted average NCV of Petronet LNG Ltd and ONGC India Ltd. based on the gas supply made by the two companies in 2004-05.

Particulars	Supply (TBTU) (a)	NCV (kCal/ M3) (b)	(a)* (b)
ONGC	666.72	8500	5667120
Petronet Lng Ltd	125.03	8981	1122894.43
	791.75		6790014.43

Weighted average NVC (Kcal/ M^3)	8575.96
Weighted average NVC (Kcal/ Kg)	11434.61
Weighted average NVC (TJ/ tonne)	0.047865278

note C) Collected from table 1-1 (Working notes for calculating fugitive CH_4 emission factor from production of fuel "k")

note D) Collected from AM0029

note E) Power generation of sample "m" plants (including low cost and must run units)

Working note-F 1:Calculation of Fuel consumption ($F_{i,m,y}$) (used for calculation of $EF_{BL, upstream, CH4}$)

Particulars	Unit	For Western Grid 2004-05 (note-A1)	For Build Margin sample "m" plants"*"

Thermal power generation	GWh	155845.2209	30138.96
Generation by Steam based stations	GWh	130816.6347	20717.59
Generation by Gas based stations	GWh	25028.58618	9,421
Generation by Diesel based stations	GWh	0	0
Fuel used in steam stations for aforesaid generation			
Coal	MT	94123000	14906372.8
Furnace Oil	MT	1012919.45	160417.2725
Light Diesel	MT	8323.24	1318.161537
LSHS	MT	534041.34	84576.7698
Gas	MT	39012	6178.377396
Lignite	MT	2609000	413190.4703
		98326296.03	15572053.85
Fuel used in Gas stations for aforesaid generation			
Natural Gas	MT	3500250	1317579.602
HSD	MT	1348.75	507.7024465
Naphtha	MT	559373.76	210561.9473
		4060972.51	1528649.252
Fuel used in Diesel stations for aforesaid generation	MT	0	0

"*" Fuel used in Build Margin sample "m" plants is estimated based on the ratio of Build Margin sample "m" plants generation to the total generation of western grid, applied to fuel consumption in the western grid, separately for steam plants and gas plants.

Data Source (note –A1)

Fuel	Unit	Consumption" ** "	Density " *** " (Kg/Lt or kg/m^3)	Consumption (MT)
Steam Stations				
Coal	MT	94123000	1	94123000
Furnace Oil	KL	1066231	0.95	1012919.45
Light Diesel	KL	10028	0.83	8323.24
LSHS	KL	574238	0.93	534041.34
Gas	MT	39012		39012
Lignite	MT	2609000		2609000
				98326296.03
Gas Stations				
Natural Gas	MMSCM	4667	0.75	3500250
HSD	KL	1625	0.83	1348.75
Naphtha	KL	776908	0.72	559373.76
				4060972.51
Diesel Stations				
LSHS	KL	0	0.93	0
Diesel Oil	KL	0	0.83	0

" ** "Collected from table 6-1 CEA General Review 2004-05, Published by Central Electricity Authority, Ministry of Power, Government of India.

" *** "

1) Density of gas has been taken from , a presentation made by Gail India Ltd.
2) Density of Furnace Oil and Diesel (including HSD and Light Diesel) has been collected from CO_2 Baseline Database for Indian Power Sector, December 2006, issued by CEA, Ministry of Power, Government of India
3) Density of Naphtha is collected from the website of Bharat Petroleum (www.bharatpetroleum.in)
4) Density of LSHS is collected from the website of www.energyefficiencyasia.org

List of Build Margin Sample *"m"* Plants									
SR NO	**NAME**	**UNIT NO**	**DATE OF COMM.**	**CAPACITY MW AS ON 31/03/2005**	**TYPE**	**FUEL 1**	**FUEL 2**	**2004-05 Net Generation GWh**	**2004-05 in Build Margin**
1	GANDHI NAGAR	5	17-Mar-98	210	THERMAL	COAL	OIL	1,421	1
2	HAZIRA CCCP	1	30-Sep-01	52	THERMAL	GAS	n/a	378	1
3	HAZIRA CCCP	2	30-Sep-01	52	THERMAL	GAS	n/a	368	1
4	HAZIRA CCCP	3	30-Sep-01	52.1	THERMAL	GAS	n/a	377	1
5	DHUVARAN CCPP	1	04-Jun-03	67.9	THERMAL	GAS	n/a	0	1
6	DHUVARAN CCPP	2	22-Sep-03	38	THERMAL	GAS	n/a	0	1
7	WANAKBORI	7	31-Dec-98	210	THERMAL	COAL	OIL	1,508	1
8	KUTCH LIG.	3	02-Apr-97	75	THERMAL	LIGN	OIL	411	1
9	ESSAR GT IMP.	1	10-Aug-95	515	THERMAL	GAS	NAPT	3,285	1
10	G.I.P.C.L. GT	5	26-Aug-97	106	THERMAL	GAS	NAPT	732	1
11	G.I.P.C.L. GT	6	18-Nov-97	54	THERMAL	GAS	NAPT	367	1
12	SURAT LIG.	1	16-Jan-00	125	THERMAL	LIGN	OIL	762	1
13	SURAT LIG.	2	06-Nov-99	125	THERMAL	LIGN	OIL	839	1
14	G.T.E. CORP.	1	01-Apr-98	135	THERMAL	GAS	NAPT	724	1
15	G.T.E. CORP.	2	01-Apr-98	135	THERMAL	GAS	NAPT	775	1
16	G.T.E. CORP.	3	14-Feb-98	135	THERMAL	GAS	NAPT	750	1
17	G.T.E. CORP.	4	13-Oct-98	250	THERMAL	GAS	NAPT	1,336	1
18	SANJAY GANDHI	3	28-Feb-99	210	THERMAL	COAL	OIL	1,393	1
19	SANJAY GANDHI	4	23-Nov-99	210	THERMAL	COAL	OIL	1,322	1
20	VINDH_CHAL STPS	7	03-Mar-99	500	THERMAL	COAL	OIL	3,545	1
21	VINDH_CHAL STPS	8	26-Feb-00	500	THERMAL	COAL	OIL	3,570	1
22	K_KHEDA II	3	31-May-00	210	THERMAL	COAL	OIL	1,462	1
23	K_KHEDA II	4	07-Jan-01	210	THERMAL	COAL	OIL	1,362	1
24	CHANDRAPUR	7	01-Oct-97	500	THERMAL	COAL	OIL	3,123	1
25	RELIANCE ENERGY	1	14-Aug-99	48	THERMAL	NAPT	n/a	329	1
26	DHABOL GT	1	12/11/1998	235	THERMAL	NAPT		0	1
27	DHABOL GT	2	12/11/1998	235	THERMAL	NAPT		0	1
28	DHABOL GT	3	12/11/1998	235	THERMAL	NAPT		0	1
29	DHABOL GT	4	12/11/1998	35	THERMAL	NAPT		0	1
30	KADANA	3	2-Jan-1998	60	HYDRO			76	1
31	KADANA	4	27-May-1998	60	HYDRO			76	1
32	S.SAROVAR CHPH	1	4-Oct-2004	50	HYDRO			22	1
33	S.SAROVAR CHPH	2	4-Sep-2004	50	HYDRO			22	1
34	S.SAROVAR CHPH	3	1-Sep-2004	50	HYDRO			22	1
35	S.SAROVAR CHPH	4	1-Sep-2004	50	HYDRO			22	1
36	S.SAROVAR CHPH	5	15-Dec-2004	50	HYDRO			22	1
37	S.SAROVAR RBPH	1	1-Feb-2005	200	HYDRO			149	1
38	INDIRA SAGAR	1	1-Jan-2004	125	HYDRO			168	1
39	INDIRA SAGAR	2	18-Jan-2004	125	HYDRO			168	1

