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

CONTENTS

SECTION A. General description of project activity

A.1 Title of the project activity:

"UNOSUGEN Natural gas based grid connected Combined cycle power generation project"

Version: - 05

Date: 27/12/2012

A.2. Description of the project activity:

The proposed project activity i.e. the natural gas (including LNG) fired power plant consists of one block of 382.5 MW. It is located at Kamrej taluka which is about 28 km northeast of Surat city in the state of Gujarat in India. The project activity falls in Scope Number 1; Sectoral Scope – Energy Industries (renewable - / non-renewable sources).

(1) Purpose of the Project Activity

There has been continual addition in the power generation capacity in India. However, the demand has increased even faster, thus continuously outstripping the availability of power in the country. This has resulted in substantial energy and peak shortages. Due to such deficit of electricity supply in the country and especially in the NEWNE Grid of India, Torrent Power Limited (TPL) proceeded to set up a grid connected power generation project (comprising one block of 382.5 MW).

a) The scenario existing prior to the start of the implementation of the project activity

The project activity is a new grid connected power generation plant based on natural gas (including LNG).

b) The project scenario, including a summary of the scope of activities/measures that are being implemented within the project activity

The proposed project activity is a natural gas (including LNG) fired power plant consisting of one block of 382.5 MW based on combined cycle technology with single shaft configuration. A block consists of –

- Advance class (F Class) gas turbine (SGT5 4000F) with several advanced technologies namely:
  - Special metallurgy of vanes and blades
  - Fuel Burners of special advanced design
  - A special hydraulically controlled axial positioning device for axially positioning the gas turbine rotor
- Matching triple pressure Heat Recovery Steam Generator (HRSG)
- Steam Turbine and Generator

Due to the above features including the transfer of advanced class power generation technology and the usage of only clean and less carbon intensive fuel i.e. natural gas (including LNG) in the power plant, the project activity causes use of an environmentally safe and sound technology which would control GHG emissions as well as mitigate to a great extent regulated emissions such as SPM, NOx and SO_2 from power generation.

The plant will predominantly operate in base load mode. The generator's electrical output is at 20 kV. The evacuation to grid will be at 400 kV switch-yard of the project activity. The auxiliary consumption for the plant is estimated to be around 3%. The detailed description of the technology employed by the project activity is given under section A.4.3.

c) The scenario, as identified in section "B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario"

The baseline scenario as identified in section B.4 is that of domestic coal fired power plant *using sub critical technology.* The details on technology, efficiency, operating lifetime for this identified baseline scenario have been given under Section A.4.3 and Section B.4.

As the coal based power plant emits higher amount of greenhouse gases (GHG), the project activity, in comparison with such coal based plant, would control GHG emissions thus, leading to substantial reductions in GHG emissions due to the use of a less carbon intensive fuel and a much higher efficient power generation plant.

(2) How the project activity reduces greenhouse gas emissions

The emissions sources and the GHG involved in the project activity, according to the methodology used i.e. AM0029 are:

	Source	Gas	Included?	Justification / Explanation
Baseline	Power Generation in the Build Margin in the NEWNE Grid (baseline)	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.
Project Activity	On-site natural gas combustion in the Block	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 is not included within the project boundary and is covered under leakage calculations

As per the baseline scenario analysis described under section B.4 domestic coal fired power plant *using sub critical technology* is the most economical and feasible alternative. As the coal based power plant emits higher amount of greenhouse gases (GHG), the project activity, in comparison with such coal based plant, would control GHG emission thus, would lead to substantial reductions (average 1,270,597 tCO2 per year) in GHG emissions due to the use of a less carbon intensive fuel and a much higher efficient power generation plant.

(3) 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 in its interim guidelines for CDM projects the indicators of Social well being, Economic well being, Environmental well being and Technological

well being for the assessment of the sustainable development benefits[1]. In brief, the project activity fulfils these indicators as follows:

Social Well Being:

- The power plant contributes to empowerment and poverty alleviation of the vulnerable sections of the society i.e. the scheduled caste and scheduled tribes by providing direct and indirect employment opportunities for such section of society. Also, it promotes local skills, local entrepreneurship and community development.

- Increased availability of electrical energy will in the long run reduce the dependence on less efficient and more polluting energy sources (e.g. use of lanterns for lighting, burning of coal / wood for heating etc.) for domestic consumption. This improves the health of women in particular through reduction of indoor air pollution.

- 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.

Environmental Well Being:

- Usage of coal for power generation is not constrained by law but its use is rather encouraged by the government policies in view of its availability. The project activity by the adoption of combined cycle, an efficient technology as well as natural gas (including LNG) 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. The dry low NOx type burner used in project activity reduces not only the NOx emissions but also water consumption.

- Development and maintenance of greenbelt and greenery development on a good part of the land within the plant boundary will not only provide a barrier between the plant and the surrounding areas, but will 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. Moreover, the project activity would neither lay stress on existing users of river water nor would have any negative impact on the surrounding flora and fauna.

Economic well being:

- Reduction of the energy shortages in the NEWNE Grid will inter-alia improves the productivity of industry, agriculture and commercial activities that is currently suffering from frequent power cuts and thereby enhancing the economic growth.

- Encourages developments in the local economy.

Technology well being:

- The combined cycle gas turbine applied is highly efficient (i.e. High temperature F class gas turbine having 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.

[1] http://moef.nic.in/modules/about-the-ministry/CCD/cdm_iac.html (Copy of document is provided to DOE)

- Further the project activity has many features which increases the fuel efficiency (for details refer to section A.2 and A.4.3).

  Torrent Power Limited (TPL) is committed to spend at least 2% of CER revenue towards society / community development activities of local areas. The detail action plan is mentioned in Appendix-5.

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)	Private Entity: M/s Torrent Power Limited	No

- M/s Torrent Power Limited (TPL) shall be the lead and nodal entity for all communication with CDM – Executive Board and Secretariat. The contact information has been provided in Annex 1. This project activity has been developed as a CDM project and may 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:

- 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 constructed and operated is in Kamrej taluka, which is about 28 km northeast of Surat city in the state of Gujarat in India. The project site is located approximately at 72°59'26.125"E longitude and 21°20'25.995"N latitude. The approximate location of the site is shown below.

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:

- **Purpose of the Project Activity**

Despite significant efforts to augment the power generation base, India is still perennially short of electric power. The demand for power has been continuously outstripping the availability of power in the country, which has resulted in substantial energy and peak shortages. During 01/04/2009 to 31/03/2010 the average energy shortage in the country and in the NEWNE Grid was around 10% and 12% respectively while the average peak shortage was around 13% and 14% respectively[2]. Due to such deficit of electricity supply in the country and especially in the NEWNE Grid of India, Torrent Power Limited (TPL) proceeded to set up a grid connected power generation project (comprising one block of 382.5 MW). The plant is based on

[2] http://www.cea.nic.in/reports/yearly/annual_rep/2009-10/ar_09_10.pdf (page no. 157) (Copy of document is provided to DOE)

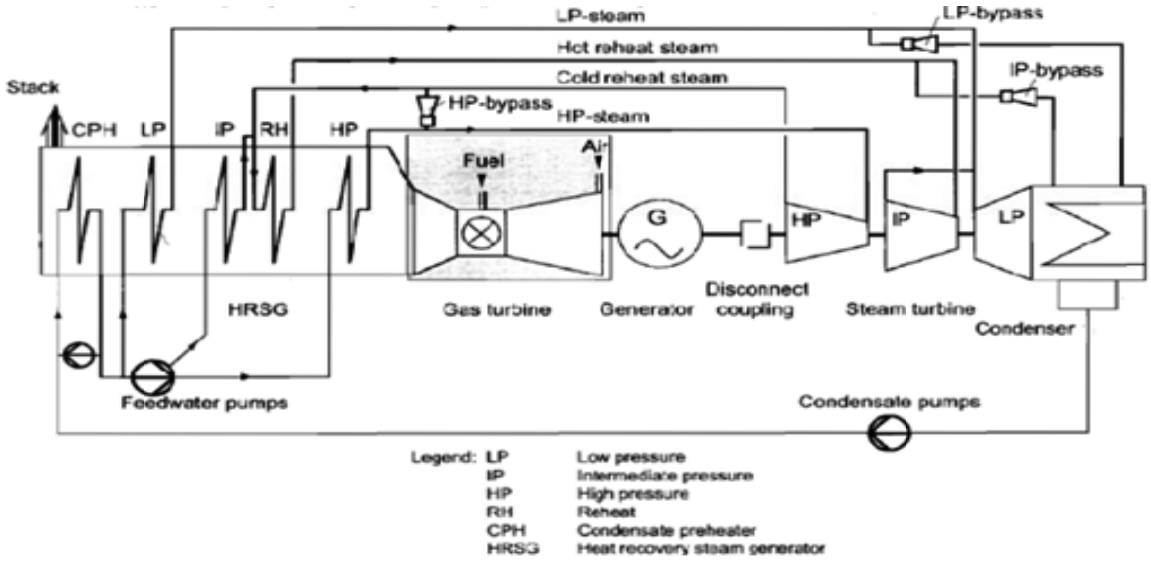
efficient combined cycle technology as described earlier and can use natural gas or Re-gasified Liquefied Natural Gas (LNG) as fuel.

a) The scenario existing prior to the start of the implementation of the project activity

The project activity is a new grid connected power generation plant based on natural gas (including LNG). However, the scenario existing prior to the start of the implementation of the project activity in the grid is the continuation of power generation by existing or proposed new power plants connected to the NEWNE Grid based on existing fuel mix.

b) The scope of activities/measures that are being implemented within the project activity

- The project activity is based on the combined cycle technology where it utilizes a combination of gas turbine (GT) and steam turbine (ST) for generating electricity. The project activity uses the single shaft configuration in which both GT and ST drive a common Generator. The gas turbine assembly comprises an air compressor, a combustor and a turbine. The ambient air after being compressed in the air compressor is mixed with the fuel in the combustor and fired. The energy from the hot gases generated by the combustion of the fuel drives the gas turbine. The rotating turbine drives an electric generator which generates electrical energy. The hot gases leaving the gas turbine are directed to a Heat Recovery Steam Generator (HRSG) where their energy is used to generate steam at three pressure levels. Hot gases then leave the HRSG to the atmosphere through a stack. The steam produced in HRSG is introduced into the steam turbine for driving the electrical generator which will also simultaneously be driven by the GT for electricity generation. The steam exhausted from the steam turbine is condensed in a condenser using cooling water. The condensate is pumped back to the HRSG thus completing the steam and water cycle. The following is the schematic diagram of the CCPP with single shaft configuration as employed by the project activity:



Combined cycle power plants are highly efficient. As they combine a gas powered turbine with a steam turbine, the energy produced by fuel combustion is extracted twice, thus there is comparatively lower fuel consumption. Another advantage of these power plants is that the natural gas they run on is less carbon-dioxide intense than other fossil fuels. Hence there is higher environmental value.

- The proposed project activity i.e. the natural gas (including LNG) fired power plant consists of one block of 382.5 MW. A block consists of advance class (F Class) gas turbine (SGT5 4000F), matching triple pressure

heat recovery steam generator, Steam Turbine and Generator. The following are the main equipments and systems that will be installed within the project activity:

Gas Turbine Assembly (GT)
The Gas Turbine assembly would consist of a multistage compressor and a gas turbine. The following is a brief description of major components of Gas Turbine Assembly.

Compressor Section
The compressor would be of a multiple stage axial type design with modulating inlet guide vanes. The compressor shall have the provision of inter stage air extraction which would be used for cooling and sealing air for turbine nozzles, blades, vanes, wheel spaces and bearings, and for surge control during start-up. The aerofoil shaped compressor rotor blades are designed to compress air efficiently at high blade tip velocities. The air compressed by Compressor shall enter into the gas turbine section for firing.

Gas-Turbine Section
Each gas turbine shall be complete with integral compressor, turning gear, fuel gas conditioning, regulation and supply system for efficient and reliable firing of Natural Gas (NG), RLNG, commingled fuel gas comprising a random mix of NG and RLNG and also capable of efficient and reliable firing of lean gas. The gas turbine section shall have combustors with natural gas firing capability. The combustion of air and fuel mixture shall take place in the combustors and the hot pressurized combustion gas produced would be converted to mechanical energy, by expansion in the gas turbine. The gas turbine would drive on one end the electric generator and on the other end the axial flow air compressor. The gas turbine generator would have its own starting system, which would either use the generator as the starting motor by supplying it with a variable frequency power supply. The generator would be provided with associated lubrication oil system complete with lube oil pumps, lube oil reservoir, and lube oil coolers.

Heat Recovery Steam Generator (HRSG)
The HRSG shall be a horizontal flow, three-pressure, reheat type unit designed for operation with the selected combustion turbine. Exhaust gas from the Combustion Turbine will be routed to the HRSG through insulated ductwork, where it will pass through the super-heater, reheater, evaporator, and economizer sections of the HRSG where the thermal energy of the hot gas will be recovered to the maximum extent. After the usable heat has been extracted from the combustion turbine exhaust gas stream, it will then be discharged to the atmosphere through the HRSG exhaust stack. No simple cycle operation is envisaged and hence no bypass stack and associated dampers shall be provided. The HRSG has several sections of tube banks that transfer the heat contained in the exhaust flow from the combustion turbine to the condensate water and feed-water to generate steam for the steam turbine. The steam thus produced in HRSG shall be routed to Steam turbine.

Steam Turbine
Steam from the HRSG would be supplied to a condensing type two cylinder reheat steam turbine through main steam piping. The steam turbine would be complete with lube oil and control oil system, jacking oil system, governing system, protection system, and gland sealing steam system. The steam entry to the turbine would be through a set of emergency stop and control valves, which would govern the speed/ load of the machine. High pressure (HP) and low pressure (LP) bypass systems of 100% HRSG capacity for dumping the HP and LP steam to the condenser during start up and turbine trip conditions would be provided. Since a single shaft configuration has been proposed for implementation of the Project, the steam turbine section shall be duly equipped with a synchro self shifting (SSS) clutch for coupling it with common electric generator.

Generator (Alternator) coupled to GT and ST

Hydrogen cooled electric generator of adequate rating complete with static excitation system, automatic voltage regulator, generator hydrogen gas system, seal oil system, lubricating oil system, online partial discharge detection system and other required auxiliaries and accessories shall be provided for the proposed Generation project. Gas Turbine and Steam Turbine would have a common Electric Generator coupled on the same shaft.

Condensing Equipment and Auxiliaries

The steam turbine would be provided with a surface type deaerating condenser fixed to the turbine exhaust for condensing the exhaust steam from the steam turbine. 2 x 100 %, (one working and one standby) mechanical vacuum pumps would be provided for evacuation of the steam air mixture from the condenser. 2 x 100 %, (one working and one standby) condensate extraction pumps (CEP) would be provided to pump the condensate from the condenser hot well into the deaerator through the condensate preheater of the HRSG.

Feed Water System

Normally deaeration of condensate takes place in the deaerating type condenser. Further, a constant pressure deaerator has been proposed for feed water heating and deaeration of the HRSG feed water during start ups and abnormal conditions. The deaerator would be equipped with a feed water storage tank. The deaerator would be located at a suitable elevation to provide the required net positive suction head for the feed water pumps. The deaerated feed water contained in the feed water storage tank would be supplied to the HRSG by interstage tap-off type HP - HRSG feed water pumps. The IP and LP feed water would be from the interstage tap off of the pump. The feed water flow to the HRSG would be regulated through feed water control valves.

Steam Cycle

Steam is generated at three pressure levels, namely high pressure (HP), Intermediate pressure (IP) and low pressure (LP) in the HRSG. While HP steam is admitted to the HP steam turbine through the HP stop and governor control valves, the reheat steam would be admitted to IP section of the IP/LP turbine through the interceptor stop and control valve. The LP steam would be injected to the LP section of the IP/LP turbine through the LP interceptor stop and control valves. The steam turbine would be a mixed pressure, reheat condensing type.

Chemical Dosing System

Phosphate and hydrazine dosing systems would be provided to ensure chemical conditioning of the water so as to prevent scale formation and to remove the dissolved oxygen present in the feed water. Phosphate solution would be added into the HRSG drum directly, while hydrazine would be injected into the feed water at the feed water pumps suction. Provision for dosing of hydrazine at the discharge of condensate extraction pumps will also be provided. Each system would be complete with solution preparation-cum-feed tanks, agitators I mixers, metering pumps, piping, valves and fittings.

Compressed Air System

Compressed air system for supplying instrument air, service air for the plant and pressuring air to isolated phase bus ducts of the Generators shall consist of dry type screw compressor units, air dryers with separate receiver, on line dew point measurement, interconnecting piping, etc.

Several efficiency increasing properties and advanced technologies incorporated in the project activity are described below:

- The Gas Turbines, SGT5-4000F (previously known as V94.3A) are "F" Class gas turbines that use several advanced technologies namely:

- Special metallurgy of Vanes and blades - capable of withstanding much higher Turbine Inlet Temperature (TIT around 1200 Celsius) of combusted gas at inlet to gas turbine as compared with those of "E" 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-.

- 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 (up to about 30-40% load) and then changing over to "pre-mix" mode. This reduces the NOx level right from start load instead of from 45% load. Also the efficiency of the gas turbine is 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/NM3) for loads greater than 70% and the Indian norm being 50ppm.

- 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. This device by minimizing the leakages of gas combustion products from gas turbine blade tips, improves the efficiency of the gas turbine..

- 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. Such configuration is equipped with Axial Flow Surface Condenser, which reduce the leaving losses of steam at the outlet of Steam Turbine (ST) and hence improves the efficiency of Combined Cycle Power Plant.

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 control GHG emissions as well as mitigate to a great extent regulated emissions such as SPM, NOx and SO_2 from power generation. 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.

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 average net calorific value of 8100 kCal/SCM[3] (0.03391308 Giga Joules/ SCM) and LNG is expected to have an average calorific value of 8981.82 kCal/SCM[4] (0.03759789Giga Joules/SCM)[5] .