List of Build Margin Sample *"m"* Plants									
SR NO	**NAME**	**UNIT NO**	**DATE OF COMM.**	**CAPACITY MW AS ON 31/03/2005**	**TYPE**	**FUEL 1**	**FUEL 2**	**2004-05 Net Generation GWh**	**2004-05 in Build Margin**
40	INDIRA SAGAR	3	27-Feb-2004	125	HYDRO			168	1
41	INDIRA SAGAR	4	28-Mar-2004	125	HYDRO			168	1
42	INDIRA SAGAR	5	23-Jul-2004	125	HYDRO			168	1
43	INDIRA SAGAR	6	29-Dec-2004	125	HYDRO			168	1
44	INDIRA SAGAR	7	27-Oct-2004	125	HYDRO			168	1
45	INDIRA SAGAR	8	23-Mar-2005	125	HYDRO			168	1
46	BANSAGAR (II)	1	18-Feb-2002	15	HYDRO			33	1
47	BANSAGAR (II)	2	1-Sep-2002	15	HYDRO			33	1
48	BANSAGAR (III)	1	26-Nov-2000	20	HYDRO			27	1
49	BANSAGAR (III)	2	25-Aug-2001	20	HYDRO			27	1
50	BANSAGAR (III)	3	2-Sep-2002	20	HYDRO			27	1
51	RAJGHAT (MP)	1	15-Oct-1999	15	HYDRO			29	1
52	RAJGHAT (MP)	2	29-Sep-1999	15	HYDRO			29	1
53	RAJGHAT (MP)	3	3-Nov-1999	15	HYDRO			29	1
54	TAWA	1	31-Mar-2002	6.75	HYDRO			15	1
55	TAWA	2	31-Mar-2002	6.75	HYDRO			15	1
56	KOYNA-IV	15	28-Mar-2000	250	HYDRO			527	1
57	KOYNA-IV	16	3-Mar-2000	250	HYDRO			267	1
58	KOYNA-IV	17	25-Nov-1999	250	HYDRO			718	1
59	KOYNA-IV	18	7-Oct-1999	250	HYDRO			224	1
60	BHANDARDHARA-II	2	30-Mar-1996	34	HYDRO			30	1
61	SURYA	1	31-Dec-1998	6	HYDRO			13	1
62	MANIKDOH	1	1-Nov-1996	6	HYDRO			4	1
63	DIMBE	1	12-Mar-1997	5	HYDRO			9	1
64	WARNA	1	16-Sep-1998	8	HYDRO			31	1
65	WARNA	2	1-Sep-1999	8	HYDRO			31	1
66	DUDH GANGA	1	27-Feb-2000	12	HYDRO			31	1
67	DUDH GANGA	2	31-Mar-2000	12	HYDRO			31	1
68	BHIVPURI	1	31-Mar-1998	24	HYDRO			75	1
69	BHIVPURI	2	29-Sep-1998	24	HYDRO			75	1
70	BHIVPURI	3	24-Sep-1999	24	HYDRO			75	1
71	BHIVPURI	4	24-Sep-1997	1.5	HYDRO			5	1
72	BHIVPURI	5	24-Sep-1997	1.5	HYDRO			5	1
73	KHOPOLI	1	13-Feb-2002	24	HYDRO			95	1
74	KHOPOLI	2	25-Mar-2003	24	HYDRO			95	1
75	KHOPOLI	3	2-Mar-2001	24	HYDRO			95	1
			TOTAL	**8422**			**Total**	**34,587**	
			Coat	3,085			Coal	20,718	
			Gas	2,380			Gas	9,421	
			Hydro	2,957			Hydro	4,448	

Table E.1-Calculation Of Emissions Reduction (ER_y)

Calculation Of Emissions Reduction (ER_y)

Particulars	Value	Unit
Emissions in the baseline scenario (BE_y) (note-1)	7073040	t CO_2e
Emissions in the project scenario (PE_y) (note-2)	3581398	t CO_2e
Leakages (LE_y) (note-3)	301938	t CO_2e
Emissions Reduction (ER_y)	**3189704**	**t CO_2e**

Data Sources:

note 1) Refer to table 1-1 " Calculation of emissions in the baseline scenario"

note 2) Collected from project emissions calculations

note 3) Collected from leakages calculations

Table 1-1 Calculation of emissions in the Baseline Scenario (BE_y)		
Particulars	Value	Unit
Electricity generated in the project plant($EG_{PJ,y}$) (note-4)	9067.99941	GWh
Baseline CO_2 emission factor ($EF_{BL, CO2,y}$) (note-5)	780	t CO_2/GWh
Emissions in the Baseline Scenario (BE_y)	**7073039.54**	**t CO_2e**

Data Sources:

note 4) Collected from project emissions calculation.

note 5) Collected from table BE-1 "Identifying the Baseline Scenario Emission Factor"

Annex 4

MONITORING INFORMATION

1. The monitoring plan

This document serves as the Monitoring Plan (MP) for the "1147.5 MW Natural gas- based grid connected Combined cycle power generation project" in Akhakhol Village, District Surat, Gujarat state.
The MP presents a plan to meet the requirements for the collection, processing and reporting of data required to fulfil the requirements in decision 7/CMP.17. It describes management systems and procedures to be implemented by Torrent upon project implementation in order to ensure consistent project operation as well as monitoring, processing and reporting of data required for the calculation of emission reductions (ERs) taking into account AM0029 and the guidance presented in the Validation and Verification Manual.
If necessary, the MP can be updated and adjusted to meet operational requirements, provided such modifications are approved by a Designated Operational Entity (DOE) during the process of validation and/or verification.

2. Obligations of Torrent Power's CDM manager

It is the responsibility of Torrent Power's CDM manager to develop and implement a management and operational system that meets the requirements of this MP. Equally, it is his responsibility to enter into appropriate agreements with institutions in India to secure adequate data gathering, processing and recording, if required.

3. Description of data required to be monitored

The MP foresees recording of the following parameters during project operation in order to enable calculation of emission reductions from the project activity. In tables 1-3 they are described in detail. The tables also show the recording frequency of each parameter as given in AM0029.