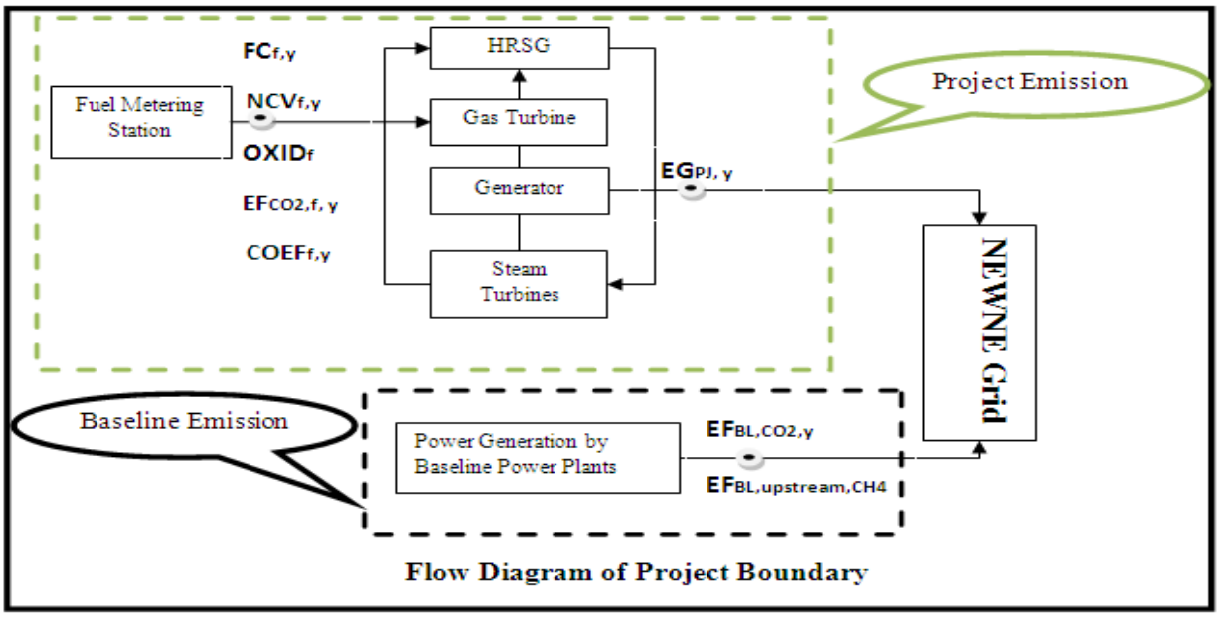
[3] A press note by The Indian Express dated 10/04/2009 titled "Govt allocates KG-D6 gas to power sector" having mention of NCV of domestic gas (Reliance KG-D6) as 8100 Kcal/SCM (Copy of document is provided to DOE)- http://www.indianexpress.com/news/govt-allocates-kgd6-gas-to-power-sector/445266/

[4] A Report on "Subsidies Discipline on Natural Resource Pricing" having mention of GCV of RLNG gas-9880 Kcal/SCM (page no. 72) (Copy of document provided to DOE) http://wtocentre.iift.ac.in/DOC/subsidies%20discipline%20final%20report-Natural%20resourse%20Pricing1.pdf

[5] http://www.unitconversion.org/energy/kilocalories-it-to-gigajoules-conversion.html (Copy of document is provided to DOE)

The plant will predominantly operate in base load mode. The generator's electrical output is at 20 kV. The evacuation to grid will be at 400 kV switch-yard of the project activity. The auxiliary consumption for the plant is estimated to be around 3%.

The monitoring equipments and their location in the system are given as under:



Flow Diagram of Project Boundary

1.	Main metering system and backup metering system for monitoring of electricity exported by the Project
2.	Flow Meter system to monitor the quantity of gas combusted at the gas suppliers' terminal at the project site and also checked before the usage at GT. The supplier terminal also measures continuous NCV of the gas being fed.

Installed Capacity	382.5 MW
Plant Efficiency (%)	57% (at 100% load) for "F" class gas turbines
Guaranteed Plant Availability Factor	93%[6]
Useful Lifetime of the equipments	25 years[7]
EPC Arrangements	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.

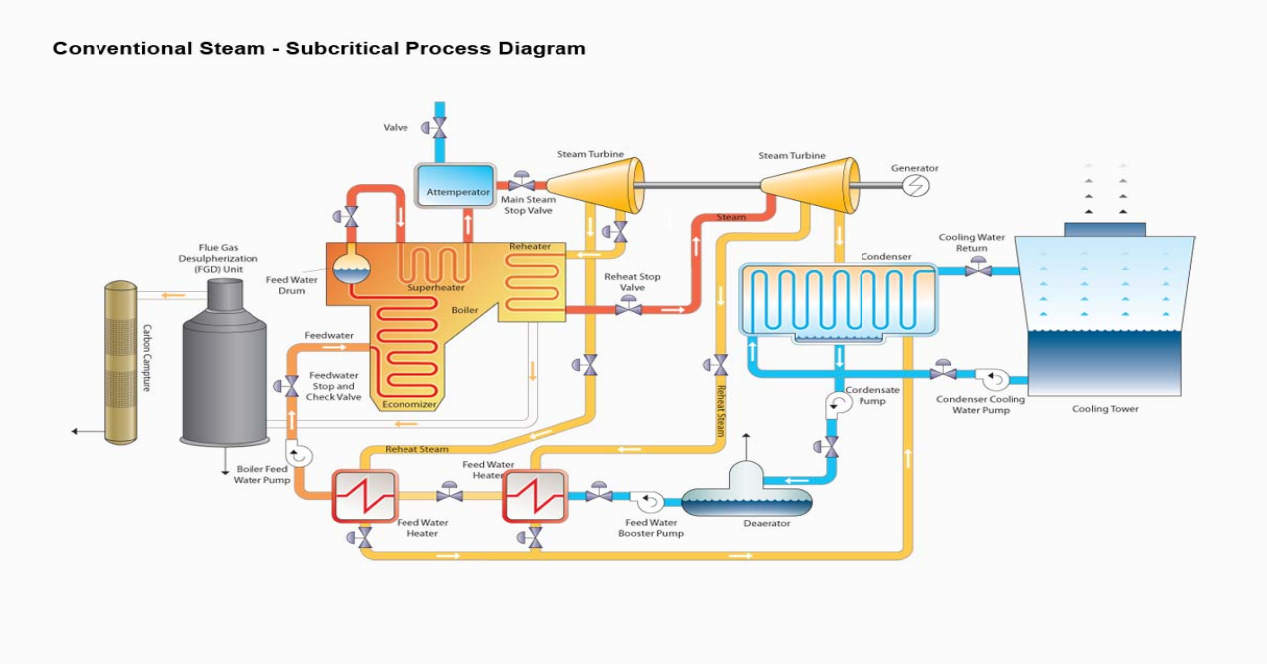
[6] As per EPC Contract (Copy of document is provided to DOE)

[7] CERC Tariff Regulations, 2009 (Page no. 9) (Copy of document is provided to DOE)

The emissions sources and the GHG involved in the project activity, according to the methodology used i.e. AM0029 are given in section B.3 of this PDD.

c) <u>The baseline scenario, as identified in section "B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario"</u>

The baseline scenario as identified in section B.4 is that of domestic coal fired power plant *using sub critical technology* as the levelized cost of production per unit is the lowest under this scenario (refer Investment Analysis). Below is the diagram of a coal based power plant using conventional (sub critical) technology:



Typical sub critical units use steam parameters ranging from 150 to 170 kg/cm^2 with various combinations of temperature between 535^{o}C to 565^{o}C[8]. The gross efficiency of these units is around 37%[9] depending on the design, operating parameters and coal type. Thus, in the absence of the project activity, the same type and level of services would have been provided through a domestic coal fired power plant with sub critical technology. The GHG emissions in the baseline scenario (i.e. power generation using coal as fuel with subcritical technology) would be higher.

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

Years	Annual estimation of emission reductions in tonnes of CO_2e
2013 (From 2nd April to 31st December)	953,818
2014	1,270,597

[8] CERC Tariff Regulations, 2009 (Page no. 46) (Copy of document is provided to DOE)

[9] Based on the Gross station heat rate of 2300 kCal/kWh as per CERC Tariff Regulations, 2009 (Page no. 46), the efficiency is calculated as 860 kCal/kWh / 2300 kCal/kWh (conversion factor of 1kWh = 860 kCal)

2015	1,270,597
2016	1,270,597
2017	1,270,597
2018	1,270,597
2019	1,270,597
2020	1,270,597
2021	1,270,597
2022	1,270,597
2023 (1st January to 1st April)	316,779
Total estimated reductions (tonnes of CO_2e)	**12,705,971**
Total number of crediting years	**10 years**
Annual average over the crediting period of estimated reductions (tonnes of CO2e)	1,270,597

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"
- **Reference:** AM0029 Version 03, EB 39; Sectoral Scope: 01, valid from 30/05/2008 onwards
- **Reference to other methodologies or tools:**
  - Version 06.1.0 of the "Tools for the demonstration and assessment of additionality", EB 69
  - Version 02.2.1 of the "Tool to calculate the emission factor for an electricity system", EB 63

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 382.5 MW (i.e. one block of 382.5MW) for electricity generation. • The Project activity will be connected to the NEWNE grid of India through LILO (Loop In Loop Out) of 400 kV D/C line at UNOSUGEN.
Main Condition No.2.	The geographical/ physical boundaries of the baseline grid can be clearly identified and information pertaining to the grid and estimating baseline emissions is publicly available.	• As the project activity is expected to supply power to NEWNE Grid, the same has been chosen as the Baseline Grid. The geographical scope of the NEWNE Grid comprises the following[10] ❖ Gujarat, Madhya Pradesh, Maharashtra, Goa and Chhattisgarh states and union territories of Daman & Diu and Dadra & Nagar Haveli in Western Region ❖ Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura in North Eastern Region

[10] CO2 Baseline Database published by Central Electricity Authority, January, 2012. http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm (Copy of document is provided to DOE)

Sr. No.	Requirements as per Baseline Methodology	Why applicable to this Project Activity
		❖ Bihar, Jharkhand, Orissa, West Bengal, Sikkim and Andaman Nicobar in Eastern Region and ❖ Chandigarh, Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab, Rajasthan, Uttar Pradesh and Uttarakhand in Northern Region. • 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), Power Grid Corporation of India Limited and its website (http://www.powergridindia.com), Central electricity regulatory commission (www.cercind.gov.in), etc. • Official information related to the baseline grid carbon emission factor is publicly available with CEA, Ministry of Power, Government of India Link- (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm). This information is compiled by CEA, Ministry of Power, Government of India.
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.	• The main producers of natural gas in India are Oil & Natural Gas Corporation Ltd. (ONGC), Reliance Industries Limited (RIL) and Gujarat State Petroleum Corporation (GSPC) *(Refer Appendix-1 A for details)*. Government has awarded around 200 blocks under New Exploration Licensing Policy (NELP). The domestic natural gas availability through conventional and unconventional sources (Shale gas, Coal Bed Methane, Gas Hydrates) by 2015/18 (i.e. within the first three/four years of the start of the crediting period of the project activity) is expected to be of average 543 mmscmd *(see Appendix-1 A)* against which the project activity will utilize around 1.6 mmscmd. Thus, around 340 times the capacity of the project activity could be fired with the above available domestic natural gas. • Further, the gas pipelines network with capacity of approx. 340 mmscmd are likely to

Sr. No.	Requirements as per Baseline Methodology	Why applicable to this Project Activity
		be added in the existing gas pipeline network of approx. 217 mmscmd operation by 2015-18 thus forming a National gas Grid with a very vast network length of around 24000 km which will effectively cover all the major consumption centres in the country *(see Appendix-1 A).* • Moreover, 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 imported gas are sold at market determined prices, availability of natural gas (including LNG) in India by 2015/18 (i.e. within the first three/to five years of the start of the crediting period of the project activity-generally the time required for the establishment of necessary gas supply infrastructure) is expected to be sufficient. The gas availability by 2015/18 is expected to be average of 543 mmscmd with additional supply of approx. 360 mmscmd which is capable of firing more than 200 times the capacity of the project activity (as indicated in *Appendix-1A* to this PDD). Also, gas import through transnational pipelines at market determined prices are envisaged. Further domestic gas availability is also expected to go up. This gas availability is further accentuated by the reach provided by existing and new gas pipelines which connect to all major sources. • At the time of initiation of real action on the project activity i.e. in July 2010, 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, comparable in size to the project activity, in choosing natural gas as fuel. For example ~2100 MW of gas based power generation

Sr. No.	Requirements as per Baseline Methodology	Why applicable to this Project Activity
		capacity has been successfully commissioned which indicates sufficient gas availability[11]. However, such capacity is under various stages of CDM registration. There are several examples[12] of sufficient availability of natural gas in the open market in Gujarat, in which state the project activity is located. Please also refer *Appendix 1-B* for LNG supply scenario at the time of start of project activity. • 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 the electricity generated using such infrastructure's natural gas (including LNG supplies). • The South Korean Government has approved two deals under which Kogas will import

[11] Central Electricity Authority of India Report "Monthly Report on Broad Status of Thermal Power Projects in the Country" dated June 2010 (page no. 5 & 6) (Copy of document is provided to DOE) () www.cea.nic.in/archives/thermal/bs/june10.pdf

[12] Petronet LNG Limited expanded the capacity of its Dahej terminal (on the western coast of Gujarat) to 10 mmtpa from 5 mmtpa in July 2009. The capacity of Shell's Hazira terminal was expanded from 2.5 mmtpa to 3.6 mmtpa in July, 2009. Thus, the additional regasification capacity of 6.1 mmtpa is capable of supporting the generation of additional ~5700 MW. Therefore, it can be said that around 15 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. (Source: Infraline and Indian Infrastructure Research).

Major, long-term LNG contracts for a total capacity of 48 Mtpa (capable of firing around 47000 MW of power generation) were signed during 2009-10: 1) China with Icon energy, BG, Shell and Exxon for total 10 Mtpa, 2) Japan with BG, EWC, Chevron,Sempra, Indon. Gov, Exxon and NWS for total 20 Mtpa, 3) Korea with Woodside and Chevron for total 5 Mtpa, 4) India with Qatargas for 4 Mtpa, 5) Taiwan with Exxon for 1.2 Mtpa, 6) Poland with Qatargas for 1 Mtpa, 7) Pakistan with GdF Suez for 4.25 Mtpa and 8) Malaysia with Santos for 3 Mtpa. (http://www.streamrgn.com/servlet/ContentServer?gnpage=3-140-0&centralassetname=3-140-Balance-2Trimestre2010&centralassettype=Balance) (Copy of document is provided to DOE)

Sr. No.	Requirements as per Baseline Methodology	Why applicable to this Project Activity
		5.64 million mt/year (approx. 21 mmscmd) of LNG from Shell and Total in the coming years.[13] Further, Qatar has commissioned its train no. 7 having capacity to produce 7.8 million tonnes per annum (approx. 30 mmscmd) of LNG.[14] The first cargo was en route to Hazira receiving terminal in India[15]. The above sourcing in India and in the East and West Asia (in the neighborhood of India) would be capable of firing more than 12000 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**). • At the time of start of the project activity, ~3329 MW gas based capacity was under construction and ~8387 MW gas based capacity had been planned to be commissioned by 2022. Such total capacity addition of ~11716 MW would require ~49 mmscmd of gas supply in future[16] against the availability of 543 mmscmd by 2015/18*(Refer Appendix-1 A for details)*. 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 the unaffordable prices of natural gas within Indian context.***

[13] http://www.platts.com/RSSFeedDetailedNews/RSSFeed/NaturalGas/8244844 (Copy of document is provided to DOE)

[14] http://www.qatargas.com/news.aspx?id=246702 (Copy of document is provided to DOE)

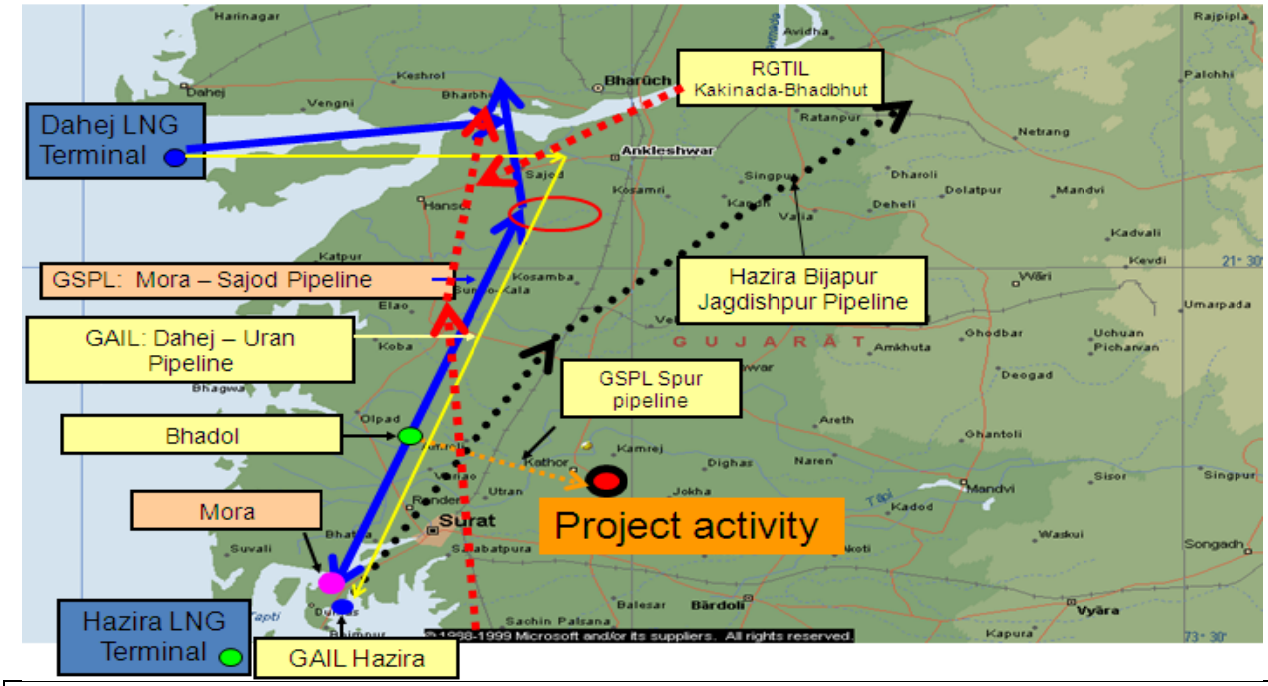
15 http://www.gulfoilandgas.com/webpro1/MAIN/Mainnews.asp?id=14314 and http://www.qatargas.com/Projects.aspx?id=78#top (Copy of document is provided to DOE)

[16] http://www.cea.nic.in and A Presentation by BHEL on Equipment Supply to Power Project - National Power Conference 2009 dated 04/12/2009 (Copy of document is provided to DOE)

Sr. No.	Requirements as per Baseline Methodology	Why applicable to this Project Activity
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 on energy basis.	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., 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.	• During the period 2013 (the beginning of the crediting period) to 2015-18 and thereafter (during the balance period of the crediting period) there are definite as well as highly probable new facilities and expansion plans which would be capable of supplying more than 500 million m^3 per day of natural gas, which can fire approx. 100000 MW of power generation (*Refer Appendix 1 A to this PDD*). • During the last few years (even during financial depression of 2009-10), the Natural Gas (including LNG) prices have been fluctuating which in fact indicates that prices have not become inelastic (*Refer Appendix 2 of this PDD*). • 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.