Table 1: Parameters to be monitored for calculation of project emissions:

ID	Data variable	Source of data	Data unit	Recording frequency
$FC_{f,y}$	Fuel consumption	Flow meter	m^3	Daily
$NCV_{f,y}$	Net calorific value	Fuel supplier(s)/ transporter(s)	GJ/m^3	Fortnightly
$EF_{CO2,f,y}$	Emission factor for fuel consumed	Preferably fuel supplier(s)/ fuel transporter(s). If this is not available, local data and then country specific data/IPCC values will be used	t CO_2/GJ	Annually
$OXID_f$	Oxidation factor for Natural Gas	IPCC current default value	Number	Annually

Table 2: Parameters to be monitored for calculation of baseline emissions:

ID	Data variable	Source of data	Data unit	Recording frequency
EG_{PJy}	Electricity generation by project activity for supply	Electricity meter	MWh	Hourly measurement , monthly recording
EF_y or $EF_{BL,CO2}$	Baseline Grid emissions factor using Build Margin	Preferably CEA baseline database (Ministry of Power, Government of India). If unavailable, calculation from raw data of CEA(Ministry of Power, Government of India), as well as from IPCC and others (as detailed in B.7.1)	t CO_2/GWh	Annually

Table 3: Parameters to be monitored for calculation of emissions due to leakage:

ID	Data variable	Source of data	Data unit	Recording frequency
$FC_{LNG,Y}$ (For CO_2 emissions from LNG)	LNG consumption	Fuel supplier(s)	m^3	Daily

4. Approach used in this monitoring plan

This MP has been designed to clearly separate data collection activities and ER calculation activities. Each activity follows its own organizational structures and procedures. ER calculation will be undertaken with a stand-alone Excel spreadsheet (in the following referred to as the "Workbook"). Data collection activities have been designed to derive verifiable monthly and/or yearly values from the periodic measurements undertaken for each parameter that can be easily processed in a Workbook for ER calculation.

After validation and after each reporting of emission reductions to the DOE the CDM Manager will organize a meeting with all staff involved in the execution of MP. The purpose of the meeting will be the identification for corrective actions in the organizational structures and procedures in order to provide for more accurate future monitoring and reporting taking into account possible requests for improvements by the DOE. Findings of the meeting will be communicated to the DOE and alterations might be made to the MP in accordance with the DOE's advice.

Section 5 outlines the organizational structures and procedures for collection, processing, review, storage and reporting of data required for ER calculation.

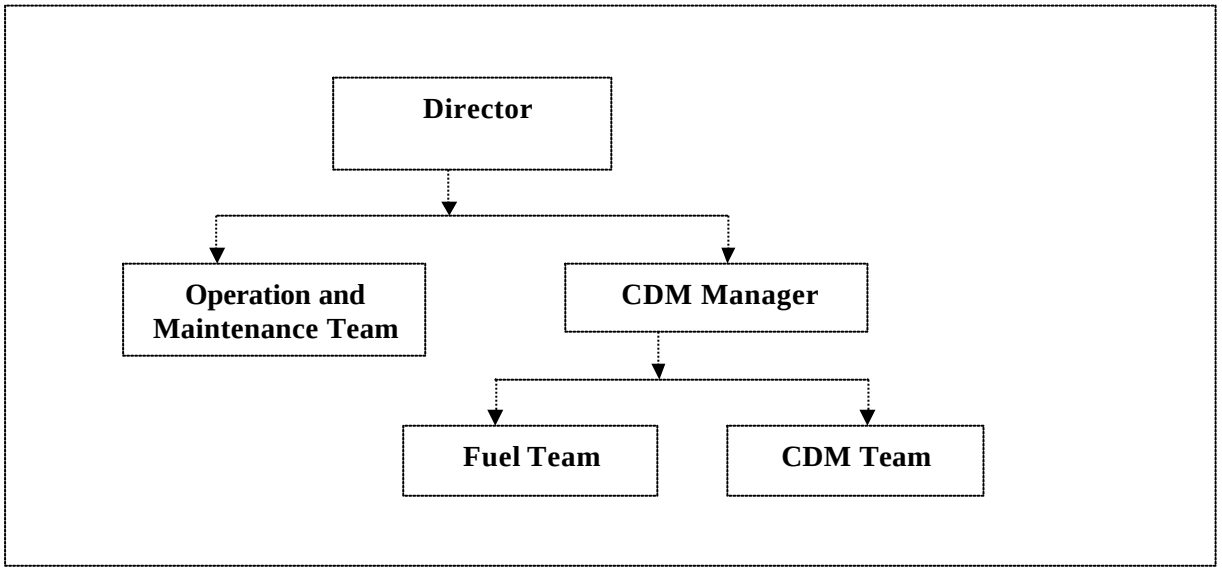
Section 6 presents the "Workbook" for ER calculation and describes its functioning. For calculation of ERs this MP follows the formulae specified in AM0029. All formulae have been incorporated in the workbook.

Section 7 describes different protocols to be prepared during project implementation (e.g. training protocol).

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

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

A) CDM Organization Structure:



The Director of Torrent Power has issued an official order, authorizing the CDM Manager to implement the PDD and the Monitoring Plan and delegating all powers in relation thereto, to the CDM Manager including the power to direct O&M team, and fuel team, CDM team to:

(a) Provide all information/data required for this monitoring plan

b) Comply with all the requirements as per the Project Design Document and Monitoring Plan.

c) Adherence to the laid down protocols, procedures and processes, in relation to CDM project activity, by the aforesaid O&M team, fuel team and the CDM team

d) Refer all conflicts, discrepancies, mistakes, etc in relation to the Monitoring Plan of the CDM project activity, to the CDM manager for resolution, which resolution in this regard shall be final and binding on the aforesaid teams.

The CDM team consists of CDM auditor and CDM compiler. The O&M team is headed by the Head-O&M and the Fuel team is headed by the Fuel Manager.

B) CDM responsibility matrix:

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

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

Table 4: Organizational Structures and Procedures for Monitoring, Processing, Review, Storage and Transfer

Parameters		**Project Emissions**				**Baseline Emissions**		**Leakage Emissions**
		$FC_{f,y}$	**$NCV_{f,y}$**	**$EF_{CO2,f,y}$**	**$OXID_f$**	**$EG_{pj,y}$**	**$EF_{BM,y}$**	**$FC_{LNG,Y}$ Quantities (for CO_2 emission from LNG)**
Monitoring of Raw data	Responsible person at Torrent	Head O & M	Fuel Manager	Fuel Manager	CDM Manager	Head- O&M	CDM Manager	Fuel Manager
	Data source	Flow meter	Fuel supplier(s)/ transporter(s)	Fuel Supplier(s)/ Fuel Transporter(s), local data, country specific values/ IPCC values in that order of preference.	IPCC current default value	Electricity meter	CEA (Ministry of Power, Government of India), IPCC and others.	Fuel supplier(s)
	Frequency of data collection	Daily	Fortnightly	Annually	Annually	Hourly measurement , Monthly recording	Annually	Daily
	Data format	Electronic	Electronic	Electronic	Electronic	Electronic	Electronic	Paper
	Procedures for maintenance and calibration of monitoring equipment	As per calibration and maintenance protocol	Not applicable	Not applicable	Not applicable	As per calibration and maintenance protocol	Not applicable	Not applicable
Data processing	Responsible person at Torrent	CDM Compiler	CDM Compiler	CDM Compiler	CDM Compiler	CDM Compiler	CDM Compiler	CDM Compiler