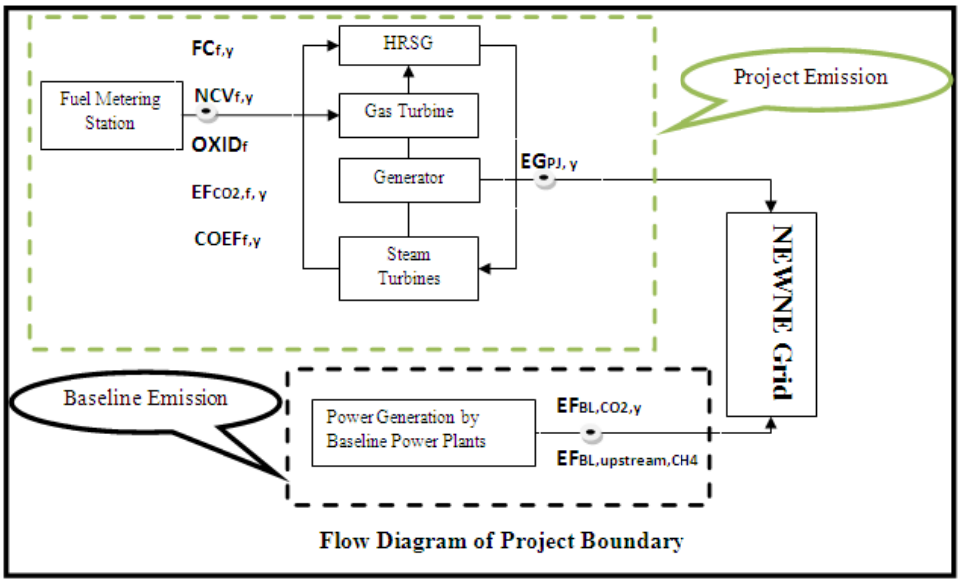
Fuel Gas Infrastructure:-

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 and all power plants connected physically to the baseline grid that the CDM project power plant is connected to.



Flow Diagram of Project Boundary

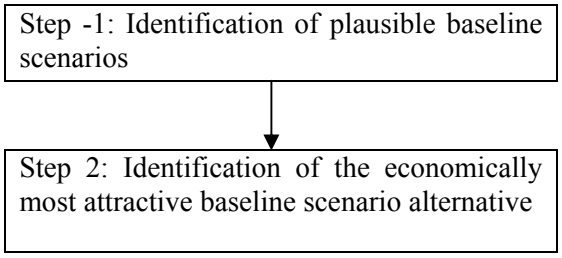
- The GHG emission sources applicable to this project activity that are within the project boundary are mentioned below.

	Source	Gas	Included?	Justification / Explanation
Baseline	Power Generation in the Build Margin in the NEWNE Grid (baseline 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 Block	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.

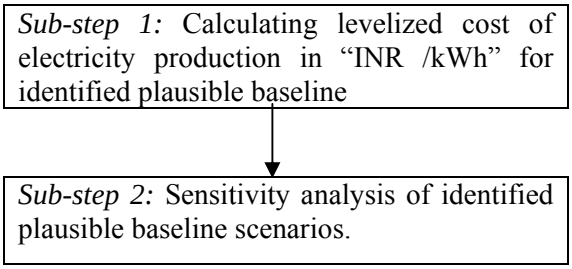
- Gas transportation facility is not included within the project boundary and is covered under leakage calculations.

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 AM0029 leads us to the following assessment at the start of the project activity.

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. 382.5 MW gas based CCPP with 57% efficiency[17] (at 100% load factor under standard operating conditions) and lifetime of 25 years[18]	Yes	Yes	Yes	Plausible baseline scenario
B) **Power generation using Natural Gas but technologies other than the project activity.** **(1)** 340 MW[19] gas based combined cycle power plant with 52% efficiency[20] (at 100% load factor under standard operating conditions) and lifetime of 25 years[21]	Yes	Yes	Yes	Plausible baseline scenario

[17] As per the EPC contract (Copy of document is provided to DOE)

[18] CERC Terms and Conditions Regulations 2009 (Page no. 9) (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Copy of document is provided to DOE)

[19] Hazira CCPP - PDD (UNFCCC Registration No. 2915) (Copy of document is provided to DOE)

[20] http://www.ge-energy.com/products_and_services/products/gas_turbines_heavy_duty/9e_heavy_duty_gas_turbine.jsp (Copy of document is provided to DOE)

[21] CERC Terms and Conditions Regulations 2009 (Page no. 9) (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Copy of document is provided to DOE)

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
(2) Open cycle Power generation plants using Natural Gas with efficiency 35% to 42%[22] and lifetime of 25 years[23].	Yes	Yes	No The scenario could cater to the base load demand but has lower system efficiency compared to the project activity. Further, as per 11th Plan (2007-12) of power generation capacity addition in India, no such power plants are recently constructed or are under construction or are being planned (http://www.cea.nic.in/archives/plg/monitor_11plan/oct09.pdf). Based on the above, the scenario is not realistic and credible.	Not a plausible baseline scenario
C) Power generation technologies using energy sources other than Natural gas (1) Wind source (153 Nos. 2.5 MW wind turbines[24] with a life of 25[25] years)	No • Wind based power generation cannot deliver base load power throughout the	Yes	No • Wind flow is not available throughout the year	Not a plausible baseline scenario.

[22] http://en.wikipedia.org/wiki/Combined_cycle (Copy of document is provided to DOE)

[23] CERC Terms and Conditions Regulations 2009 (Page no. 9) (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Copy of document is provided to DOE)

[24] Ministry of New and Renewable Energy of India Annual Report 2010-11 (page no. 3) (Copy of document is provided to DOE)

[25] http://cercind.gov.in/Regulations/Amend_Renewable_Energy_tariff.pdf (Page no. 5) (Copy of document is provided to DOE)

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
	year. The same is also considered by Electricity Regulatory Commission of India (Central and Gujarat State) for providing lower Capacity Utilisation Factor for determination of tariff for power generated based on wind (i.e. 23% and 30% respectively capacity factor on an average)[26&27]		and it is very difficult to predict. Hence, the Power generated based on wind is considered as Non-Firm Power (i.e. unpredictable) and such situation leads to very low and uncertain capacity utilisation factor for wind based power generation[28] • Also wind based generation is possible only in a few places with wind potential[29]. • Due to low and unpredictable capacity factor, wind based power is not a realistic and credible baseline scenario.	
(2) Solar thermal parabolic[30] through power plant with a life of 25[31] years	No • Cannot provide base load power throughout the day and / or year on continuous basis • Solar thermal power	Yes	No • Solar energy not available throughout the year. • Cannot provide the quantum of power	Not a plausible baseline scenario

[26] CERC (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2009 dated 16/09/2009 (Page no. 22) (Copy of document is provided to DOE)

[27] http://www.gercin.org/renewablepdf/en_1303211765.pdf (Page no.21) (Copy of document is provided to DOE)

[28] CERC (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2009 dated 16/09/2009 (page no. 3) (Copy of document is provided to DOE)

[29] http://www.cwet.tn.nic.in/html/departments_wpdmap.html (Centre for Wind Energy Technology (C-WET) wind power density map) (Copy of document is provided to DOE)

[30] Ministry of New and Renewable Energy of India press note on "India's first Megawatt Size Grid Connected Solar Power Plant at Jamuria, West Bengal" (Copy of document is provided to DOE)

[31] http://cercind.gov.in/Regulations/Amend_Renewable_Energy_tariff.pdf (Page no. 5) (Copy of document is provided to DOE)

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
	delivers only 23% capacity factor on an average[32]		contemplated	
(3) 5 MW Solid biomass[33] fired power plant with efficiency 20%[34] and with a life of 20[35] years	No • Majority Biomass fuel is generated by agricultural activity in India (i.e. agro residue)[36]. Hence, 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	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 ~1105 MW in NEWNE Grid[37], biomass represents only ~0.95% of the total installed capacity in the NEWNE Grid[38]. • Out of the total installed capacity of ~420 MW[39] in the Western Region of the NEWNE Grid, approx 219 MW is in Maharashtra[40] (Western Region)	Not a plausible baseline scenario

[32] http://www.cercind.gov.in/2009/November09/284-2009_final_3rdDecember09.pdf (Page no. 40) (Copy of document is provided to DOE)

[33] http://biomass-power.industry-focus.net/index.php/haryana-biomass-projects/93-deepak-spinners-had-set-up-5-mw-biomass-plant-at-baddi.html (Copy of document is provided to DOE)

[34] http://zebu.uoregon.edu/1998/ph162/l17.html (Copy of document is provided to DOE)

[35] http://cercind.gov.in/Regulations/Amend_Renewable_Energy_tariff.pdf (Page no. 5) (Copy of document is provided to DOE)

[36] Bio Mass Energy India Issue 04/06/2010 (Copy of document is provided to DOE)

[37] Ministry of New and Renewable Energy of India report on "State-wise details of cumulative interactive renewable power installed capacity as on 31.03.2010" (Copy of document is provided to DOE)

[38] A report on All India Regionwise Generating Installed Capacity (MW) Copy of document is provided to DOE)

[39] Ministry of New and Renewable Energy of India report on "State-wise details of cumulative interactive renewable power installed capacity as on 31.03.2010" (Copy of document is provided to DOE)

[40] Ministry of New and Renewable Energy of India report on "State-wise details of cumulative interactive renewable power installed capacity as on 31.03.2010" (Copy of document is provided to DOE)

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
	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. (http://books.google.co.in/books?id=Jmuz3rysSpAC&pg=PA111&dq=alternative+use+of+bio+mass+india&hl=en#v=snippet&q=alternative%20use%20&f=false) • Also, there does not exist any organised market like that of coal or gas, from where biomass can be sourced. • Biomass cannot 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		and most of biomass plants here 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 have risen from INR350/MT[41] in 2004 to INR ~1801/MT (Approx. price) in 2010[42]. 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.	

[41] UNFCCC Ref No. 1116 (PDD Page no. 19) (Copy of document is provided to DOE)

[42] CERC Regulation 2009 – Terms and conditions for Tariff Determination from Renewable Energy Sources (Page no. 31) (Copy of document is provided to DOE)

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
	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		• As biomass scenario cannot deliver outputs and services similar to the project activity neither in terms of base load power nor in terms of size and as further supply can cause destruction of precious forests, due to reasons contained under this column as well as preceding column this scenario is not realistic and credible.	
(4) 350 MW[43] domestic Coal fired power plant using conventional technology (sub critical) with ~37.78% efficiency[44] (under site conditions) and lifetime of 25 years[45].	Yes	Yes	Yes	Plausible baseline scenario
(5) 600 MW[46] coal (imported) fired port based power plant using conventional technology (sub critical) with	Yes	Yes	Yes	Plausible baseline scenario

[43] http://www.cea.nic.in/archives/thermal/bs/dec09.pdf – Kamalanga TPP (Page no. 86) (Copy of document is provided to DOE)

[44] CERC Terms and Conditions Regulations 2009 (Page no. 46) (calculated based on 860 kcal/kwh divided by gross station heat rate of 2276 Kcal/kwh) (Copy of document is provided to DOE)

[45] CERC Terms and Conditions Regulations 2009 (Page no. 9) (Copy of document is provided to DOE)

[46] http://www.cea.nic.in/archives/thermal/bs/dec09.pdf – Coastal Energen (Page no. 84) (Copy of document is provided to DOE)

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
~39.55% efficiency[47] (under site conditions) and lifetime of 25 years[48].				
(6) 660 MW[49] domestic coal fired based power plant using super critical boiler technology with ~39.52% efficiency[50] (under site conditions) and lifetime of 25 years[51].	Yes	Yes	Yes	Plausible baseline scenario
(7) 660 MW[52] coal (imported) fired port based power plant using super critical boiler technology with ~41.36% efficiency[53] (under site conditions) and lifetime of 25 years[54].	Yes	Yes	Yes	Plausible baseline scenario

[47] CERC Terms and Conditions Regulations 2009 (Page no. 46) (calculated based on 860 kcal/kwh divided by gross station heat rate of 2174 Kcal/kwh) (Copy of document is provided to DOE)

[48] CERC Terms and Conditions Regulations 2009 (Page no. 9) (Copy of document is provided to DOE)

[49] http://www.cea.nic.in/archives/thermal/bs/dec09.pdf (Amravati TPP) (Page no. 73) (Copy of document is provided to DOE)

[50] CERC Terms and Conditions Regulations 2009 (Page no. 46) (calculated based on 860 kcal/kwh divided by gross station heat rate of 2176 Kcal/kwh) (Copy of document is provided to DOE)

[51] CERC Terms and Conditions Regulations 2009 (Page no. 9) (Copy of document is provided to DOE)

[52] http://www.cea.nic.in/archives/thermal/bs/dec09.pdf – Tirora power plant (Page no. 72) (Copy of document is provided to DOE)

[53] CERC Terms and Conditions Regulations 2009 (Page no. 46) (calculated based on 860 kcal/kwh divided by gross station heat rate of 2079 Kcal/kwh) (Copy of document is provided to DOE)

[54] CERC Terms and Conditions Regulations 2009 (Page no. 9) (Copy of document is provided to DOE)

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
(8) 135 MW[55] Lignite fired power generation plant with ~37.78% efficiency[56] (under site conditions) and life time of 25 years.[57]	Yes	Yes	Yes	Plausible baseline scenario.
(9) Naphtha based power generation with ~46% efficiency[58] and lifetime of 25 year[59].	Yes	Yes	No The total power generation capacity based on Naphtha was less than 2% of total installed power generation capacity of India and the PLF% of such capacity was less than 30% (i.e. considering total Naphtha based generation capacity of 2562 MW and Net generation of 6425 GWh)for the year 2008-09 as per Central Electricity Authority of India CO_2 database version 05/11/2009. Further, as per 11th Plan (2007-12) of power generation capacity addition in India, no such power plants are recently constructed	Not a plausible baseline scenario.

[55] http://www.cea.nic.in/archives/thermal/bs/dec09.pdf - Jallipa-Kapurdi TPL by Raj West Power Limited (JSW) (Page no. 44) (Copy of document is provided to DOE)

[56] CERC Terms and Conditions Regulations 2009 (Page no. 46) (calculated based on 860 kcal/kwh divided by gross station heat rate of 2276 Kcal/kwh) (Copy of document is provided to DOE)

[57] CERC Terms and Conditions Regulations 2009 (Page no. 9) (Copy of document is provided to DOE)

[58] http://www.cea.nic.in/reports/articles/thermal/data_petroleum_fuels.pdf (page 4) (Calculated based on Heat Rate of 1858.06 kCal/kwh) (Copy of document is provided to DOE)

[59] CERC Terms and Conditions Regulations 2009 (Page no. 9) (Copy of document is provided to DOE)

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
			or are under construction or are being planned (http://www.cea.nic.in/archives/plg/monitor_11plan/oct09.pdf). Based on the above, the scenario is not realistic and credible.	
(10) 168 MW[60] reservoir based hydro power plant with a lifetime of 35 years[61].	No • Does not deliver output and services comparable to the project activity as the plant load factor (PLF) of a hydro power plant is going to be always in the range of 40 to 60%. Practically, on an average the most efficiently run hydro power plant have 50% plant load factor (PLF).[62] This is due to seasonal monsoon rainfall regime. (See note 1)	Yes	No • The features of the hydropower projects being site specific depend on the geology, topography and hydrology at the site. The construction time of a hydro project is greatly influenced by the geology of the area and its accessibility. • Moreover, hydro power plants can be constructed only in very limited sites, and can be used only to the extent the water runs.[63] • Hydro power projects generally entail a long gestation period because the reliable	Not a plausible baseline scenario.

[60] http://www.cea.nic.in/reports/yearly/annual_rep/2009-10/ar_09_10.pdf (Page no. 165) (Copy of document is provided to DOE)

[61] CERC Terms and Conditions Regulations 2009 (Page no. 9) (Copy of document is provided to DOE)

[62] http://hydropowerstation.com/?tag=loan-for-hydro-power-plant (Copy of document is provided to DOE)

[63] http://www.leonardo-energy.org/repository/Library/Papers/EfficiencyThermal.pdf (Copy of document is provided to DOE)

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
			hydrological, geological, seismological and environmental studies have to be carried out for a longer period.[64] 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, Indira Sagar, Bansagar Tons and Tehri are some of the hydro projects where the progress had been severely hampered in the past from sustained opposition to project construction by environment activists and project-affected people. • The generation of hydro plants also faces limitation, during specific time period, on account of restriction on water use due to irrigation, drinking water, industrial, environmental consideration etc[65] • Also repeated silt	

[64] http://www.infraline.com/power-database/hydro-power-156291.htm (subscription basis)

[65] Indian Electricity Grid Code Regulations 2010. (Copy of document is provided to DOE)

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
			formation leads to reduced or nil power generation even in monsoon, where water supply is copious Hydro power is generally for meeting peak load requirement[66].	