Parameters		Project Emissions				Baseline Emissions		Leakage Emissions
		$FC_{f,y}$	$NCV_{f,y}$	$EF_{CO2,f,y}$	$OXID_f$	$EG_{pj,y}$	$EF_{BM,y}$	$FC_{LNG,Y}$ Quantities (for CO_2 emission from LNG)
	Description of procedure	Consistency check, validation and recording	Consistency check, validation and recording	Consistency check, validation and recording	Consistency check, validation and recording	Consistency check, validation and recording	Consistency check, validation and recording	Consistency check, validation and recording
	Frequency of processing	Daily	Monthly	Annually	Annually	Monthly	Annually	Daily
	Format after processing	Excel	Excel	Excel	Excel	Excel	Excel	Excel
	Data storage at source	Note-2	Note-2	Note-2	Note-2	Note-2	Note-2	Note-2
Data review	Responsible person at Torrent	CDM Auditor	CDM Auditor	CDM Auditor	CDM Auditor	CDM Auditor	CDM Auditor	CDM Auditor
	Description of procedure	As per data review protocol	As per data review protocol.	As per data review protocol	As per data review protocol	As per data review protocol	As per data review protocol	As per data review protocol
Monthly/ Yearly aggregation of data	Responsible person at Torrent	CDM Compiler	CDM Compiler	Not Applicable	Not Applicable	CDM Compiler	Not Applicable	CDM Compiler
	Description of procedure	Aggregates the daily measurements to monthly value and saves it in electronic format	Aggregates the monthly measurements to annual value and saves it in electronic format	Not applicable	Not applicable	Aggregates the monthly measurements to yearly value and saves it in electronic format	Not applicable	Aggregates the daily measurements to monthly value and saves it in electronic format

Parameters		Project Emissions				Baseline Emissions		Leakage Emissions
		$FC_{f,y}$	$NCV_{f,y}$	$EF_{CO2,f,y}$	$OXID_f$	$EG_{pj,y}$	$EF_{BM,y}$	$FC_{LNG,Y}$ Quantities (for CO_2 emission from LNG)
Storage of aggregated data	Responsible person at Torrent	CDM Manager	CDM Manager	CDM Manager	CDM Manager	CDM Manager	CDM Manager	CDM Manager
	Frequency of storage	Monthly	Monthly	Annually	Annually	Monthly	Annually	Monthly
	Format of data stored	Electronic (Excel) and paper version	Electronic (Excel) and paper version	Electronic (Excel) and paper version	Electronic (Excel) and paper version	Electronic (Excel) and paper version	Electronic (Excel) and paper version	Electronic (Excel) and paper version
	Duration of storage	Note-2	Note-2	Note-2	Note-2	Note-2	Note-2	Note-2

Note-2: Kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, which ever occurs later.

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

A) Data Monitoring
The data that will be monitored include:

a) Monitoring of Electricity generated by the Project: The electricity generated by the project will be through metering equipment at the plant. The data can also be monitored and recorded at the on-site control centre using a computer system. There will be Main metering system and backup metering system. The meter reading will be readily accessible for DOE. Calibration test records will be maintained for verification.
b) Monitoring of quantity of Gas combusted: Quantity of gas combusted will be monitored through flow metering equipments. Detailed monitoring procedure of quantity of Gas combusted by the project will be established in accordance with the agreements with the gas suppliers and gas transporter .The LNG consumed will be based on the data provided by fuel supplier(s)
The flow meter reading will be readily accessible for DOE. Calibration test records will be maintained for verification.
c) Monitoring of NCV: The NCV of gas is used in the calculation of CO2 emission coefficient. Hence the measurement report of Gas character must be obtained from fuel supplier(s)/ transporter(s).
d) Monitoring the data needed to calculate the baseline emission factor:
The baseline emission factor is obtained from the CEA baseline database (Ministry of Power, Government of India) or calculated from raw data of CEA (Ministry of Power, Government of India), IPCC and others. The project owner should check the data and submit the revised ex-post calculation to the DOE on annual basis.
The emission factor calculation for arriving at emission reduction of this project will be calculated based on the data available in accordance with the approved methodology AM0029 and will be verified by DOE.

B) Calibration and Maintenance:

The detailed calibration, testing and maintenance procedure shall be prepared by the CDM Manager based on the agreements with the fuel supplier(s), fuel transporter(s) etc), equipment manufacturer's recommendations and the industry and national standards as applicable.

C) Verification of Monitoring Results:

The verification of the monitoring results of the project is mandatory process required for all CDM projects.
The responsibilities for verification of the project are as follows:
1. *The CDM Manager will arrange for the verification and will prepare for the audit and verification process to the best of its abilities.*

2. *The CDM Manager will facilitate the verification through providing the DOE with all required necessary information, before, during and, in the event of queries, after verification.*
3. *The project owner will fully cooperate with the DOE and instruct its staff and management to be available for interviews and respond honestly to all questions from DOE.*

6. Description of organizational structures & procedures for calculation of emission reductions as well as review, storage and reporting of the ER calculation results

Calculation of ERs is carried out by the CDM Manager annually by utilisation of an excel-based workbook whose functions are explained in detail below.
The CDM Manager must retain a copy of every month's workbook. Each month's workbook must be saved on the plant server under a unique name reflecting the month for which monitoring has been carried out and hard copies of the workbook shall be printed out, signed by the CDM Manager in accordance with company procedures, and stored in the archive room. In addition, after each data entry and/or modification of the workbook, electronic copies of the workbook shall be saved under a new name, and hard copies shall be signed and stored safely. Yearly summaries are calculated based on the monthly results.
The workbooks serve as a data base for the periodic reporting of ERs to the verifying DOE by the CDM Manager. After completion of the workbook the ER results are reviewed according to the procedures laid out in the data review protocol.

Description of the workbook for emission reduction calculation

This section explains and illustrates the steps required to be performed by the CDM Manager to enable the GHG emission reductions to be calculated on an annual basis using the workbook. It presents the worksheets contained in the workbook and explains their use. The section is intended as a user manual for the workbook. The relevant formulas are displayed in the relevant worksheets for easier orientation. The electronic workbook is an Annex to the MP and an integral part thereof.

The CDM Manager is responsible for ensuring the entry of the required data shown in tables below into the electronic workbook and completion of the workbook starting with April 2008 or a date not earlier than the date of registration, as required by the monitoring methodology and the data input templates in the electronic workbook.
The workbook is designed with 1) Data entry and aggregation screen, and 2) Data calculation screen. The data to be entered is keyed in the data entry screen and also aggregated in the same screen where necessary. The data calculation screen has all the formulas required for the calculation as per the approved methodology and is linked to the appropriate cell of data entry screen.

The screen shots of these screen along with formula used are given below:

1) Data Entry Screen:

a) $FC_{f,y}$

	Frequency	Daily
	Source	Flow Meter
	Data Unit	m^3
	Day	
	1	
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
	11	
	12	
	13	
	14	
	15	
	Fortnightly total	
	16	
	17	
	18	
	19	
	20	
	21	
	22	
	23	
	24	
	25	
	26	
	27	
	28	

29	
30	
31	
Fortnightly Total	
Monthly Total	

Same tabular format shall apply for each month of the year.