[66] Hydro Development Plan for 12th Five Year Plan by Central Electricity Authority of India (2012-2017) (Copy of document is provided to DOE)

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
(11) Cluster of 4 units of 120 MW each[67] of run of river (ROR) hydro power plants with a lifetime of 35 years[68]	No • Does not deliver output and services comparable to the project activity as the plant load factor (PLF) of a hydro power plant is going to be always in the range of 40 to 60%. Practically, on an average the most efficiently run hydro power plant have 50% plant load factor (PLF).[69] This is due to seasonal monsoon rainfall regime (See note 1). Moreover, hydro power plants can be constructed only in very limited sites, and can be used only to the extent the water runs.[70] Hydro power projects generally entail a long gestation period because the reliable hydrological, geological, seismological and environmental studies have to be carried out for a longer period. [71]	Yes	No • Hydro power is for meeting peak load requirement [72].	Not a plausible baseline scenario

[67] http://www.cea.nic.in/reports/yearly/annual_rep/2009-10/ar_09_10.pdf (Page no. 165) (Copy of document is provided to DOE)

[68] CERC tariff guidelines 2009-14 (Page no. 9) (Copy of document is provided to DOE)

[69] http://hydropowerstation.com/?tag=loan-for-hydro-power-plant (Copy of document is provided to DOE)

[70] http://www.leonardo-energy.org/repository/Library/Papers/EfficiencyThermal.pdf (Copy of document is provided to DOE)

[71] http://www.infraline.com/power-database/hydro-power-156291.htm (available subscription basis) (Copy of document is provided to DOE)

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
(12) 220 MW[73] Nuclear reactor based power plant with efficiency of 42%[74] and with a lifetime of 40 years[75].	Yes	No • Not permitted to any Stakeholders including the Project participant except for Nuclear Power Corporation of India, a 100% Government owned company[76]. • This scenario is currently available only to Nuclear Power Corporation of India Limited, a 100% Government of India owned Company[77] whose capacity additions are driven by the Government of India initiatives based on its long term	No • Due to limited uranium reserve and the constraint in imports, the expansion of nuclear power generation has been hampered. Hence this scenario is not realistic and credible[78]. • The lead time for a nuclear power plant is very high at nearly 8 years[79] 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 time of a Nuclear Plant is almost more than double than that of gas based plants.	Not a plausible baseline scenario

[72] Hydro Development Plan for 12th Five Year Plan by Central Electricity Authority of India (2012-2017) (Copy of document is provided to DOE)

[73] http://www.npcil.nic.in/main/AllProjectOperationDisplay.aspx (Copy of document is provided to DOE)

[74] http://www.infraline.com/power/reforms/report/Ch3.aspx (Copy of document is provided to DOE)

[75] http://www.leonardo-energy.org/life-expectancy-nuclear-power-plants (Copy of document is provided to DOE)

[76] A National Report to The Convention on Nuclear Safety by Government of India (Copy of document is provided to DOE)

[77] http://www.world-nuclear.org/info/inf53.html (Copy of document is provided to DOE)

[78] http://www.dae.gov.in/parlqa/2010/budget2010/lsus050510.pdf (Copy of document is provided to DOE)

[79] An article on "Nuclear Power in India" on Ananthapuri.com (Copy of document is provided to DOE)

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
		strategic programmes and not by the project activity. A joint venture set up between Nuclear Power Corporation of India Limited (NPCIL) and National Thermal Power Corporation (NTPC) (NTPC is largely government-owned) has been made in April 2010 with NPCIL holding 51%. • It may be pertinent to note here that Nuclear Power Corporation of India is under the administrative control of 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	• Hence for above reasons this alternative baseline 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
		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.		
D) **Import of electricity from connected grid, including the possibility of new interconnection** (1) Electricity Imports from neighbouring countries	Yes	No	No Nepal is facing such acute shortage of electricity that the government of Nepal has declared "National Electricity Crisis" in FY 2008-09. In FY 2008-09, out of 3859 GWh of annual demand only 3130.77 GWh could be served through available sources and 728.23 GWh (i.e. more than 20%) had to be curtailed as load shedding to keep the	Not a plausible baseline scenario

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
			system in operation. Further, the contribution of various sources of served energy is as follows: (a) Hydro-88.33% (b) Import from India-11.39% and (c) Thermal-0.29%. Based on the above, the import of electricity from Nepal is not a credible alternative.(Annual Report of Nepal Electricity Authority – August 2009 (page 14 & 15) - http://www.nea.org.np/anual-report.html) The electricity access in Bangladesh was approx. 47% in FY 2009. In FY 2009, due to shortage of available generation capacity with respect to the increasing demand, Bangladesh Power Development Board had to resort to load shedding, which varied up to 30.49% of maximum demand. The load shedding was imposed on 351 days. The maximum demand served in this year was 4162 MW against the forecast demand of 6066 MW as per updated Power System Master Plan. Based on the above, the import of	

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
			electricity from Bangladesh is not a credible alternative. (Annual Report 2008-09 Bangladesh Power Development Board Page 8- http://www.bpdb.gov.bd/bpdb/index.php?option=com_content&view=article&id=75&Itemid=81) Electricity consumption per capita in Myanmar is among the lowest in Asia and has been growing very slowly since 1980. The total electricity production was approx. 6500 MUs (i.e. ~ 750 MW) in 2009. Further, the development of power transmission infrastructure is very difficult due to inaccessible terrain between India and Myanmar. Based on the above, the import of electricity from Myanmar is not a credible alternative (http://data.un.org/Data.aspx?d=EDATA&f=cmID:EL;trID:019). Based on the Political conflict between India and Pakistan and Power shortage in Pakistan (http://en.wikipedia.org/wiki/Electricity_se	

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
			ctor_in_Pakistan), the import of electricity from Pakistan is not a credible alternative. The electricity import from Bhutan is less than 1% of total generation of India (http://cea.nic.in/archives/exec_summary/dec09.pdf). Further, such electricity is generated by hydro power plants in Bhutan which is not comparable in terms of service to be provided by the Project (i.e. base load). Based on the above, the import of electricity from Bhutan is not a credible alternative.	
(2) Electricity Imports from other Indian grids Under the possibility of existing connection	No • Electricity Import from other regional grids in India is not possible at all times as these grids are suffering from shortages to meet their energy demand and in particular the peak demand. • The monthly average peak deficit of the Southern Grid for the year 2009-2010 was 9.3% (as contained in *Note-2*): • Electricity Imports are possible only in periods of temporary surplus from Southern	Yes	No • As this scenario does not deliver output and services comparable to the project activity and as there are significant transmission constraints, this scenario is not realistic and credible.	Not a plausible baseline scenario.

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
	Grid. But the peak deficits occur in mostly all months of the year as is demonstrated in *Note-2*. • It can be concluded from the above that Imports do not deliver base-load power and therefore there is no denying the fact 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:[80]

Particulars	2007-08	2008-09	2009-10
No. of projects in NEWNE Grid	141	143	143
Installed capacity (MW)	25,674.55	26,374.55	26,348.75
Generation (Gwh)	83,391.45	79,885.74	75,189.19
Avg. Plant Load Factor (%)	37.08%	34.58%	32.58%
Projects having Plant Load Factor>50%	33	28	18
Aggregate Capacity (MW) of the Projects having Plant Load Factor>50%	5,191.85	4,723.25	5,010.65

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 2007-08, 2008-09 and 2009-10 was only 37.08%, 34.58% and 32.58% 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. 20 % of the entire hydro capacity in NEWNE Grid.

c) An analysis of the projects having over 50% Plant Load Factor in either of the three years i.e. 2007-08, 2008-09 and 2009-10 , shows that there is a wide divergence in the monthly plant load factor over different months of the same year. This shows that monthly Plant Load Factor in hydro projects depends on seasonal

[80] http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm (Version 4 for 2007-08, Version 5 for 2008-09 and Version 6 for 2009-10) (Copy of document is provided to DOE)

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 Southern Region during the year 09-10[81] (Source: http://www.cea.nic.in)

Month	Peak Demand	Peak Met	Surplus/(Deficit) (MW)	Surplus/ (Deficit) (%)
Apr-09	29,376	26,372	-3,004	**-10.2%**
May-09	27,650	25,674	-1,976	**-7.1%**
Jun-09	28,099	25,131	-2,968	**-10.6%**
Jul-09	26,755	24,843	-1,912	**-7.1%**
Aug-09	28,387	26,015	-2,372	**-8.4%**
Sep-09	27,271	26,445	-826	**-3.0%**
Oct-09	28,787	26,030	-2,757	**-9.6%**
Nov-09	26,841	25,106	-1,735	**-6.5%**
Dec-09	27,094	25,911	-1,183	**-4.4%**
Jan-10	28,395	26,898	-1,497	**-5.3%**
Feb-10	29,347	26,893	-2,454	**-8.4%**
Mar-10	32,082	29,053	-3,029	**-9.4%**
Average	28,340	26,198	-2,143	**-7.6%**

[81] http://www.cea.nic.in/archives.html (Monthly Executive Summary 2009-10) (Copy of document is provided to DOE)

Step 2: Identify the economically most attractive baseline scenario alternative

- *Sub Step -1: Calculating levelized cost of electricity production in "INR /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. 382.5 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. 340 MW gas based CCPP)
  C. Power generation technologies using energy sources other than Natural Gas:
     1. 350 MW coal (domestic) fired based power plant using conventional technology.
     2. 600 MW coal (imported) fired port based power plant using conventional technology.
     3. 660 MW coal fired (domestic) power plant using super critical boiler technology.
     4. 660 MW coal (imported) fired port based power plant using super critical boiler technology.
     5. 135 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 INR /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	CERC (Terms and conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 13)
2	Normative Plant Availability Capacity Utilization (PAF)	85%	CERC (Terms and conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 42)
3	Permissible increase in O&M	5.72 % p.a.	CERC (Terms and conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no.28 & 30)
4	Return on Equity allowed on	15.5% p.a.	CERC (Terms and conditions of Tariff)

	pre tax basis		Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 21)
5	Depreciation limited to	90%	CERC (Terms and conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 23)
6	Depreciation Rate as per CERC	Straight line method 5.28% *(Depreciation after 12 years from commercial operation to be spread over balance useful life)*	CERC (Terms and conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 24) and refer Point 17(4) Appendix III (http://cercind.gov.in/2009/Whats-New/tariff-pdf/Appendix-III.pdf)
7	Rate of interest on working capital borrowing	11.75% (SBI PLR) (Declared in Jun-2009 and remained applicable in Jan-2010. Thus it was latest available SBI PLR at the time of decision making)	http://in.reuters.com/article/2012/03/12/india-plr-idINL4E8EC3BM20120312
8	Corporate Tax Rate (including surcharge)	33.99%	Income Tax Act, 1961 for the assessment year 2010-11
9	Minimum Alternate Tax (including surcharge)	16.995%	
10	Tax Depreciation Rate	15 % (WDV Basis)	Income Tax Act, 1961
11	Depreciation rate as per Companies Act	5.28% (SLM basis)	As per The Companies Act, 1956
12	Interest rate on long term loan	12%	Modal BPLR of PSBs for October 2009 (Table 17) considered as being conservative vis-à-vis average BPLR of 12.25% offered by public sector bank in October 2009 (Table 16) (Second Quarter Review of Monetary Policy 2009-10 (http://rbi.org.in/scripts/NotificationUser.aspx?Id=5326&Mode=0))
13	Tenure of long term loan	12 years including one year of moratorium with quarterly repayment	Loan sanction letter from SBI dated 10/02/2011 for the project activity
14	USD Exchange rate on 31/12/2009	46.68 INR/US $	RBI website (http://www.rbi.org.in/scripts/ReferenceRateArchive.aspx)

15	Rate of Depreciation of Rupees against USD	0.7 % p.a.	Calculated based on RBI reference Rate for 03/01/2000 and 31/12/2009 (http://www.rbi.org.in/scripts/ReferenceRateArchive.aspx)
16	Expected Salvage value in the terminal year (%)	10%	http://energytechnologyexpert.com/financial-models/how-to-evaluate-economic-feasibility-of-a-power-plant-project-use-project-finance-model/
17	Discounting Rate	10.19%	Discount rate as notified by Central Electricity Regulatory Commission on 30/09/2009 (http://cercind.gov.in/Escalation-rate/Notification-dated-30-09-09.pdf) (Page no. 1)

B. **General assumptions for Gas Based Projects**

Sr.No.	Particulars	Detail	Source
1	Auxiliary consumption	3.00%	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 49)
2	O & M charges	1.849 million INR/MW for year 2013-14	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 28)
3	Working Capital		Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 25 &26)
	Receivable	2 months	
	Fuel	1 month	
	O & M	1 month	
	Maintenance spare	30% of O&M expenses	
4	Ex-terminal Price of gas (including transportation and taxes as applicable)	6.35 US $/MMBTU	Please refer sheet "Fuel Pricing" for levelised cost working of Natural Gas (UNOSUGEN – Project Activity)
5	VAT	12.5+2.5% (For LNG)	Gujarat Sales tax Act for the year 2010-11 (http://www.caclubindia.com/forum/late

			st-vat-rate-amendments-as-on-01-april-2010-76397.asp)
6	Central Sales Tax	2% (For Domestic gas)	http://www.allindiantaxes.com/ait-news-233.php
7	Service Tax (Including Cess)	10.3%	http://www.simpletaxindia.net/2011/02/service-tax-rate-chart-exemption-limit.html
8	Calorific value on GHV basis	9395 kCal /scm (39.33 Mega Joules)	Please refer sheet "Assumption" for levelised cost working of Natural Gas (UNOSUGEN – Project Activity)

C. General assumptions for Coal Based Projects

Sr.No.	Particulars	Detail	Source
1	Auxiliary consumption (Unit with cooling tower)	8.50%	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 48)
2	Secondary Fuel oil consumption	1.0 ml/kWh	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 48)
3	Loss in transit and handling	0.80%	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 35)
4	O & M charges	INR 1.462 million/MW for 600 MW and above unit set and INR 1.999 million/MW for 300-350 MW unit set for year 2013-14	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 27)
5	Working Capital -		Central Electricity Regulatory

	Receivable	2 months	Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 24-25)
	Fuel	2 months	
	O & M	1 month	
	Maintenance spare	20% of Operation and Maintenance	
	Secondary fuel	2 months	
6	Landed cost of diesel	INR 30.60/ litre	CERC Draft Order dated September 2009 (http://cercind.gov.in/2009/August09/Draft-Order-on-price-cap.pdf) (Page no. 4)
7	Gross Calorific value of fuel oil	10500 kCal/kg	CO2 baseline Database for Indian Power Sector, November 2009 issued by Central Electricity Authority, Ministry of Power, Government of India. (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm)

D. Specific assumptions for CCPP comprising advance class gas turbine:

Sr.No.	Particulars	Detail	Source
1	Project Capacity	382.5 MW	As per the Management Decision dated 28/01/2010 for the project activity and the EPC contract dated 02/07/2010
2	Project cost	INR 18330 million	As per the EPC Contract dated 02/07/2010 placed for the project activity being conservative vis-à-vis INR 19500 Million as per the Management Decision dated 28/01/2010.
3	Cost/MW	INR47.92 million/MW	
4	Heat Rate on GHV basis	1663.71 (Kcal/Kwh)	As per EPC contract dated 02/07/2010 for the project activity being comparable to the existing power plant under operation of similar configuration

E. Specific assumptions for Imported Coal using conventional technology:

Sr.No.	Particulars	Detail	Source
1	Project Capacity	600 MW	Coastal Energen Total Project cost of INR 48000 million is divided equally between 2 Units (http://www.cea.nic.in/archives/thermal/bs/dec09.pdf) (Page no. 84)
2	Project cost	INR 24000 million	
3	Cost/MW	INR 40 million/MW	
4	Heat Rate on GHV basis	2174 (Kcal/Kwh) (537°/565°C Temperature)	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 Max. Design Heat Rate for

			Indian coal (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 46)
5	Landed cost of coal	85.74 US $ per MT	Please refer the sheet "Fuel Pricing_Coal" of the workbook "Imported Coal – Conventional")
6	Gross Calorific value	5900 kCal /kg	

F. Specific assumptions for Indigenous Coal using conventional technology

Sr.No.	Particulars	Detail	Source
1	Project Capacity	350 MW	Kamalanga TPP Total Project cost of INR 45400 million is divided equally between three units of 350 MW each. (http://www.cea.nic.in/archives/thermal/bs/dec09.pdf) (Page no. 86).
2	Project cost	INR 15134 million	
3	Cost/MW	INR 43.24 million/MW	
4	Heat Rate on GHV basis	2276 (Kcal/Kwh) (537°/565°C Temperature)	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 Max. Design Heat Rate for Indian coal (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 46)
5	Landed cost of coal	INR 1133.18 per MT	Please refer the sheet "Fuel Pricing_Coal" of the workbook "Domestic Coal – Conventional")
6	Gross Calorific value of coal	3755 kCal /kg	CO_2 Baseline Database for the Indian Power Sector, November, 2009, issued by Central Electricity Authority, Ministry of Power, Government of India (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm)

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

Sr.No.	Particulars	Detail	Source
1	Project Capacity	660 MW	Amravati TPP – M/s Indiabulls Power Limited Total Project Cost of INR 68880 Million divided equally between 2 Units of 660 MW each (http://www.cea.nic.in/archives/thermal/bs/dec09.pdf) (Page no. 73).
2	Project cost	INR 34440 million	
3	Cost/MW	52.18 million INR/MW	
4	Landed cost of coal	INR 1133.18 per MT	Please refer the sheet "Fuel Pricing_Coal" of the workbook "Domestic Coal - Supercritical")

5	Heat Rate on GHV basis	2176 (Kcal/Kwh) (565°/593°C Temperature)	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 Max. Design Heat Rate for Indian coal (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 46)
6	Gross Calorific value of coal	3755 kCal /kg	CO_2 Baseline Database for the Indian Power Sector, November, 2009, issued by Central Electricity Authority, Ministry of Power, Government of India (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm)

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

Sr.No.	Particulars	Detail	Source
1	Project Capacity	660 MW	Tirora. Total Project cost of INR 92630 million is divided equally between 3 Units of 660 MW each. (http://www.cea.nic.in/archives/thermal/bs/dec09.pdf) (Page no. 72).
2	Project cost	INR 30876.7 million	
3	Cost/MW	INR 46.78 million /MW	
4	Landed cost of coal	85.74 US$ per MT	Please refer the sheet "Fuel Pricing_Coal" of the workbook "Imported Coal - Supercritical")
5	Gross Calorific value	5900 kCal /kg	
6	Heat Rate on GHV basis	2079 (Kcal/Kwh) (565°/593°C Temperature)	CERC Tariff Regulations, 2009 dated 19/01/2009 Max. Design Heat Rate for Imported coal (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 46)

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

Sr.No.	Particulars	Detail	Source
1	Project Capacity	340	UNFCCC Ref No. 2915 - 340 MW Gas based combined cycle power project expansion at Hazira (http://cdm.unfccc.int/Projects/DB/BVQI1250060108.72/view)
2	Project cost	INR 8126.5 million	
3	Cost/MW	INR 23.90 million /MW	
4	Heat Rate on GHV basis	1950 Kcal/Kwh	

J. Specific assumptions for Lignite fired power generation plant

Sr. No.	Particulars	Details	Source
1	Project capacity	135 MW	Jallipa-Kapurdi TPL by Raj West Power Limited (JSW) in Rajasthan. Total Project Cost of INR 50750 Million divided equally between 8 Units of 135 MW each (http://www.cea.nic.in/archives/thermal/bs/dec09.pdf) (Page no. 44)
2	Project cost	INR 6343.75 Million	
3	Cost per MW	INR 46.99 Million	
4	Landed cost of Lignite	INR 1663.86 per MT	Please refer the sheet "Lignite_Price" of the workbook "Lignite based power plant"
5	Gross calorific value of Lignite	3500 Kcal/Kg	Report on Gujarat Lignite Resources and Scope for Joint Sector Thermal Power and SSI Project (Annexure IV)
6	Loss in transit and handling	0.20% - for pit head	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (page no. 35)
7	O&M cost for lignite based plants	For the year 2013-14: INR 2.998 Million per MW escalated @ 5.72% per annum thereafter.	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (page no. 28)
8	Oil consumption	1.25 ml/kWh	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (page no. 48)
9	Capacity Utilization	85%	CERC (Terms and conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 42)
10	Heat Rate on GHV basis	2276 (Kcal/kWh) (537°/565°C Temperature)	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009

			(http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 46)
11	Expected Moisture Content in %	30%	Report on Gujarat Lignite Resources and Scope for Joint Sector Thermal Power and SSI Project (Annexure IV)
12	Heat Rate Factor for Moisture Content @ 30%	1.04	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 45)
13	Auxiliary consumption	10%	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (8.5% for coal based + 1.5%) (Page no. 49)
14	Working Capital		Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 dated 19/01/2009 (http://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf) (Page no. 24-25)
	Receivable	2 months	
	Fuel	1.5 month	
	O & M	1 month	
	Maintenance spare	20% of Operation and Maintenance	
	Secondary fuel	2 months	
15	Landed cost of diesel	INR 30.60/ litre	CERC Draft Order dated September 2009 (http://cercind.gov.in/2009/August09/Draft-Order-on-price-cap.pdf) (Page no. 4)
16	Gross Calorific value of fuel oil	10500 kCal/kg	CO2 Baseline Database for Indian Power Sector, November, 2009 issued by Central Electricity Authority, Ministry of Power, Government Of India. (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm).

Table 3:

- ***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:***

Sr.No.	Alternative	Levelized Cost (INR/kWh)
A	Project activity not implemented as a CDM project, i.e. 382.5 MW gas based combined cycle power plant with advance class gas turbine	3.72
B	Power Generation using natural gas but technology other than the project activity (i.e. 340MW gas based CCPP)	3.53
C	Power generation technologies using energy sources other than Natural gas.	
1.	**350 MW domestic coal fired power plant using conventional technology (sub critical)**	**2.29**
2.	600 MW coal (imported) fired port based power plant using conventional technology (sub critical).	3.18
3.	660 MW domestic coal fired based power plant using super critical boiler technology.	2.31
4.	660 MW coal (imported) fired port based power plant using super critical boiler technology.	3.24
5.	135 MW Lignite fired power generation plant	3.28

Conclusion:-

The baseline scenario as identified by the above Investment Analysis is that of domestic coal fired power plant *using sub critical technology* as the levelized cost of production per unit is the lowest under this scenario.

Typical sub critical units use steam parameters ranging from 150 to 170 kg/cm^2 with various combinations of temperature between 535^{o}C to 565^{o}C[82]. The efficiency of these units is around 35% depending on the design, operating parameters and coal type. Thus, in the absence of the project activity, the same type and level of services would have been provided through a domestic coal fired power plant with sub critical technology. The GHG emissions in the baseline scenario (i.e. power generation using coal as fuel with subcritical technology) would be higher.

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

- The sensitivity analysis is to be conducted as per guidance 20 and 21 of Annex 5, EB 62 for important variables impacting the levelized cost of generation (i.e. constitute more than 20% of either total project cost or total project revenues). Based on the same, the major parameters and their percentage impact on revenue is as under:-
  - Fuel - ~62% of total revenue
  - O&M Cost - ~14% of total revenue
- Thus fuel is the only factor which impacts revenue by more than 20%. Accordingly fuel price, heat rate and PLF, the three inputs which will impact fuel consumption / revenue are selected for sensitivity analysis. However, to be conservative, O&M cost, the next highest input impacting revenue is also selected for sensitivity analysis.
- Further, the Project cost has also been considered as a parameter for sensitivity analysis.

[82] CERC Tariff Regulations, 2009

- Based on the above, the sensitivity has been conducted for the above alternatives to confirm that the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions
  - Fuel Prices: Increase or decrease by 10%
  - Load Factor : Increase or decrease by 10%
  - Project Cost : Increase or decrease by 10%
  - O & M Cost : Increase or decrease by 10%
  - Heat Rate: Increase or decrease by 10%
- Table 4 below shows the economic evaluation of the sensitivity analysis on identified plausible baseline options :

Table-4:

Alternatives	Fuel Price	
	+10%	**-10%**
Project activity not implemented as a CDM project	3.96	3.49
Power Generation using natural gas but technology other than the project activity	3.79	3.26
350 MW coal (domestic) fired based power plant using conventional technology (sub critical)	**2.37**	**2.21**
600 MW coal(imported) fired port based power plant using conventional technology (sub critical)	3.37	2.98
660 MW coal (domestic) fired power plant using super critical boiler technology	2.39	2.23
660 MW coal(imported) fired port based power plant using super critical boiler technology	3.42	3.05
135 MW Lignite fired power generation plant	3.42	3.14
Alternatives	**Load Factor**	
	+10%	**-10%**
Project activity not implemented as a CDM project	3.60	3.88
Power Generation using natural gas but technology other than the project activity	3.44	3.63
350 MW coal (domestic) fired based power plant using conventional technology (sub critical)	**2.16**	**2.45**
600 MW coal(imported) fired port based power plant using conventional technology (sub critical)	3.07	3.31
660 MW coal (domestic) fired power plant using super critical boiler technology	2.18	2.48
660 MW coal(imported) fired port based power plant using super critical boiler technology	3.11	3.39
135 MW Lignite fired power generation plant	3.10	3.50
Alternatives	**Project Cost**	
	+10%	**-10%**
Project activity not implemented as a CDM project	3.82	3.63
Power Generation using natural gas but technology other than the project activity	3.57	3.48
350 MW coal (domestic) fired based power plant using conventional technology (sub critical)	**2.38**	**2.20**
600 MW coal(imported) fired port based power plant using conventional technology (sub critical)	3.26	3.09
660 MW coal (domestic) fired power plant using super critical boiler technology	2.42	2.20
660 MW coal(imported) fired port based power plant using super critical boiler technology	3.34	3.14

135 MW Lignite fired power generation plant	3.38	3.17
Alternatives	**O&M Cost**	
	+10%	**-10%**
Project activity not implemented as a CDM project	3.77	3.68
Power Generation using natural gas but technology other than the project activity	3.57	3.48
350 MW coal (domestic) fired based power plant using conventional technology (sub critical)	**2.34**	**2.24**
600 MW coal(imported) fired port based power plant using conventional technology (sub critical)	3.21	3.14
660 MW coal (domestic) fired power plant using super critical boiler technology	2.35	2.28
660 MW coal(imported) fired port based power plant using super critical boiler technology	3.27	3.20
135 MW Lignite fired power generation plant	3.36	3.20
Alternatives	**Heat Rate**	
	+10%	**-10%**
Project activity not implemented as a CDM project	3.96	3.49
Power Generation using natural gas but technology other than the project activity	3.79	3.26
350 MW coal (domestic) fired based power plant using conventional technology (sub critical)	**2.37**	**2.21**
600 MW coal(imported) fired port based power plant using conventional technology (sub critical)	3.37	2.98
660 MW coal (domestic) fired power plant using super critical boiler technology	2.39	2.23
660 MW coal(imported) fired port based power plant using super critical boiler technology	3.42	3.05
135 MW Lignite fired power generation plant	3.42	3.14

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) : >>

Serious consideration of CDM incentive is demonstrated complying with paragraph 2, Annex 13, EB 62 and the latest version of CDM glossary as mentioned below.

1. As per CDM Glossary of Terms (Version 05), the project participant has issued Notice to Proceed to EPC Contractor for the implementation of the project activity on 02/07/2010 and the same is considered as the start of the project activity.

2. As Start date of project activity is after 02/08/2008, as per guidance referred above, project participant must inform UNFCCC and DNA about the commencement of project activity and intent to seek CDM status within 6 months from the "Start Date". Project participant has intimated prior consideration to both UNFCCC and DNA on 30/11/2010 i.e. within 6 months from start date of 02/07/2010. CDM status could be seen online on the website of UNFCCC. Copies of correspondence with UNFCCC and DNA are submitted to DOE for Validation.

The proposed power plant uses natural gas, relatively less GHG intensive fuel compared to other fossil fuels like coal, lignite etc. resulting in reduction of anthropogenic emission of GHG. There is no legal requirement in India to choose natural gas in preference to higher GHG intensive fuels like coal. The national and sectoral policies that may guide the implementation of above options can be understood from discussions provided under the previous section. As per existing national legislation/regulation applicable to similar projects there is no restrictions on utilization of any fuel for Grid Connected Generating stations. Therefore, for the financial viability, the Natural Gas Based Power Project would not have been preferred over fuels viz. Coal, Lignite, Naphtha etc. with conventional technologies.

The project activity leads to additional GHG emission reductions than that would have occurred in its absence. The project's additionality has been assessed and demonstrated according to the following three steps specified in AM0029 version 3.0.

Step 1: Benchmark Investment analysis

Demonstrate that the proposed CDM project activity is unlikely to be financially attractive by applying sub-steps 2b (Option III: Apply benchmark analysis), Sub-step 2c (Calculation and comparison of financial indicators), and 2d (Sensitivity Analysis) of the version 06.1.0 of the "Tool for demonstration assessment and of additionality" agreed by the CDM Executive Board.

To determine whether the proposed project activity is economically or financially less attractive than the other alternatives without the CDM revenues, the sub-steps 2b, 2c and 2d have been followed as required under AM0029, version 03.

Sub-step 2(b): Benchmark Analysis (Option III)

Based on Option III of sub-step (2b), the indicator that has been selected for benchmark analysis is the levelized Cost for power generation in INR/kWh. As explained under baseline scenario analysis, for power generation projects, levelized Cost was found to be the most suitable indicator.

In this regard please also refer to the paragraph-19 of the "Guidelines on the Assessment of Investment Analysis" version – 05, EB 62, Annex 5.

"If the proposed baseline scenario leaves the project participant no other choice than to make an investment to supply the same (or substitute) products or services, a benchmark analysis is not appropriate and an investment comparison analysis shall be used. If the alternative to the project activity is the supply of electricity from a grid this is not to be considered an investment and a benchmark approach is considered appropriate."

The present project activity is a green field natural gas based grid connected Combined Cycle Power Plant (CCPP) of 382.5 MW. As mentioned above, the existing national legislation/regulation applicable to similar projects there is no restrictions on utilization of any fuel for Grid Connected Generating stations. Hence, in absence of the project activity the project proponent would have invested in developing power plant based on any of the alternatives mentioned in section above.

In line with AM0029, version 3.0 and also following the investment analysis guideline, the levelized cost of power generation has been considered as the suitable financial indictor and the lowest value of the same amongst all the alternatives have been used to establish the benchmark.

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

The levelized Cost for all the plausible options to the proposed project activity has been calculated and presented in Section B.4 above. A summary of these levelized Cost calculations is presented in the table below:

Sr.No.	Alternative	Levelized Cost (INR/kWh)
A	Project activity not implemented as a CDM project, i.e. 382.5 MW gas based combined cycle power plant with advance class gas turbine	3.72
B	Power Generation using natural gas but technology other than the project activity (i.e. 340MW gas based CCPP)	3.53
C	Power generation technologies using energy sources other than Natural gas.	
1.	**350 MW coal (domestic) fired based power plant using conventional technology (sub critical)**	**2.29**
2.	600 MW coal (imported) fired port based power plant using conventional technology (sub critical).	3.18
3.	660 MW coal (domestic) fired power plant using super critical boiler technology.	2.31
4.	660 MW coal (imported) fired port based power plant using super critical boiler technology.	3.24
5.	135 MW Lignite fired power generation plant	3.28

Thus, it can be seen that domestic coal fired power plant using sub critical technology is economically the most attractive baseline scenario.

Sub-step 2d (Sensitivity Analysis)

- 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, load factor, project cost, O&M cost and heat rate.
- Table below shows the economic evaluation of the sensitivity analysis on identified plausible baseline options

Alternatives	Fuel Price	
	+10%	**-10%**
Project activity not implemented as a CDM project	3.96	3.49
Power Generation using natural gas but technology other than the project activity	3.79	3.26
350 MW coal (domestic) fired power plant using conventional technology (sub critical)	**2.37**	**2.21**
600 MW coal(imported) fired port based power plant using conventional technology (sub critical)	3.37	2.98
660 MW coal (domestic) fired power plant using super critical boiler technology	2.39	2.23
660 MW coal(imported) fired port based power plant using super critical boiler technology	3.42	3.05
135 MW Lignite fired power generation plant	3.42	3.14
Alternatives	**Load Factor**	
	+10%	**-10%**

Project activity not implemented as a CDM project	3.60	3.88
Power Generation using natural gas but technology other than the project activity	3.44	3.63
350 MW coal (domestic) fired power plant using conventional technology (sub critical)	**2.16**	**2.45**
600 MW coal(imported) fired port based power plant using conventional technology (sub critical)	3.07	3.31
660 MW coal (domestic) fired power plant using super critical boiler technology	2.18	2.48
660 MW coal(imported) fired port based power plant using super critical boiler technology	3.11	3.39
135 MW Lignite fired power generation plant	3.10	3.50
	Project Cost	
Alternatives	**+10%**	**-10%**
Project activity not implemented as a CDM project	3.82	3.63
Power Generation using natural gas but technology other than the project activity	3.57	3.48
350 MW coal (domestic) fired power plant using conventional technology (sub critical)	**2.38**	**2.20**
600 MW coal(imported) fired port based power plant using conventional technology (sub critical)	3.26	3.09
660 MW coal (domestic) fired power plant using super critical boiler technology	2.42	2.20
660 MW coal(imported) fired port based power plant using super critical boiler technology	3.34	3.14
135 MW Lignite fired power generation plant	3.38	3.17
	O&M Cost	
Alternatives	**+10%**	**-10%**
Project activity not implemented as a CDM project	3.77	3.68
Power Generation using natural gas but technology other than the project activity	3.57	3.48
350 MW coal (domestic) fired power plant using conventional technology (sub critical)	**2.34**	**2.24**
600 MW coal(imported) fired port based power plant using conventional technology (sub critical)	3.21	3.14
660 MW coal (domestic) fired power plant using super critical boiler technology	2.35	2.28
660 MW coal(imported) fired port based power plant using super critical boiler technology	3.27	3.20
135 MW Lignite fired power generation plant	3.36	3.20
	Heat Rate	
Alternatives	**+10%**	**-10%**
Project activity not implemented as a CDM project	3.96	3.49
Power Generation using natural gas but technology other than the project activity	3.79	3.26
350 MW coal (domestic) fired power plant using conventional technology (sub critical)	**2.37**	**2.21**
600 MW coal(imported) fired port based power plant using conventional technology (sub critical)	3.37	2.98
660 MW coal (domestic) fired power plant using super critical boiler technology	2.39	2.23
660 MW coal(imported) fired port based power plant using super critical boiler technology	3.42	3.05
135 MW Lignite fired power generation plant	3.42	3.14

The sensitivity analysis also confirms that under all the possible scenarios, the levelized cost of electricity generation of the project activity is much higher than the baseline scenario and hence making the project activity uncompetitive without CDM revenue.

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

As to assess and demonstrate whether the project is additional, the benchmark analysis is also performed below using Project IRR as financial indicator and WACC as benchmark. Accordingly, the below given process was followed to demonstrate additionality using the Benchmark Analysis:

1. **Choice of Appropriate benchmark:**

   As per the Guidelines on the Assessment of Investment Analysis, Version 5, EB62 paragraph 12, "In case where a benchmark approach is used the applied benchmark shall be appropriate to the type of IRR calculated. Local commercial lending rates or weighted average cost of capital (WACC) are appropriate benchmarks for a project IRR". Based on this, the PP has taken into account the Weighted Average Cost of capital as the Benchmark Return. Accordingly, Project IRR is the suitable financial parameter to demonstrate the additionality of the project.

   Project IRR has been computed for the project on post-tax basis and compared with post- tax benchmark of Weighted Average Cost of Capital (WACC). Since this project activity is such that it could be developed by an entity other than the project participant, the benchmark is based on parameters that are standard in the market.

2. **Calculation of Benchmark:**

   The Weighted Average Cost of Capital (WACC) for the project has been calculated as given below:

   $WACC = CoE * \{E/(E+D)\} + CoD_{post\ tax} * \{D/(E+D)\}$

   Where:
   CoE – Cost of equity
   $CoD_{post\ tax}$ – Post-Tax Cost of Debt
   E – Equity
   D – Debt

   a. CoE – Cost of Equity:

   As per the Guidelines on the Assessment of Investment Analysis, Version 5, EB62 paragraph 15'If the benchmark is based on parameters that are standard in the market, the cost of equity should be determined either by: (a) selecting the values provided in Appendix A; or by (b) calculating the cost of equity using best financial practices, based on data sources which can be clearly validated by the DOE, while properly justifying all underlying factors. The values in the table in Appendix A may also be used, as a simple default option, if a company internal benchmark is used.'

   This project activity is such that it could be developed by an entity other than the project participant. Hence the benchmark is based on parameters that are standard in the market. The project participant has

opted for calculating the cost of equity following the current financial practices of the country. All the relevant data has been taken from the publicly available authentic sources and presented to the DOE for verification.

The Capital Asset Pricing Model (CAPM) approach has been used for calculation of cost of equity which is a generally accepted methodology for determining this parameter. CAPM is based on the portfolio theory of finance in which risks are classified into:

- Systematic risk - risk applicable to the market as a whole, such as inflation, tax rises, interest rates, etc.
- Specific risk - residual risk unique to an individual firm or a small group of companies that form a subset of the market.