Monthly Fuel consumption-January (m^3)	
Monthly Fuel consumption-February (m^3)	
Monthly Fuel consumption-March (m^3)	
Monthly Fuel consumption-April (m^3)	
Monthly Fuel consumption-May (m^3)	
Monthly Fuel consumption-June (m^3)	
Monthly Fuel consumption-July (m^3)	
Monthly Fuel consumption-August (m^3)	
Monthly Fuel consumption-September (m^3)	
Monthly Fuel consumption-October (m^3)	
Monthly Fuel consumption-November (m^3)	
Monthly Fuel consumption-December (m^3)	
Annual Fuel Consumption (m^3)	

b) $NCV_{f,y}$

	Frequency	Fortnightly
	Source	Fuel Supplier(s)/ Transporter(s).
	Data Unit	GJ
	January	
	1 First Fortnight	
	2 Second Fortnight	
	Total for the month	
	February	
	1 First Fortnight	
	2 Second Fortnight	
	Total for the month	
	March	
	1 First Fortnight	
	2 Second Fortnight	
	Total for the month	
	April	
	1 First Fortnight	
	2 Second Fortnight	
	Total for the month	
	May	
	1 First Fortnight	
	2 Second Fortnight	
	Total for the month	
	June	
	1 First Fortnight	
	2 Second Fortnight	
	Total for the month	
	July	
	1 First Fortnight	
	2 Second Fortnight	
	Total for the month	
	August	
	1 First Fortnight	
	2 Second Fortnight	
	Total for the month	
	September	
	1 First Fortnight	
	2 Second Fortnight	
	Total for the month	

	October	
	1 First Fortnight	
	2 Second Fortnight	
	Total for the month	
	November	
	1 First Fortnight	
	2 Second Fortnight	
	Total for the month	
	December	
	1 First Fortnight	
	2 Second Fortnight	
	Total for the month	
	Total for the year (in GJ)	
	Total for the year (in GJ/m^3)	

C. EG_{PJy}

	Frequency	Monthly
	Source	Electricity Meter
	Data Unit	MWh
	Months	
	January	
	February	
	March	
	April	
	May	
	June	
	July	
	August	
	September	
	October	
	November	
	December	
	Total (in MWh)	
	Total (in GWh)	

D. LNG consumption ($FC_{LNG,Y}$) (For CO_2 emissions from LNG)

	Frequency	Daily
	Source	Fuel Suppliers
	Data Unit	m^3
	Day	
	1	
	2	

	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
	11	
	12	
	13	
	14	
	15	
	Fortnightly total	
	16	
	17	
	18	
	19	
	20	
	21	
	22	
	23	
	24	
	25	
	26	
	27	
	28	
	29	
	30	
	31	
	Fortnightly Total	
	Monthly Total	

Same tabular format shall apply for each month of the year.

	Monthly LNG consumption-January (m^3)	
	Monthly LNG consumption-February (m^3)	
	Monthly LNG consumption-March (m^3)	
	Monthly LNG consumption-April (m^3)	
	Monthly LNG consumption-May (m^3)	
	Monthly LNG consumption-June (m^3)	
	Monthly LNG consumption-July (m^3)	
	Monthly LNG consumption-August (m^3)	
	Monthly LNG consumption-September (m^3)	
	Monthly LNG consumption-October (m^3)	
	Monthly LNG consumption-November (m^3)	
	Monthly LNG consumption-December (m^3)	
	Annual LNG Consumption (m^3)	

Annual Data.

	Parameter	**Data Unit**	**Value**	**Data Source.**
	A. Project Activity			
	$OXID_f$	Number	1	IPCC current default value
	$EF_{(CO2,f,y)}$	t CO_2/GJ		@
	B. Leakages			
	$FC_{(F,y)}$	m^3	{From (a) of Data Entry System}	----------
	$NCV_{(y)}$	GJ/m^3	{From (b) of Data Entry System}	----------

	$EF_{(NG,upstream,CH4)}$	t CH_4/GJ	0.00016	Table L.1 of Annex 3 to PDD
	$EG_{(PJ,Y)}$	GWh	{From (c) of Data Entry System}	----------
	$EF_{BL, upstream, CH4}$	t CH_4/ MWh	**0.000647141**	Table L.1 of Annex 3 to PDD
	$GWP_{(CH4)}$	Number	21	"U.S Greenhouse Gas Inventory Program, Office of Atmospheric Programs, U.S Environmental Protection Agency."
	$EF_{co2, upstream,LNG}$	t CO_2 /TJ	6	Default value of AM0029.
	FC ($_{LNG,y}$) (For CO_2 emissions from LNG)	m^3	{From (d) of Data Entry System}	----------
	C. Baseline Emissions			
	$EF_{BL, CO2, y}$	t CO_2/ GWh		@

@ to be entered at the time of entering the values

2A) Data Calculation Screen:

Parameter	Data Unit	Formula	Value
$COEF_{(f,y)}$	tCO_2/m^3	NCV_{fy} * $EF_{(CO2,f,y)}$ * $OXID_{(f)}$ =	
$LE_{(CH4,y)}$	tCO_2e	[$FC_{(f,y)}$ * $NCV_{(f,y)}$ * $EF_{(NG,upstream,CH4}$ - $EG_{(PJ,Y)}$ * $EF_{BL, upstream, CH4}$]* GWP_{CH4}	
$LE_{(LNG, CO2,y)}$	tCO_2e	$FC_{(,y)}$ (For CO_2 emissions from LNG)* $EF_{(co2,upstream,LNG)}$	

2B) Data Calculation Screen:

Parameter	Data Unit	Formula	Value
$BE_{(y)}$	**tCO_2e**	$EG_{(PJ,y)}$ * $EF_{(BL,CO2,y)}$	
$PE_{(y)}$	**tCO_2e**	$FC_{(f,y)}$ * $COEF_{(f,y)}$	
$LE_{(y)}$	**tCO_2e**	$LE_{(CH4,y)}$ + $LE_{(LNG, CO2,y)}$	
$ER_{(y)}$	**tCO_2e**	$BE_{(y)}$ - $PE_{(y)}$ - $LE_{(y)}$	

The data entry screens and data calculation screens will be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, which ever occurs latter.

7. Organizational structures & procedures during project implementation

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

Data handling protocol

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

Training protocol

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

Calibration and maintenance protocol

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

Data review protocol

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

Appendix-1 Fuel Availability

(A) The fuel availability in India is determined based on various sources of information which is as follows:-

Domestic:

- Under the new exploration and licensing policy, potential gas blocks are bid out and the selected bidders are permitted to market gas finds at market determined prices. The recent gas finds under this policy and other significant sources available for sourcing NG include the following:

a) **Reliance Industries Ltd.**

- 400 billion m^3 gas reserve in the Krishna-Godavari basin by Reliance Industries Limited, which is expected to supply around 40 MMSCMD of gas from middle / end, 2008. Further, at an oil conference in London, a top official of Reliance Industries has claimed that natural gas reserve in KG basin could be more than 50tcf ("Reserves and technical resources put together could exceed 1.4 trillion m^3 – Atul Chandra, Head of Reliance International Operations). Reliance Industries Limited is planning to enhance the proposed production and supply from approx 40 million m^3 per day to 80 million m^3 per day.[28]
- Reliance Industries, ONGC and Great Eastern Energy Corporation Limited have established 175 billion m^3 of Coal Bed Methane over 4 Blocks. 2 among these blocks are in Madhya