The theory stipulates that specific risks can be eliminated through diversification and hence, only systematic risks determine the return expectation of investors. The basis of CAPM is the relationship between risk and return which can be expressed by the following formula:

$R_e = R_f + \beta_e * [R_m - R_f]$

Where:

R_e: Expected rate of return on equity (CoE)
R_f: Risk-free rate of return (e.g. return on government bonds)
R_m: Expected rate of return on a market portfolio
β_e: Equity Beta (Coefficient reflecting the volatility (risk) of the stock relative to the market), which measures the systematic risk of the stock

The Risk free rate (R_f) has been taken from the Redemption yield on Government of India securities based on SGL transaction available at the time of the investment decision of the project activity in January 2010.

The expected rate of return on a market portfolio (R_m) has been calculated as the compounded annual growth rate of the market portfolio. In calculating market risk premium, it is usual to use an established stock market index as a proxy for the market portfolio. In India, a choice of possible indices is available. Choice of market index will also be considerably influenced by the availability of historical data. In this regard, BSE SENSEX has the advantage of having the longest history and data is available for more than 20 years. However, BSE 500 represents broader base of equities but has historical data of less than 20 years. Thus, the expected rate of return on market portfolio has been calculated for both the indices.

Based on the above, the compounded annual growth rate of BSE SENSEX and BSE 500 has been calculated as 18.28% and 19.26% respectively for the period since inception to the month before the investment decision. However, the compounded annual growth rate of BSE SENSEX being conservative and having the longest historical data, the same has been used as the expected rate of return on a market portfolio (R_m).

Equity Beta is the measure of the expected volatility of a particular stock relative to a well-diversified market portfolio. It measures the systematic risk of a stock, i.e. the risk that cannot be eliminated in a well balanced, diversified portfolio. The beta of equity is calculated as the covariance between its return and the return on a well-diversified market portfolio, divided by the variance of the return on a well diversified market portfolio. As the project activity involves power generation, so the beta has to be taken from other listed companies involved in power generation. The following power generation companies listed on Bombay Stock Exchange (BSE) have been selected based on (a) market

capitalization (i.e. companies are in top 500 companies based on market capitalization listed on BSE) and (b) availability of market data for approximately of 4 years from the investment decision of the project activity.

Power Generation Companies
CESC Ltd.
Gujarat Industries Power Co. Ltd.
Neyveli Lignite Corp.
GVK
NTPC Ltd.
JP Power Venture
Tata Power Co. Ltd.

The beta of equity has been calculated for above-mentioned companies with reference to BSE SENSEX.

b. Post Tax Cost of Debt - $CoD_{post\ tax}$:

The Modal lending rates as published by the Reserve Bank of India is considered as the cost of debt for calculation of the WACC.

The Debt Equity ratio has been considered following the recent investment guidelines of CDM EB. Since the benchmark is based on parameters that are standard in the market, the typical debt/equity finance structure of 70:30, as observed in the power sector of the country was used. Further, the same is also in line with the Central Electricity Regulatory Commission of India Terms and Conditions of Tariff Regulations, 2009.

Accordingly the WACC as a Benchmark has been calculated as follows:

Parameter	BSE SENSEX	Source
Debt %	70%	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 Page 13
Equity %	30%	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 Page 13
Cost of Debt (Pre-Tax) (CoD)	12.00%	Modal BPLR of PSBs for October 2009 (Table 17) considered as being conservative vis-à-vis average BPLR of 12.25% offered by public sector bank in October 2009 (Table 16) (Second Quarter Review of Monetary Policy 2009-10 (http://rbi.org.in/scripts/NotificationUser.aspx?Id=5326&Mode=0))
Tax rate	16.995%	Effective Average Tax rate calculated for 12 years
Post tax Cost of Debt ($CoD_{post\ tax}$)	9.96%	Cost of Debt * (1- Tax rate)
R_f	8.30%	Maximum Redemption Yield of all Government of India Securities having tenure over 15 years up to 25 years based on SGL Transactions (http://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/27T_EBU70110.pdf)

R_m	18.28%	Compounded annual growth rate of BSE SENSEX for the period before the investment decision
Equity Beta (β_e)	1.30	A research paper titled "Estimating Risk Parameters" by the renowned scholar Aswath Damodaran (http://pages.stern.nyu.edu/~adamodar/pdfiles/papers/beta.pdf), who is a Professor of Finance at the Stern School of Business at New York University and an authority on the subject (page 9) states, "Risk and return models are silent on how long a time period one needs to use to estimate betas. Services use periods ranging from two years to five years for beta estimates, with varying results." Based on the above, the beta value has been selected.
Cost of Equity (CoE)	21.23%	$R_f + \beta_e * [R_m - R_f]$
WACC	**13.34%**	$CoE * \{E/(E+D)\} + CoD_{post\ tax} * \{D/(E+D)\}$

3. Analysis of Project IRR and comparison with Benchmark

The project IRR, without CDM revenue, was calculated based on the techno economic parameters as presented in Section B.4 for the project activity. The result is presented below:

Project IRR (without CDM revenue)	**11.02%**
Benchmark (WACC)	**13.34%**

As it is seen from the above presented values, the IRR without CDM revenue is less than the Benchmark. Hence the project is additional. The revenue from CDM credits would result in increased cash flows of the project activity and is essential for the viability of the project activity.

4. Sensitivity analysis:

The sensitivity analysis has been conducted on the important parameters in line with benchmark analysis based on levelized cost. The results are presented below:

	Project IRR (without CDM revenue)		Benchmark (WACC)
Parameters / Variation	+10%	-10%	
Fuel Price	11.03%	11.00%	13.34%
PLF	11.03%	11.00%	13.34%
Project Cost	10.99%	11.05%	13.34%
O&M cost	11.04%	10.99%	13.34%
Heat Rate	11.03%	11.00%	13.34%

Further, the sensitivity analysis with 50% increase or decrease has also been carried additionally to further verify the sensitivity of the parameters.

	Project IRR (without CDM revenue)		Benchmark (WACC)
Parameters / Variation	+50%	-50%	
Fuel Price	11.07%	10.96%	13.34%
PLF	11.07%	10.96%	13.34%
Project Cost	10.91%	11.21%	13.34%
O&M cost	11.10%	10.91%	13.34%
Heat Rate	11.07%	10.96%	13.34%

With reference to the above-mentioned, the following analysis has been done to further substantiate the sensitivity analysis:

The global trend of natural gas prices for last ten year has been analysed and the trend has been observed as upward only (http://www.oilnergy.com/1gnymex.htm#since30) as there is growing demand for natural gas as fuel among various sector. Based on the same, any decrease in the fuel price is not possible. However, the sensitivity analysis with 10% decrease in fuel price adequately covers any likely decrease in fuel price. As far as the increase in the fuel price is concerned. It has been observed that the global price has shown a maximum rise from USD 3 / MCF to USD 8 / MCF in the last ten years (http://www.oilnergy.com/1gnymex.htm#since30), a rise of ~167%. Based on the same, the sensitivity analysis for 200% increase of the fuel price has also been done and it has been found that the IRR still does not cross the benchmark.

The PLF of 85% has been considered. If such PLF is reduced by 50% (i.e. PLF of 42.5% only), the IRR is still not crossing the benchmark. However such low PLF of less than 50% in a power deficient market is not possible. Further an increase by 50 % (i.e. PLF of 127.5%) in PLF is not considered technically feasible. Based on the same, the sensitivity analysis for 10% increase and decrease adequately covers any increase or decrease in PLF.

An escalation factor of 5.72% in the O&M cost as provided under the CERC Terms and Condition of Tariff, 2009 has already been considered. It may also be noted that CERC has not prescribed any decrease in the O&M cost as such cost increases only with the operation of the plant. Based on the above, the sensitivity analysis of 10% increase or decrease in O&M cost vis-a-via 5.72% escalation prescribed by CERC adequately covers any increase or decrease in O&M cost.

The project cost of the project activity has been taken based on the EPC contract executed. Hence, there is no possibility of any major change in the project cost. Based on the same, the sensitivity analysis for 10% increase and decrease done by PP adequately covers any increase or decrease in project cost.

The heat rate considered for the project activity is based on the design heat rate as guaranteed by the OEM (EPC contractor). Further, the same is also in line with the heat rate of existing power plant being operated by TPL. Hence, there is no possibility of any major change in the heat rate. Based on the same, the sensitivity analysis for 10% increase and decrease adequately covers any increase or decrease in Heat Rate.

Further, it may be noted that the tariff of a thermal power station is determined by CERC as per CERC Terms and Conditions of Tariff Regulations 2009. As per Regulation 13 (1) of the said Regulations, the tariff for supply of electricity from a thermal generating station shall comprise two parts, namely, capacity charge (for recovery of fixed cost) and energy charge (for recovery of fuel cost).

Thus the tariff of a thermal plant, is a derived value based on primarily Project cost, Fuel cost, O&M cost, PLF etc. The Tariff will also change with a variation in any of the factors. Thus there are only minor changes in the IRR with the change in parameters. This is mostly attributable to the following reasons.

- Tariff for IRR computation has been derived from the annual levelised cost of generation.
- Cost elements as considered for computing the project IRR have been estimated following the fixed and variable cost as determined to compute levelised cost of generation.

However, the sensitivity analysis has been carried out as per the guidance 20 & 21 of EB 62 Annex 5 even though the change in Project cost, Fuel cost, O&M cost, PLF or Heat Rate will result in tariff change leading to very marginal variation in the project IRR and the sensitivity analysis also confirms that under all the possible scenarios, the Project IRR without CDM revenue is less than the Benchmark. Hence the project is additional.

Step 2: Common Practice Analysis

As per step 4 of "Tool for demonstration assessment and of additionality" version 06.1.0, EB 69, the project has to compliment additionality with Common practice analysis as a credibility check. Common practice is applied as per Stepwise approach described hereunder.

1. Under this step, it is being demonstrated that the project activity is not a common practice in India by applying Step 4 of the latest version of the "Tool for demonstration and assessment of additionality" agreed by the CDM Executive Board at the time of start of the project activity.

✓ In terms of scale, there are very few combined cycle power plants of a similar scale (i.e. 382.5 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 one amongst the few combined cycle power plant in India possessing a combination of environment friendly features hitherto not used in other combined cycle power plant in India. The following are the main features:-

a) The Gas Turbines, SGT5-4000F (previously known as V94.3A) are "F" Class gas turbines that use several advanced technologies namely: Special metallurgy of Vanes and blades capable of withstanding much higher Turbine Inlet Temperature (TIT around 1200 Celsius) of combusted gas at inlet to gas turbine as compared with those of "E" 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 "E" class gas turbines that can be inspected by third party service providers. Moreover due to this reason spare Vanes 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 in our case), at a substantial cost, for refurbishment of these parts and for providing the services for their repairs. High temperature F class gas turbines have higher fuel efficiency (i.e. 57% at 100% load) than the standard E class turbines. Very few combined cycle power plants in India use such advanced class gas turbines.

b) A device called "GT Rotor Axial Positioning Device", which is a hydraulic device for fixing the axial position of Gas Turbine Rotor so as to optimize radial clearances of rotor blades. 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. 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.

c) The project activity is the second amongst those in operations and in construction to 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. (1147.5 MW SUGEN project being the first project to have such technology which was developed by Torrent Power Limited (TPL) only i.e. the project proponent itself and has been registered as a CDM Project vide reference no. 1116). Such configuration is equipped with Axial Flow Surface Condenser, which reduce the leaving losses of steam at the outlet of Steam Turbine (ST) and hence improves the efficiency of Combined Cycle Power Plant. 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.

d) The Fuel Burners are of special advanced design due to which the fuel gas combustion takes place in "pre-mix" mode light from beginning rather than first combusting in "diffusion" mode (up to about 30-40% load) and then changing over to "pre-mix". 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. These special technology gas burners have also to be covered under OEM (Siemens) service agreement for necessary inspection and servicing since such services are not available from any third party provider due to technology restrictions.

✓ Government also, in its Integrated Energy Policy, 2006, favoured power generation through coal for the next few decades owing to its low cost and easy availability.

2. The common practise analysis is performed as per Para 47 of the Tools for demonstration and assessment of additionality version 6.1.0, EB 69.

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

The capacity of the project activity being 382.5 MW, the +50% design output or capacity comes to 573.75 MW and -50% design output or capacity comes to 191.25 MW.

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

The project activity is located in India. Hence, the applicable geographical area for the project activity is India (i.e. the Host Country).

Case 1 Considering all plants irrespective of the fuel being used for generation of electricity

337 power plants are identified within the applicable output range as calculated in Step 1 that delivers the same output or capacity (i.e. other than hydro plants as the hydro plants cannot deliver base load) and have started commercial operation before the start date of the project. The details of such power plants are given in Appendix 4. Further, there are 10 power plants out of 337 power plants as identified above which are registered CDM project activity or project activity undergoing validation.

Total no. of power plants identified that deliver the same output or capacity (i.e. base load), within the applicable output range calculated in Step 1	337
Registered CDM project activity or project activity undergoing validation.	10
N_{all}	327

Case 2 Considering only natural gas based plants

27 natural gas based power plants are identified within the applicable output range as calculated in Step 1 that delivers the same output or capacity and have started commercial operation before the start date of the project. The details of such power plants are given in Appendix 4. Further, there are 10 power plants out of 27 power plants as identified above which are registered CDM project activity or project activity undergoing validation.

Total no. of natural gas based power plants identified that deliver the same output or capacity, within the applicable output range calculated in Step 1	27
Registered CDM project activity or project activity undergoing validation.	10
N_{all}	17

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

As per Para 9 of the Tools for demonstration and assessment of additionality version 6.1.0, EB 69, the Different technologies in the context of common practice are technologies that deliver the same output and differ by at least one of the following (as appropriate in the context of the measure applied in the proposed CDM project and applicable geographical area):

(a) Energy source/fuel;
(b) Feed stock;
(c) Size of installation (power capacity):
    (i) Micro (as defined in paragraph 24 of Decision 2/CMP.5 and paragraph 39 of Decision 3/CMP.6);
    (ii) Small (as defined in paragraph 28 of Decision 1/CMP.2);
    (iii) Large;
(d) Investment climate in the date of the investment decision, inter alia:
    (i) Access to technology;
    (ii) Subsidies or other financial flows;
    (iii) Promotional policies;
    (iv) Legal regulations;
(e) Other features, inter alia:
    (i) Unit cost of output (unit costs are considered different if they differ by at least 20 %).

Case 1

Under Para 9(a) of the Tools for demonstration and assessment of additionality version 6.1.0, EB 69, plants using different fuel are identified. 310 plants use fuel other than natural gas for power generation.

Under Para 9(d) of the Tools for demonstration and assessment of additionality version 6.1.0, EB 69, 10 power plants out of remaining 17 have been identified as having different technology under the investment climate (financial flows) as being set up by Electricity Board and Public Sector Units. Further, they are owned and operated by the State or Central Government entities.

Further, it may be noted that the investment climate that prevailed after the announcement of the 1991 policy where everything was done to facilitate private sector investment was completely reversed post 2002 after Dabhol's failure. Many power projects were shelved in the aftermath of Dabhol, and a number of foreign investors pulled out notably Cogentrix (Mangalore power project), China Light and Power (Hirma Power Project) & CMS Energy[83]. Thus, the projects that began implementation prior to 2002 faced very different and favourable investment climate (promotional policies) as compared to the projects that began implementation after 2002. Five out of seven remaining plants have the project start date of prior to 2002.

Hence, there are only two power plants which had the same environment as the project activity (i.e. PEDDAPURAM CCGT & KONASEEMA CCCP).

Different technologies	Technology Difference	Number of power plants in different technology
Energy source/Fuel	Opted for natural gas based power generation even though coal based power generation is the most plausible baseline scenario.	Fuel other than that used in project activity = **310**
	Private vs. Public (Total public sector plants i.e. State & center sector)	10
	Investment climate (Promotional Policies Pre 2002)	05
N_{diff}=		**325**

Case 2

Under Para 9(d) of the Tools for demonstration and assessment of additionality version 6.1.0, EB 69, 10 power plants have been identified as having different technology under the investment climate (financial flows) as being set up by Electricity Board and Public Sector Units. Further, they are owned and operated by the State or Central Government entities.

Further, it may be noted that the investment climate that prevailed after the announcement of the 1991 policy where everything was done to facilitate private sector investment was completely reversed post 2002 after Dabhol's failure. Many power projects were shelved in the aftermath of Dabhol, and a number of foreign investors pulled out notably Cogentrix (Mangalore power project), China Light and Power (Hirma Power Project) & CMS Energy[84]. Thus, the projects that began implementation prior to 2002 faced very different and favourable investment climate (promotional policies) as compared to the projects that began implementation after 2002. Five out of seven remaining plants have the project start date of prior to 2002.

[83] http://timesofindia.indiatimes.com/articleshow/1602986123.cms

[84] http://timesofindia.indiatimes.com/articleshow/1602986123.cms

Hence, there are only two power plants which had the same environment as the project activity (i.e. PEDDAPURAM CCGT & KONASEEMA CCCP).

Private vs. Public (Total public sector plants i.e. State & center sector)	10
Investment climate (Promotional Policies Pre 2002)	05
N_{diff}	15

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

Case 1

The share of plants using technology similar to the technology used in the proposed project activity in all plants that deliver the same output or capacity as the proposed project activity is:

$F = 1 - N_{diff}/N_{all}$
$= 1 - 325/327$
$= 1 - 0.993884$
$= \mathbf{0.006116}$

$N_{all} - N_{diff} = 327 - 325 = \mathbf{2}$

Case 2

$F = 1 - N_{diff}/N_{all}$
$= 1 - 15/17$
$= 1 - 0.8823$
$= 0.1176$

$N_{all} - N_{diff} = 17 - 15 = 02$

As per Para 47 of the Tools for demonstration and assessment of additionality version 6.1.0, EB 69, the proposed project activity is a common practice within a sector in the applicable geographical area if the factor F is greater than 0.2 and $N_{all} - N_{diff}$ is greater than 3. Here, in both the cases of proposed project activity, the factor F, as calculated above, is not greater than 0.2 and $N_{all} - N_{diff}$ is less than 3.

Thus, it can be said that the proposed project activity is not a common practice within a sector in the applicable geographical area.

3.

Step 3: Impact of CDM registration

The latest version of "Tool for demonstration and assessment of additionality" version 06.1.0 does not contain this Step 5 as the same has been removed in EB 29 and therefore this Step has not been analyzed.

Timeline of the proposed CDM project activity in chronological order

Events	Date	Description of the evidence
Investment Decision	28/01/2010	Board Resolution
Main plant construction i.e. Start of project activity / Real action	02/07/2010	Notice to Proceed under the Engineering Procurement and Construction (EPC) Contract for main plant construction was issued
Prior consideration filed to UNFCCC and DNA (India)	30/11/2010	Prior consideration document (http://cdm.unfccc.int/Projects/PriorCDM/notifications/index_html)
Received Offer for Validation	23/06/2010	
Appointment of Validator	30/03/2012	Validation Contract

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 electricity generation (PE_y) are calculated in accordance with and as per equation $PE_y = \Sigma FC_{f,y} * COEF_{f,y}$ (no 1 of AM0029 Version 03, EB 39).The sub variable $COEF_{f,y}$ to be calculated in accordance with and as per equation $COEF_{f,y} = \Sigma NCV_y * EF_{CO2f,f,y} * OXID_f$ (no (1a) of AM0029 Version 03,EB 39)	The Project Activity is on-site combustion of natural gas (including LNG) to generate electricity and the design of the project power plant is to use natural gas (including LNG) 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 $BE_y = EG_{PJ,y} * EF_{BL,CO2,y}$ (no 2 of AM0029 Version 03, EB 39)	For construction of large new power capacity additions under the CDM, there is a considerable uncertainty relating to which type of other power generation is substituted by the power generation of the project plant. This depends on many factors and assumptions (e.g. whether there is a supply deficit) that are difficult to determine and that change over time. In order to address this uncertainty in a conservative manner, the Project Participants shall use for $EF_{BL, CO2,y}$ the lowest emission factor among the options 1, 2 & 3 as per AM0029. Under option 1 for calculating baseline emissions (i.e. the Build

Steps	Description	Equation Used	Methodological choices
			Margin), as per "Tool to calculate the emission factor for an electricity system" Under option 2, The combined margin, calculated according to "Tool to calculate the emission factor for an electricity system", using a 50/50 OM/BM weight; For option 3, domestic coal fired using sub critical boiler 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 3 of AM0029. 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 Tool to calculate emission factor for an electricity system), and therefore the Build Margin as per Tool to calculate emission factor for an electricity system define $EF_{BL, CO2,y}$. As Option 1 is selected, it will be estimated ex-post as stated in AM0029 and described in Tool to calculate emission factor for an electricity system during the crediting period.
C	**Procedure followed for estimating leakages (LE_y)**	Leakage emissions are calculated in accordance with and as per equation $LE_y = LE_{CH4,y} + LE_{LNG,CO2,y}$ (no 4 of AM0029 Version 03, EB 39)	
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 $LE_{CH4,y} = [FC_y * NCV_y * EF_{NG, upstream,CH4} - EG_{PJ,y} * EF_{BL, upstream,CH4}]*GWP_{CH4}$ (no 5 of AM0029 Version 03, EB 39)	As per AM0029, the emission factor for upstream fugitive CH_4 emissions occurring in the absence of the project activity should be calculated consistent with the baseline emission factor and the baseline emissions are calculated based on option 1. Hence

Steps	Description	Equation Used	Methodological choices
			the emission factor for upstream fugitive CH_4 emissions occurring in the absence of the project activity is derived using the equation given on page 7 of AM0029. 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), Gorgon (Australia), Petronet LNG (India) and Gas Production facilities at Reliance Industries Limited and (b) Gas transportation and distribution facilities of Gujarat State Petronet Ltd. (GSPL) and Reliance Gas Transportation Infrastructure Limited (RGTIL) are predominantly of recent vintage and are built and operated to international standards such as API, ASMI and ASTM (supporting proof has been provided to the validation team). The details justifying such a claim include the following: **<u>Gas Processing system</u>** **RasGas (Qatar):** RasGas has currently seven trains in operation. The engineering, procurement and construction management (EPCM) services contract for these trains was given to a joint venture between Chiyoda Corporation and Technip France[85]. The LNG that is sourced by Petronet

[85] As per RasGas Magazine on "Train 6: from concept to reality" providing detail of EPC of Gas Processing System of Ras Gas Qatar. (Copy of document is provided to DOE)

Steps	Description	Equation Used	Methodological choices
			LNG Ltd. from Rasgas comes from its Liquefaction Train No. 3. This train is owned by Ras Laffan Liquefied Natural Gas Company Limited (II) (RasGas II), operated by RasGas Company Limited (RasGas) which is a Qatari Joint Stock Company established in 2001 by Qatar Petroleum (70%) and an Oil Major, Exxon Mobil (30%)[86]. Several technological firsts helped Train 3 to become one of the most optimised LNG trains ever built. Trains 3, 4 and 5 represent one of the largest and most innovative LNG projects ever completed. Train 3 offshore facilities marked the switch from a dry-gas (gas and condensate) to a wet-gas (Gas, condensate and water) scheme, eliminating the need for process platforms and thereby reducing project cost. It set the pace for the development of RasGas' two 'mega-trains': Trains 6 and 7, the offshore EPC contract of which was awarded to J Ray McDermott, the company responsible for constructing all RasGas' offshore platform facilities to date. Trains 6 and 7 build on the success of existing RasGas expansion projects in terms of technology, design, project specifications, existing infrastructure and location. It can thus be concluded that these liquefaction trains are built and operated to international standards. The commercially proven technology for construction of liquefaction of terminals is currently of US origin. **Gorgon (Australia):** Gorgon is one of the world's largest natural gas projects and the largest single resource natural gas project in Australia's history. The complexity

[86] The company detail of Ras Gas Qatar (Copy of document is provided to DOE)

Steps	Description	Equation Used	Methodological choices
			and sheer scale of Gorgon is unprecedented. It is a modern-day scheme – a long-term, technically complex energy development signifying a dramatic advancement of engineering combined with world-class technology and expertise. The upstream EPC contractor is Gorgon Upstream Joint Venture (GUJV) a 50/50 joint venture between Technip and JP Kenny.Vetcogray, an international subsidiary of GE specializing in upstream subsea equipment, drillings, completion and production technology has been awarded the five-year Master Service Agreement for subsea equipment supply and services to the Gorgon Project. Thus it can be said that the Gorgon Project is built and operated to international standards[87]. **Petronet LNG Ltd. (PLL) – Dahej LNG Terminal:** Incorporated in April 1998, PLL has set up LNG Receiving and Regasification Terminal with an original nameplate capacity of 5 MMTPA at Dahej, Gujarat. The infrastructure was developed in the shortest possible time and at a benchmark cost. The capacity of the terminal has been expanded to 10 MMTPA and the same has been commissioned in June, 2009. The expansion involved construction of 2 additional LNG storage tanks and other vaporization facilities. PLL is currently the largest domestic importer of LNG in India. It is a joint venture company promoted by four government run oil companies i.e. ONGC, IOC, GAIL and BPCL (holding 12.5% each), French gas major and a strategic investor GdF Suez (holding 10%) and Asian

[87] http://www.projectconnect.com.au/Project_Details.asp?PID=213 (Copy of document is provided to DOE)

Steps	Description	Equation Used	Methodological choices
			Development Bank (holding 5.2%). GdF, whose business covers every aspect of the energy business viz. natural gas exploration & production, electricity production, gas supply, energy trading, supplying power, infrastructure management, transmission, liquefied natural gas (LNG) and other applications. GdF's vast experience has been of immense value while setting up Dahej LNG Terminal. The construction of the LNG terminal at Dahej was executed through a lump sum turnkey engineering, procurement, and construction (EPC) contract issued by a consortium of companies led by Ishikawajima Harima-Heavy Industries Corporation Limited (IHI), Japan. The other members of the consortium are Ballast Nedam International BV-Netherlands, Toyo Engineering India Limited, Toyo Engineering Corporation, Itochu Corporation, and Mitsui Company Limited. IHI is one of the most reputable construction companies in the world in the field of LNG regasification terminals. This terminal was commissioned in the first quarter of 2004. The Dahej LNG terminal received International standards Organization (ISO) 9001 certification for quality management system in its first year of operation. The terminal also has received Occupational Health and Safety Management system 18001 certification, and ISO 14001 certification for its Environment Management System in 2005. The company has plans to increase the capacity upto 15 mmtpa. Thus it can be seen that the Dahej LNG Terminal of Petronet LNG Ltd. is of

Steps	Description	Equation Used	Methodological choices
			recent vintage and is built and operated to international standards. **<u>Gas Production system</u>** **Reliance Industries Limited: KG-D6 Gas:** Reliance Industries Limited, the largest private sector company in India, started its oil and gas exploration and production operations in 2001 and has rapidly become a major participant in the E&P arena. It announced India's biggest gas discovery in nearly three decades and one of the largest gas discoveries in the world during 2002 i.e. the 8,100 km² KG-DWN-98 / l (KG-D6) block in the Krishna-Godavari basin of the Bay of Bengal on India's east coast. The seabed slopes sharply causing water depths to vary between 700m (2,297ft) and 1,700m (5,577ft). Work at the KG-D6 field included the development of at least 18 production wells, with subsea equipment, pipelines, a riser platform and an onshore terminal. In January 2006 Reliance awarded the overall EPCM contract for the project to US-based Bechtel. Bechtel has developed India's first deepwater gas field in the Bay of Bengal. The KG-D6 Gas project, for Reliance Industries Limited, encompassed subsea equipment, pipelines, a riser platform, and an onshore terminal. Bechtel managed engineering, procurement, installation, and commissioning of the project, which had an initial capacity of 2.8 billion cubic feet of gas per day--significantly increasing India's production capacity. The project comprised 22 subsea wells in water up to 3,937 feet (1,200 meters) deep, with the potential to expand to 50 wells. Most of the wells are 22 to 25

Steps	Description	Equation Used	Methodological choices
			miles (35 to 40 kilometers) offshore. This is the first ever discovery by an Indian private sector company. The project also included routing seven pipelines up the Nilarevu River, and construction of a large onshore gas terminal 18.6 miles (30 kilometers) south of Kakinada to receive the gas from the offshore system, dehydrate it, compress it, and feed it into an onshore pipeline that leads to Mumbai).[88] The state of the art technologies from Schlumberger Wireline and Logging while drilling (LWD) was used by RIL. The E&P's KG-D6 has won the 'Innovation for India Awards 2010' instituted by the Marico Innovation Foundation for their combined synthesis of advanced technologies, extreme engineering, innovative execution, yielding unprecedented results and impact on India's energy security. All these prove that the gas production technology at Reliance is of recent vintage and built and operated to international standards. **Gas Transportation and Distribution** **Gujarat State Petronet Limited (GSPL)** GSPL was set up to complement the efforts of GSPC. While GSPC harnesses and procures natural gas, GSPL builds the infrastructure that transmits the gas across the state of Gujarat (state in which the project activity is located) and ultimately allows last-mile linkage to the end-user. GSPL lays a gas grid, to facilitate gas transmission from supply points to demand centres. Presently, the Gujarat State Petronet Ltd. transmits

[88] http://www.bechtel.com/KGD6.html (Copy of document is provided to DOE)

Steps	Description	Equation Used	Methodological choices
			over 35 MMSCMD of natural gas. The gas grid is equipped with the latest bi-directional gas transmission technology to enable two-way gas flow. This introduces a lot of flexibility into transmission by allowing gas to be sourced or uploaded at either end of the pipeline network. Besides, the network is continuously monitored using SCADA systems integrated with GIS technology. GSPL's Operation & Maintenance function is ISO 9001:2000, ISO 14001:2004 & OHSAS 18001:2007 certified[89]. Thus, 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. **Reliance Gas Transportation Infrastructure Limited (RGTIL)** RGTIL is engaged in Natural Gas transmission and distribution business. Triggering on the discovery of gas by RIL in KGD6 field in the year 2002 at east coast of India, RGTIL embarked upon building the East-West Pipeline (EWPL), the largest Greenfield pipeline development ever undertaken in the country. In 2006 Stroytransgaz signed a contract with RGTIL to build the largest gas pipeline system in India. Commencement of commercial operations of EWPL in late 2008, has transformed the landscape of gas transmission infrastructure in the country at one stroke by adding over 1400 km of high pressure pipeline network with a transportation

[89] http://www.gspcgroup.com (Copy of document is provided to DOE)

Steps	Description	Equation Used	Methodological choices
			capacity of 80 MMSCMD. RGTIL has recently built and commissioned East West Gas Pipeline (EWPL) for transporting gas from Kakinada (Andhra Pradesh) to Bharuch (Gujarat). EWPL is a 48 inch uniform diameter (API 5L Grade X-70) pipeline across the entire trunk length of around 1375 km with wall thicknesses 17.2, 20.7 and 25.4 mm depending on the code requirement. The pipeline is 3LPE (three layer polyethylene) coated; internally epoxy lined, helically spiral submerged arc welded (for 17.2 mm) and longitudinal submerged arc welded (for 20.7 mm and 25.4 mm). Impressed current cathodic protection system has been provided to supplement the coating system for protection against external corrosion. Maximum Allowable Operating Pressure (MAOP) of the pipeline is 98.0 bar (g). The pipeline has been designed and engineered in accordance with the requirement of applicable codes and standard (ASME B 31.8) and conforming to the Oil Industry Safety Directorate's (OISD) standards 138 and 141 and other rules and regulations. Mainline block valves (MLVs) have been provided en-route the pipeline at regular interval conforming to code requirements. EWPL System is remotely operated and controlled with the help of State-of-the-art Supervisory Control and Data Acquisition (SCADA) system. Optical fiber cable (OFC) based telecommunication system is provided for effective long distance communication. Pipeline Application Software (PAS) comprises of leak detection and location, operation optimization, line pack calculations and survival analysis, pig tracking

Steps	Description	Equation Used	Methodological choices
			and look-ahead modules. Security Automation System is provided for monitoring and access control. Pipeline Operations Centre of EWPL is located in Navi Mumbai and backup operations centre is located at Gadimoga Kakinada near OT, called MPOC and GPOC respectively[90]. Thus, it can be said that Gas Transportation and Distribution facilities of RGTIL are predominantly of recent vintage and are built and operated to international standard. 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 $LE_{LNG,CO2,y} = FC_y * EF_{CO2, upstream,LNG}$ contained in AM0029 Version 03, EB 39.	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 $ER_y = BE_y - PE_y - LE_y$ (no 6 of AM0029 Version 03, EB 39)	

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:	$EF_{grid,BM,y}$
Data unit:	tCO_2/GWh
Description:	Build margin CO_2 emission factor for the project electricity system in year *y* in tonnes of CO_2 per GWh.

[90] http://www.rgtil.com/pipelines_ewpl_overview.html

Source of data used:	"CO_2 Baseline Database January 2012" for the "Indian Power Sector" provided by Central Electricity Authority (CEA) Ministry of Power ,Government of India (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm)
Value applied:	858.78
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:	$EF_{grid,CM,y}$
Data unit:	tCO_2/GWh
Description:	Combined margin CO_2 emission factor for the project electricity system in year *y* in tonnes of CO_2 per GWh.
Source of data used:	"CO_2 Baseline Database January 2012" for the "Indian Power Sector" provided by Central Electricity Authority (CEA) Ministry of Power ,Government of India (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm)
Value applied:	920
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 domestic coal for power generation.
Source of data used:	GCV and conversion factor (GCV to NCV) sourced from "CO_2 Baseline Database March 2011" for the "Indian Power Sector" provided by Central Electricity Authority (CEA) Ministry of Power ,Government of India (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm)
Value applied:	3755 KCal/Kg / 1.036 (GCV to NCV conversion factor) * 4.186 KJ/KCal / 10^3 = 15.17 GJ/tonne

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:	CO_2 emission factor per unit of energy of coal.
Source of data used:	CO_2 Baseline Database January 2012 for the "Indian Power Sector" provided by Central Electricity Authority (CEA) Ministry of Power ,Government of India (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.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 January 2012 for the "Indian Power Sector" provided by Central Electricity Authority (CEA) Ministry of Power ,Government of India (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.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:	Specified by Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 for non-coking domestic coal power generation. (www.cercind.gov.in)
Value applied:	37.78%
Justification of the choice of data or description of measurement methods and procedures actually applied:	The Data has been collected from Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009 for non-coking domestic coal power generation (official source). Further, the same is in line with estimated energy efficiency of baseline scenario as identified under section B.4
Any comment:	Nil.

C. Leakages

C.1

Data / Parameter:	$EF_{NG, upstream, CH4}$
Data unit:	tCH_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
Justification of the choice of data or description of measurement methods and procedures actually applied:	Data has been collected from official sources. US/Canada values have been chosen. The justification for the same in given in step C.1 of section B.6.1.
Any comment:	Nil.