[28] http://www.teluguportal.net/modules/news/artical.php?storyid=3956

www.siliconindia.com/shownews/33248

http://www.thehindubusinessline.com/2003/11/22/stories/2003112202500200.htm

Pradesh, the neighbour state of Gujarat, where the project activity is located. This is expected to yield a supply of approx 10 million m^3 per day[29]

b) **Gujarat State Petroleum Corporation Limited**

- Gas Reserve of more than 550 billion m^3 reportedly discovered by the Gujarat State Petroleum Corporation Limited in the Krishna-Godavari fields, whose supply of approx. 40 million m^3 per day is expected from 2009 / 2010[30].

c) **Panna-Mukta-Tapti gas fields**

- Additional production is expected from Panna-Mukta-Tapti gas fields to the extent of 5.0 million m^3 per day by post-monsoon of 2007[31].

d) **Rajasthan by Focus Energy Ltd**

- 170 billion m^3 gas discovery is in Rajasthan by Focus Energy Ltd., which is billed as one of the largest ever land gas finds in recent times. This is expected to yield a supply of approx 10 million m^3 per day[32] .

Imports

a) **Petronet LNG Limited**

- Petronet LNG Ltd (PLL) is expanding its current capacity of 5.0 million metric tons per annum regasification capacity (approx 20 million m^3 per day) to 12.5 million metric tons per annum (approx 50 million m^3 per day), which is expected to be commissioned by end 2008. PLL is also setting up a facility for receiving and re-gasifying 2.5 million metric tons per annum (approx 10 million m^3 per day) of LNG in Cochin. PLL has signed a fuel supply

[29] http://www.indlawnews.com/a5b2375c7ae191c06f1a6dc25b020826

[30] http:/www.gujaratpetro.com/operationalgspc.htm

[31] Business Line News dated 6th September,2006 (www.businessline.com)

agreement with Rasgas of Qatar for supply of 7.5 million tons per annum (approx 30 MMSCMD) for a period of 25 years. PLL is in negotiation with various parties including Rasgas of Qatar for sourcing additional 7.5 million tons per annum of LNG (approx 30 million m^3 per day) for the aforementioned new projects as well as expansion. Indian Oil Companies have contracted with Iran for supply of 5.0 million metric tons per annum (approx 20 million m^3 per day) of LNG from December, 2009, which may also be re-gasified in PLL's facilities[33].

b) **Hazira LNG Ltd. (Promoted by Shell Ltd.)**

- Hazira LNG Ltd. (HLL) promoted by Shell and currently owned by Shell and Total has a regasification capacity of 2.5 million metric tons per annum (approx. 10 million m^3 per day) at Hazira. HLL has plans of increasing this capacity to 10.0 million tons per annum (approx. 40 million m^3 per day), depending upon demand in India. The capacity utilization in this terminal is currently reported to be low as users are not willing to pay the market price applicable globally[34].

c) **Gujarat State Petroleum Corporation Limited (GSPCL)**

---

[32] http://economictimes.indiatimes.com/articleshow/1612228.cms

[33] Annual Report Petronet LNG Limited – www.petronetlng.com

http://inhome.rediff.com/money/2003/oct/11spec1.htm

http://www.thehindubusinessline.com/2005/07/26/stories/2005072600070300.htm

Http://www.indiaembassy.gov.qa/ibr99/ibr-aug99.html

[34] http://sify.com/finance/fullstory.php?id=14339198

http://www.thehindubusinessline.com/2005/04/22/stories/2005042202690300.htm

www.energyintel.com

- Gujarat State Petroleum Corporation Ltd is proposing to set up a 5 million metric tons per annum (approx 20 million m^3 per day) LNG Regasification Terminal at pipavav in Gujarat[35].

d) Dabhol LNG

- Dabhol LNG with a regasification capacity of 5 million metric tons per annum (approx. 20 million m^3 per day) is expected to be commissioned by middle of 2008. Due diligence exercise is underway to disinvest this regasification terminal. Among the many interested, **PLL** is in the fore front[36].

e) Other Imports

- Imports through pipelines from Iran, Kazakhstan and Myanmar of approx over 130 million m^3 per day are also under consideration.

(Sourcing of gas through LNG or piped imports would not be difficult as India is advantageously located amongst countries rich in gas reserves. viz. Qatar, Iran, Myanmar, Malaysia, Indonesia, Australia and CIS States).

[B] According to another source (Gail/Infraline: Natural Gas in India 2006 – a reference book, http://naturalgas.infraline.com/) the likely availability of natural gas from various sources in India is as follows:

Summary of Gas Availability (million m^3 per day**):**

Source	**Immediate**	**Medium Term (2007-09)**	**Long Term (2010-2011)**
ONGC	51	50	30
OIL (Raj.+NE)	4	5	5
Sub Total	55	55	35
JV producers	17	53	59
LNG sources	18	30	36
Iran LNG	--	--	18
Transnational pipelines* :	--	--	148

[35] http://www.thehindubusinessline.com/2006/10/13/stories/2006101304400200.htm

[36] http://sify.com/finance/fullstory.php?id=14339198

Iran and Myanmar			
Other LNG sources*: Adgas, Petronas, Qatar. Australia	--	--	18
Total	90	138	314

Source: DGH/OIL/LTGP 2K

*Expected

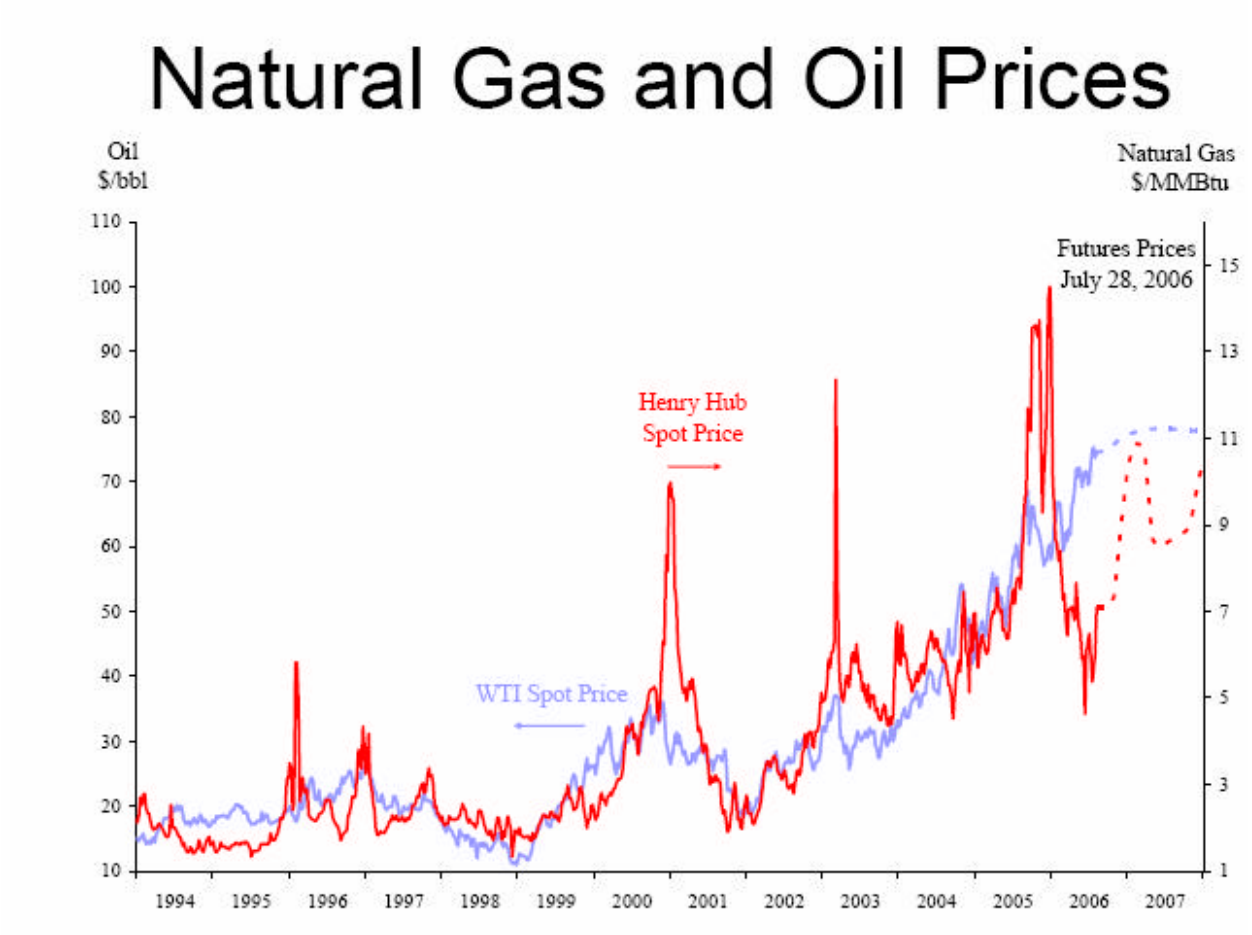
Since the gas availability from international sources is long term in nature, therefore it is envisaged that the total gas availability in the country by 2010-11 could be in the range of 250-314 million m^3 per day

To sum up,

(a) India currently has gas sales of about 90 million m^3 per day. Additional supplies to the tune of approximately 250 million m^3 per day are expected by 2010/11, which means that the overall supplies are expected to grow four fold. The expected additional supplies of around 250 million m^3 per day during the first three/four years of the crediting period of the project activity can support approx 60000 MW of power generation.

(b) Most of the current gas sold in India is currently in or from the Western Region, in which the project activity is located. The Bombay High Gas production, Cairn Gas, Niko Gas and the regasification terminals of Petronet, Shell Hazira and Dabhol are all located in the Western region. The major sources of Natural gas viz Qatar and Iran are also to the West of India. A good part of the Krishna Godavari Gas of approx 120 million m^3 per day is expected to be brought to the Western region and in particular Gujarat (where the project activity is located) through the grand East West pipeline of more than 1400 km in length. All the regasification terminals in the Western Region are connected or proposed to be connected to the trunk lines of Gail (Dahej-Uran pipeline, HVJ pipeline) and GSPL (Mora Sajod pipeline, which is being extended on both the North and South sides). Therefore in the future also a major part of the additional supplies of natural gas is expected to be available in the Western Region of India. Therefore projects comparable in size to the project activity shall not be constrained by natural gas availability in the baseline grid

Appendix-2



Source: North American Natural Gas Markets,
by Stephen Brown
Federal Reserve Bank of Dallas
Presentation to International Seminar on Natural Gas
Rio de Janeiro, Brazil - 31 Julho 2006
(http://iis-db.stanford.edu/evnts/4582/Brown_NorthAmericaNatGas.pdf)

Appendix-3

Environment Impact Assessment Report

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
Construction Phase						
Land	•Flooding during rainy season •Increase in soil erosion •Loss of trees and habitat •Sediment deposition •Interference with natural drainage pattern •Visual alteration of landscape	•Site clearing •Soil excavation •Mobilization of plant and heavy machinery •Construction of civil structures	•Making garland drain along plant boundary to collect storm water runoff will avoid flooding. •Proper compacting of backfill areas will reduce soil erosion. •Greenbelt and horticulture development will create natural habitat. •Adequate sloping of dumped earthworks and building materials will reduce wind losses and siltation of drains. •Restoring land surface consistent with existing contour conditions will not alter drainage pattern. •Using the excavated soil for greenbelt and horticulture and landscaping purpose will improve the general aesthetics of the landscape.	Long-term positive impact	•Torrent will ensure that all the mitigating measures are incorporated in the contract documents. Technical Department/EMU will check that all documented measures are effectively implemented by the contractor. •The supervision will be done daily.	EPC contractor, EMU/ Technical Department of Torrent will monitor and supervise.
Surface water	•Water pollution •Waterborne diseases •Siltation of water course	•Wastewater generated from domestic services and surface runoff	•Safe drinking water will be provided to workers. •Toilets will have septic tanks and soak pits. •Sedimentation pit will be made to collect the runoff water and it will be	Short-term, negative impact	•These clauses are already incorporated in GCC of EPC tender specifications. Torrent will ensure that all the mitigating measures are incorporated in the EPC contracts. •Technical Department/EMU of Torrent will ensure the quality of drinking water as per contract	EPC contractor, EMU of Torrent will monitor and supervise.

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
			reused for dust suppression.		document.	
Air quality	• Dust nuisance from site due to vehicular movement and windborne surface dust	• Vehicular movement, haulage of building materials and earthworks	•Water sprinkling will be done for dust suppression. •Service road will be suitably stabilized for smooth traffic flow. •Road surface will be cleaned regularly. •Vehicle wheels will be cleaned to dislodge soil prior to entering the public utility road. •Air around the site will be monitored regularly to ensure compliance with ambient air quality standard.	Short-term, negative impact	•Torrent will ensure that all the mitigating measures are incorporated in the EPC contracts. Technical Department /EMU of Torrent will also check the efficacy of water sprinkling measures adopted by the contractor and will ensure that the public roads are not soiled. •By appointing approved lab, the ambient air quality will be monitored at three locations (120^{o} to each other) at the plant boundary. Level of particulate matter, SO2 and NO2 in air will be measured twice a week.	EPC contractor, EMU of Torrent will monitor and supervise.
Solid waste	• Soil contamination and degradation	• In appropriate waste disposal	• Empty cement bags will be sold for reuse. •Spent oil will be given to registered recyclers for reprocessing.	Long-term, negative impacts	• Torrent will ensure that all the mitigating measures are conveyed in the contract documents.	EPC contractor, EMU of Torrent will monitor and supervise.

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
Noise	• Nuisance to surrounding population due to increased noise level	•Vehicular movement, construction machinery, piling work	• Major construction activity will be done only during daytime. •Vehicular movement during night time will be avoided. •Earplugs will be provided to workers exposed to high noise level.	Short-term, negative impact	•Torrent will ensure that all the mitigating measures are conveyed in the contract documents. •By appointing an approved lab, the noise quality will be monitored at three locations (120^{o} to each other) at the plant boundary. Noise level (in dB [A] Leq.) will be measured for day and night time twice a week.	EPC contractor, EMU of Torrent will monitor and supervise.
Socio-economic and cultural environment	•Direct job creation for about 500 people during construction period •Indirect economic development due to market multiplier effect •Creation of infrastructure facilities •Immigration of outside labour force	•Deployment of construction workers •Development of infrastructure facilities like roads and residential quarters •Deployment of contract vehicles	•Locals will be deployed during construction to the extent the same are available in line with requirement of skill. •Effective public relations strategy will be maintained and the locals will be allowed to use the developed infrastructure facility. There will be regular interaction with locals to solve their problems.	Long-term, positive impact	•Torrent will ensure that locals are deployed during the construction phase. • Torrent will interact with the local population.	EPC contractor, PRO of Torrent will monitor and supervise.

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
	• Friction between workers and local Population •Development of squatter slums. •Stress on natural resources like wood, water, sanitation • Inducement of traffic Congestion and road safety hazards.					
Operation Phase						

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
Water drawn from Tapi River	• Stress on existing users of river water	• Plant operation (cooling, service water and steam generation)	Historical water balance of the river is positive. Sufficient water is always available in the river and will continue even after allocating water to the project activity.	Negligible impact	•EMD of TORRENT will monitor water availability in Tapi River on monthly basis. •It will also keep proper records of water availability and drawn.	EMD of TORRENT
Surface water quality	• Discharge of treated Wastewater into Dokhar nala, which ultimately joins Tapi River after traveling 6-7 kilometers.	• Boiler and cooling water blow down. •Demineralised water plant regeneration, filter backwash and other washing during plant operation.	Wastewater will be treated to conform to prescribed discharge standards and then discharged into Dokhar nala. •The assimilative capacity of the nala will be utilized to create negligible impact on Tapi River water quality. •Regular monitoring of water quality and quantity and ensuring compliance with prescribed discharge standard will be done.	Insignific ant impact on Tapi River water quality	• EMD of TORRENT will develop in-house facilities required to check wastewater quality. It will record the flow meter readings every day. •Wastewater quality readings from online instruments (acidity/alkalinity, conductivity, dissolved oxygen, and temperature) will be recorded every hour. The wastewater quality will be tested every day for oil, suspended solids, dissolved solids, residual chlorine and phosphate.	EMD of TORRENT

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
Ground water	• Rainwater harvesting structures and water reservoir will improve the quality and quantity of groundwater.	• No ground water will be used during construct ion or plant operation.	• Rooftop rainwater harvesting structure will be made. Seepage, if any, from reservoir will improve the quality and quantity of groundwater.	Long-term positive	• The EMD of TORRENT will test groundwater quality of Akhakhol village every year. Special attention will be given to parameters like oil, suspended solids, dissolved solids, residual chlorine and phosphate.	EMD of TORRENT
Air quality	• Air emissions in the form of oxides of nitrogen in excess of stipulated limits can cause problems to biological and physical environment	• Firing of Natural Gas (including LNG)	•NOx emissions from turbines will be limited to 50 parts per million. •Regular monitoring of air and ensuring compliance with emission standard will be done.	Insignific ant impact on existing ambient air quality	•On-line NOx monitors will be installed in each stack. •The monitors will be capable of giving continuous readings of NOx emissions, which will be recorded by the EMD. •The EMD will develop facilities for ambient air sampling and testing. The air quality will be monitored at three locations (120^{o} to each other) at the plant boundary. Levels of particulate matter, SO2 and NO2 in air will be measured twice a week.	EMD of TORRENT

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
Noise quality	•Increased noise generation due to operating turbines and compressors. •Increased traffic flow will add to existing noise level.	• Turbines , compressors	•Low noise turbines (85 decibel on the A scale) are selected for the plant. •Plant vehicles will be maintained and serviced at regular intervals.	Insignific ant impact	•The EMD will develop facilities for noise testing. The noise quality will be monitored at three locations (120^{o} to each other) at the plant boundary. Noise level will be measured for day and night time twice a week.	EMD of TORRENT
Solid waste	• Indiscriminate disposal of solid waste will create leaching and affect soil and groundwater quality.	• Water treatment plant sludge, spent oil, and lubricants	•Sludge from water treatment plant is not hazardous or toxic. •It will be dewatered in centrifuge and used as landfill material inside the premises. •Spent oil and lubricants will be collected in drums and given to authorized recyclers for reprocessing as per rules.	Insignific ant impact	• The EMD will keep proper records of solid waste generated from the water treatment plant. It will identify low-lying land inside the plant premises for disposal. It will also keep records of quantity of spent oil and lubricants generated from the plant, mode of storage and disposal details.	EMD of TORRENT

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
Biological environment	• There will be insignificant impact because there is no ecologically sensitive area, no forest cover, no national park, no wildlife sanctuaries, no sensitive or endangered species in and around the project area. • The Tapi River is impounded by two dams/weirs; upstream and downstream of Surat; hence aquatic diversity is poor.	• Plant operation	• 100% compliance with applicable discharge standards for air emissions and wastewater quality will be ensured.	Insignificant impact	• The EMD will keep a watch on the general conditions of surrounding flora. It will also obtain records of the crop yield of surrounding villages on yearly basis from the Taluka office.	EMD of TORRENT

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
Public health and safety	• Accident and damage to life and property due to handling flammable gas	• Natural Gas (including LNG) receipt and use in power generation.	•Fire fighting facility •Water reservoir, pumps, and hydrant network •On-site and off-site emergency plan •Active and passive accident control equipment and risk mitigation measures will be implemented.	Long-term negative	•The EMD of TORRENT will develop facilities for monitoring of wind speed and direction at the site. •The Safety Department of TORRENT will conduct mock drills every year to ensure efficacy of the risk mitigating measures.	Safety Department of TORRENT
Socio-economic and cultural environment	•Threat to traditional agriculture practices •Loss of livelihood for people dependent on agriculture •Pressure on resources from unplanned peripheral development •Increased access of outsiders disturbing traditional	• Project development and operation	•Peripheral development will occur due to population influx and increased business opportunities. •Community development plan will be introduced, which will encourage local entrepreneurship, provide employment to locals depending upon their skills. Training programs for developing self-sufficiency among the local youths will be organized. •Public relations strategy will encourage respect for local traditions and religious beliefs. •Community development schemes like tree planting, free health checkup and medicines, donating building materials and furniture for school building renovation. •Locally	Long-term, positive	•Public relations officer (PRO) of TORRENT will ensure that qualified locals are preferred for employment. •He will also interact with the local population and take appropriate steps to solve their problems. •He will implement the community development schemes in surrounding villages.	PRO of TORRENT

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
	beliefs and religion.		available services of farmers, plumbers, electricians, vehicle repair shops, shopkeepers and traders, hotels and eateries will be utilized to the maximum.			

EMD = environmental management department, EMU = environmental management unit, EPC = engineering, procurement, and construction, GCC = general conditions of contract; LNG = liquefied natural gas, NO2 = nitrogen dioxide, NOx = nitrogen oxides, PRO = public relations officer, SO2 = sulfur dioxide, TORRENT = Torrent Power Limited.

- - - - -