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. **Estimated annual baseline emissions**

Parameters	Description	Source	Data Unit	Value
Build margin CO_2 emission factor for the	$EF_{grid,BM,y}$	CO_2 Baseline Database January 2012" for the "Indian Power Sector"	t CO_2/GWh	858.78

baseline grid (NEWNE grid) i.e. the Project electricity system		provided by Central Electricity Authority (CEA) Ministry of Power ,Government of India (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm)		
Combined margin CO_2 emission factor for the baseline grid (NEWNE grid) i.e. the Project electricity system	$EF_{grid,CM,y}$	CO_2 Baseline Database January 2012" for the "Indian Power Sector" provided by Central Electricity Authority (CEA) Ministry of Power ,Government of India (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm)	t CO_2/GWh	920.00
Net calorific value for non-coking domestic coal for power generation	NCV_{coal}	GCV and conversion factor (GCV to NCV) sourced from CO2 Baseline Database January 2012" for the "Indian Power Sector" provided by Central Electricity Authority (CEA) Ministry of Power ,Government of India (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm) Please refer Annex 3 for calculation	KCal/ Kg (to be converted into GJ/tonne)	15.17
CO_2 emission factor per unit of energy of coal.	$EF_{CO2,coal}$	CO_2 Baseline Database January 2012" for the "Indian Power Sector" provided by Central Electricity Authority (CEA) Ministry of Power ,Government of India (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm) Please refer Annex 3 for calculation	gCO_2/MJ (to be converted to t CO_2 /TJ)	95.80
Oxidation factor of coal.	$OXID_{coal}$	CO_2 Baseline Database January 2012" for the "Indian Power Sector" provided by Central Electricity Authority (CEA) Ministry of Power ,Government of India (http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm)	NIL	0.98
Fuel CO_2 emission co-efficient	$COEF_{coal}$	Calculated As: $(NCV_{coal} * EF_{CO2,coal} * OXID_{coal}) / NCV_{coal} / 10^3$ Please refer Annex 3 for calculation	tCO_2e/GJ	0.093884
The energy efficiency of the most likely baseline scenario	η_{BL}	Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009(www.cercind.gov.in)	%	37.78%
Emission factor of the most likely baseline	$EF_{BL,CO2}$	Calculated as per equation no. 3 of AM0029:	tCO_2/GWh	894.64

scenario		((COEF $_{BL}$ * 3.6) / η_{BL}) * 1000 Please refer Annex 3 for calculation		
Baseline emissions factor	EF $_{BL,CO2,y}$	The lowest emission factor among the Build Margin, Combined Margin and the Emission factor of the most likely baseline scenario as per AM0029.	tCO_2/GWh	858.78
Project electricity generation (i.e. net evacuation to the grid)	$EG_{PJ,y}$	Estimated for ex-ante calculation Please refer Annex 3 for calculation	GWh	2,762.65
Estimated annual baseline emissions	**BE_y**	**Calculated as per equation no. 2 of AM0029:** **$EG_{PJ,y}$ * EF $_{BL,CO2,y}$**	**tCO_2**	**2,372,510.41**

2. **Estimated annual project emissions**

Parameters	Description	Source	Data Unit	Value
Volume of fuel combusted in project plant	FC $_{f, y}$	Estimated for ex-ante calculation Please refer Annex 3 for calculation	m^3	504,355,190.95
Net calorific value of fuel combusted in project plant	$NCV_{f,y}$	Estimated for ex-ante calculation Please refer Annex 3 for calculation	GJ/ m^3	0.035752
CO_2 emission factor per unit of energy of fuel combusted in project plant	$EF_{CO2,f,y}$	Table 1-4 Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories due to unavailability of fuel transporter or local data. Please refer Annex 3 for calculation	t CO2/GJ	0.056100
Oxidation factor of fuel combusted in project plant	$OXID_f$	Current IPCC default values	Nil	1.00
CO_2 emission co-efficient of fuel combusted in project plant	$COEF_{f,y}$	As per equation 1(a) of AM0029: $\Sigma NCV_y * EF_{CO2f,f,y} * OXID_f$	tCO2/ m^3	0.00200570
Estimated annual project emissions	**PE $_y$**	**Calculated as per equation (1) of AM0029:** **FC $_{f, y}$ * $COEF_{f,y}$**	**tCO_2**	**1,011,585.70**

3. **Estimated annual Leakages**

Parameters	**Description**	**Source**	**Data Unit**	**Value**
Emission factor for upstream fugitive	EF $_{NG,}$	Table- 2 of AM0029.	tCH_4/ GJ	0.00016000

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	$_{upstream, CH4}$	US/Canada values have been chosen. The justification for the same in given in Steps C.1 of section B.6.1.		
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	$EF_{BL, upstream, CH4}$	Procedure followed for estimating Leakage) of section B.6.1 "Explanation of Methodological Choices". Please refer Annex 3 for calculation	tCH_4/MWh	0.00051304
Global warming potential of methane valid for the relevant commitment period	GWP_{CH4}	Data collected from IPCC Fourth Assessment Report: Climate Change 2007	Nil	21.00
The estimated leakage emissions due to fugitive upstream CH4 emissions	$LE_{CH4, y}$	Calculated as per equation no. 5 of AM0029 $[FC_{f,y} * NCV_{f,y} * EF_{NG, upstream, CH4} - EG_{PJ,y} * EF_{BL, upstream, CH4}] * GWP_{CH4}$ Please refer Annex 3 for calculation	tCO_2e	30,822.56
Volume of LNG combusted in project plant	$FC_{LNG\ y}$	Estimated for ex-ante calculation Please refer Annex 3 for calculation	TJ	9,917.51
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	$EF_{CO2, upstream, LNG}$	Please refer explanation in Part C2 of Section B.6.1 in line with AM0029	$t\ CO_2/\ TJ$	6.00
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 equation given on page no. 9 of 14 $FC_{LNG\ y} * EF_{CO2, upstream, LNG}$ Please refer Annex 3 for calculation	tCO_2e	59,505.04

Leakages	**LE_y**	**Calculated as per equation no 4 of AM0029 Please refer Annex 3 for calculation**	**tCO_2e**	**90,327.61**

4. **Estimated annual Emission Reduction**

Parameters	Description	Source	Data Unit	Value
Estimated Annual Emission Reduction	**ER y**	**Calculated as per equation no 6 of AM0029 version 3.0 BEy - PE y - LEy Please refer Annex 3**	**tCO2e**	**1,270,597.11**

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)**
2013 (From 2nd April to 31st December)	759,382	1,781,008	67,808	**953,818**
2014	1,011,586	2,372,510	90,328	**1,270,597**
2015	1,011,586	2,372,510	90,328	**1,270,597**
2016	1,011,586	2,372,510	90,328	**1,270,597**
2017	1,011,586	2,372,510	90,328	**1,270,597**
2018	1,011,586	2,372,510	90,328	**1,270,597**
2019	1,011,586	2,372,510	90,328	**1,270,597**
2020	1,011,586	2,372,510	90,328	**1,270,597**
2021	1,011,586	2,372,510	90,328	**1,270,597**
2022	1,011,586	2,372,510	90,328	**1,270,597**
2023 (1st January to 1st April)	252,204	591,503	22,520	**316,779**
Total (tonnes of CO2e)	10,115,857	23,725,104	903,276	**12,705,971**
*** 2013- 2014 from 2nd April 2013**				

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, whichever occurs later.

B.7.1 Data and parameters monitored:

A - Monitoring parameters for the Baseline emission factor:
A1:

Data / Parameter:	Build Margin CO_2 emission factor ($EF_{grid, BM,y}$ or $EF_{BL,CO2,Y}$)
Data unit:	tCO_2/ GWh
Description:	Build margin CO2 emission factor for the baseline grid (NEWNE grid) i.e. the Project electricity system
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. The latest version of such database will be used. 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 shall be used. Otherwise, this parameter shall be calculated as provided in "Tool to calculate the emission factor for an electricity system version 2.2.1"
Value of data applied for the purpose of calculating expected emission reductions in section B.5	858.78 t CO2/GWh
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 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.

A2:

Data / Parameter:	$EG_{PJ, y}$
Data unit:	MWh
Description:	Net annual electricity generated in the project plant (delivered to the baseline grid) during any year 'y'. In case the monitoring and verification period selected is

	different from a full 12 months period, actual net electricity delivered to the grid for such period will be used.
Source of data to be used:	Measured and recorded by the meter installed in the plant complying with the applicable regulatory requirement. Data will be recorded and archived in the power plant.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	2,762,652.15 MWh
Description of measurement methods and procedures to be applied:	The meter will be installed (main meter and check meter on all outgoing lines) as per applicable regulatory requirement and will be used for the measurement of net electricity generated from the project activity and delivered to the grid.
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 0.2S. The measurement and calibration procedure shall be done as specified in the CEA (Government/Regulatory authority) regulations (currently once in five years (http://www.cea.nic.in/reports/regulation/meter_reg.pdf - page 12). The data will be cross-verified with weekly statement issued by the authority (state / central as applicable) and in order of being conservative the lower of two data will be considered for the monitoring period.
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: Monitoring parameters for Project Activity:

B1:

Data / Parameter:	$FC_{f,y}$
Data unit:	m^3
Description:	Annual quantity of natural gas (including LNG) 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:	Fuel flow meter reading at the project boundary. The consumption of natural gas (including LNG, if any) 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 Transporter(s) bills. In case of any significant difference (i.e. plus or minus 1%) in the consumption figures, the higher of the two readings (project-end and Natural Gas Transporter's end) for the monitoring period would be used in order to be conservative.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	504,355,190.95 m^3
Description of measurement methods	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

and procedures to be applied:	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 (currently it provides for 16 years validity)
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:	GJ/m^3 (available in KCal/m3 to be converted to GJ/m^3 by multiplying with (4.186/10^6), since 1 Cal = 4.186 J)
Description:	This is average 'Net Calorific Value' of natural gas to be consumed in the project activity for each day. In case, Gross Calorific Value (GCV) is available instead of NCV, then GCV to NCV conversion will be completed based on gas characteristics required for conversion of GCV to NCV obtained from the gas transporter(s).. These values will be obtained fortnightly.
Source of data to be used:	The data for NCV (GCV if available instead) will be provided by the gas transporter(s). In case GCV is available, then gas characteristics required for conversion of GCV to NCV will be obtained from the gas transporter(s).
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.035752 GJ/m^3
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.

B3:

Data / Parameter:	$EF_{CO2,f,y}$
Data unit:	tCO_2/GJ
Description:	Emission factor for natural gas (including LNG) in tonnes of carbon dioxide per Giga Joule.
Source of data to be used:	IPCC values
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 : $COEF_{f,y} = \sum NCV_{f,y} * EF_{CO2,f,y} * OXID_f$ Where, $\sum NCV_{f,y}$ 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	0.00200570 tCO_2/m^3
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.

B.6

Data / Parameter:	PE_y
Data unit:	tCO_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-1of AM0029.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1,011,585.70 tCO_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 (including LNG) combusted in the project plant during the year "y" in cubic meters. 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:	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	504,355,190.95 m^3

calculating expected emission reductions in section B.5	
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:	$NCV_{NG,y}$ or NCV_{y}
Data unit:	GJ/ m^3 (available in KCal/m3 to be converted to GJ/m^3 by multiplying with (4.186/10^6), since 1 Cal = 4.186 J)
Description:	This is average 'Net Calorific Value' of natural gas to be consumed in the project activity for each day. 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 fortnightly.
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	0.035752 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 baseline grid) during any year 'y'. In case the monitoring and verification period selected is different from a full 12 months period, actual net electricity delivered to the grid for such period will be used.
Source of data to be used:	Measured and recorded by the meter installed in the plant complying with the applicable regulatory requirement. Data will be recorded and archived in the power plant.
Value of data applied for the purpose of calculating expected	2,762,652.15 MWh

emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Refer to table A.2 "Net electricity generated in the plant" under sub section B " Monitoring parameters for project activity" of section B.7.1
QA/QC procedures to be applied:	Refer to table A.2 "Net electricity generated in the plant" under sub section B " Monitoring parameters for project activity" of section B.7.1
Any comment:	Refer to table A.2 "Net electricity generated in the plant" under sub section B "Monitoring parameters for project activity" of section B.7.1

C.4:

Data / Parameter:	$FC_{LNG,y}$ (for CO_2 emissions from LNG)
Data unit:	Terra Joules (available in m^3 to be converted in terms of Tera Joules on the basis of a) GCV of Gas provided by fuel transporter(s) and b) 1 calories = 4.186 joules)
Description:	Quantity of LNG consumed during the year "y" in terms of cubic meters. In case, monitoring and verification are planned to be completed for lesser or greater duration than a year, this parameter will be actual LNG consumption value for such period.
Source of data to be used:	As the quantity of LNG consumed is likely to vary on day to day basis, Daily value provided by fuel transporters on fortnightly basis will be used.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	239,798,432.10 m^3 (which is to be converted in terms of Tera Joules on the basis of a) GCV of Gas provided by fuel transporter(s) and b) 1 calories =4.186 joules) or 9,917.51 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 the fuel transporter and verified with the fortnightly invoices raised by the fuel transporter 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. 2) The reason for including this as a parameter for monitoring is that this data varies and is required for calculating $LE_{LNG,CO2,y}$.

C.5:

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 tCH_4 per MWh electricity generation in the project plant.
Source of data used:	It will be calculated for power plants included in the Build Margin, in line with the baseline emission factor. This data will be computed consistent with the Build Margin emission factor i.e. the baseline emission factor based on latest available information from (a) Central Electricity Authority, Ministry of Power, Government of India, (b) AM 0029, version 03 and/or(c) other reliable data sources which are available in public domain.

Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.000513040 tCH_4/ MWh
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 are required.
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.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 (TPL) 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 is 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 18/02/2012**.**

(3) Mr. Ashok Modi of Torrent Power Limited (TPL). is responsible for the application of the baseline and monitoring methodology to the project activity and the entity (viz. Torrent Power Limited (TPL) is also a project participant listed in Annexure-1

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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:

02/07/2010, which is the date, the Notice to Proceed under Engineering Procurement and Construction contract for main plant construction was issued

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

The project activity is expected to be operational for a period of 25 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:

Later of 02/04/2013 or a date not earlier than the date of request for registration

C.2.2.2. Length:

10 years 00 months 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. By notification of the Government of India in the Ministry of Environment and Forests, vide number S.O.1533(E), dated 14/09/2006 the required construction of new projects or activities or the expansion or modernization of existing projects shall be undertaken in any part of India only after prior environmental clearance[91]. 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. There would be 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 of 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 *appendix-3*.

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

[91] http://envfor.nic.in/legis/eia/so1533.pdf (Copy of document is provided to DOE)

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 Power Limited (TPL) 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

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

Torrent Power Limited (TPL) 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 Power Limited (TPL) sent out a notice on 14/11/2011 to representatives of various stakeholder groups viz Government of Gujarat, Gujarat Control Pollution Board, NGOs, representatives of surrounding villages, contractors, employees of Torrent Power Limited (TPL) and consultants, with a brief on the project, informing them of the proposed meeting on 25/11/2011 at UNOSUGEN Project Site, Off National Highway No. 8, Taluka Kamrej, Surat District (where the project activity is located) 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 14/11/2011. This notice also gave time for the various stakeholders to file their observations by 5:00 pm on 30/11/2011 in writing.

There were 51 participants representing various parties including from local communities, NGOs, state government, employees, and contractors who attended the meeting on 25/11/2011. Villagers from the vicinity also showed interest in the project and related social and environmental development activities.

The meeting agenda was as follows:

Sr No	Agenda Item
1.	Welcome address to the representatives
2.	Election of a Chairperson for the meeting by the stakeholder group representatives from amongst themselves.
3.	Introduction on CDM on request from Chair.
4.	Introduction of the project on request from the Chair.
5.	Open house discussion on the merits of the project with permission of the Chair.
6.	Circulation of questionnaire and compilation of the response received.
7.	Preparation and circulation of draft Minutes of the Meeting and signing of the MOM.

E.2. Summary of the comments received:

The Chairman called upon the participants to seek clarifications on the likely impacts of the project and it being structured as clean development mechanism project under Kyoto Protocol and to express their opinion on the project. The participants sought clarifications on Kyoto Protocol and Clean Development Mechanism process.

The stakeholders viewed Torrent Group as a reputed group of companies contributing to local economy. There were no adverse comments received and the stakeholders were appreciative of the project being undertaken. Overall there was agreement that the proposed project was a beneficial project from sustainability viewpoint. Further, they were also in agreement of the beneficial effects of the said project activity and expressed their views that such type of projects should be promoted.

After the detailed discussion / interaction on the pros and cons of this project, the Chairman and the President – Kamrej Taluka Panchayat appreciated the positive and constructive role played by Torrent Power Limited (TPL) by bringing up much needed power generation capacity in the region and in the process ensuring all-round development of the surrounding regions. The chairman summarized the concerns articulated and clarifications

provided. Specific concerns and their clarification thereof by Torrent Power Limited (TPL) are shown in the table in section E.3.

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

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

A local stakeholders' consultation meeting for 382.5 MW UNOSUGEN Natural gas based grid connected Combined cycle power generation project was convened on 25/11/2011 at 10:30 a.m. at UNOSUGEN Project Site, Off National Highway No. 8, Taluka Kamrej, Dist. Surat 394155, Gujarat, India. The detail of proceeding of the meeting is given below:

Mr. Jinal Mehta from Torrent Power Limited (TPL) introduced about Torrent Power Limited (TPL) and welcomed Mr. J. V. Bhatt (Mamlatdar & Executive Magistrate, Taluka Kamrej), Mr. R. V. Modi (President – Kamrej Taluka Panchayat), Local Villagers, NGOs, contractors, employees & all other stakeholders who devoted their time and effort to attend the meeting. He introduced the objective of the meeting.

Mr. Jinal Mehta from Torrent Power Limited (TPL) requested the participants to elect a chairman to conduct the meeting. Mr. Shantilal Gajjar (Sarpach of Dhoran Pardi Village), proposed the name of Mr. J. V. Bhatt, (Mamlatdar & Executive Magistrate, Taluka Kamrej), Mr. Jayantibhai Parmar (Deputy Sarpanch of Navi Pardi Village) seconded the proposal. Accordingly Mr. J. V. Bhatt (Mamlatdar & Executive Magistrate, Taluka Kamrej), was elected as the chairman and conducted the meeting.

Mr. Jinal Mehta from Torrent Power Limited (TPL) was invited to provide a brief on the Kyoto Protocol and Clean Development Mechanism. He explained how carbon levels and greenhouse gases in the atmosphere is increasing and its impact to the global warming. Then he briefed the participants about the Kyoto Protocol and Clean Development Mechanism there in and elaborated the need for the project under this mechanism to catalyze sustainable development. He briefed about the current power scenario in India and informed that the power generation in India is dominated by coal based generation which emits higher green house gases. Compared to this UNOSUGEN Power Project being natural gas based emits much lower gases and is thus beneficial for the environment.

Mr. Jinal Mehta from Torrent Power Limited (TPL) explained salient features of the project. Further he explained how the project will lead to substantial greenhouse gas emissions reductions due to the use of a less carbon intensive fuel and a much higher efficient power generation. He also explained stakeholders about contribution of the project in Social well being, Economic well being, Environmental well being and Technological well being i.e. contribution of the project towards sustainable development.

The Chairman called upon the participants to seek clarifications on the likely impacts of the project and it being structured as clean development mechanism project under Kyoto Protocol and to express their opinion on the project. The participants sought clarifications on Kyoto Protocol and Clean Development Mechanism process.

The stakeholders viewed Torrent Group as a reputed group of companies contributing to local economy. There were no adverse comments received and the stakeholders were appreciative of the project being undertaken. Overall there was agreement that the proposed project was a beneficial project from sustainability viewpoint. Further, they were also in agreement of the beneficial effects of the said project activity and expressed their views that such type of projects should be promoted.

The Chairman Mr. J.V. Bhatt (Mamlatdar & Executive Magistrate) and Mr. R.V. Modi (President – Kamrej Taluka Panchayat) appreciated the positive and constructive role played by Torrent Power Limited (TPL)by bringing up much needed power generation capacity in the region and in the process ensuring allround development of the surrounding regions. Specific concerns and their clarification thereof by Torrent Power Limited (TPL) are given in the table below:

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Stakeholder concern / question/comment	Answer / outcome
What are the significant impacts of the project on environment?	This project has been designed with advanced and efficient technology and shall operate without any significant environmental impact. All the pollution control equipments will be operated as per standard procedures and maintained in a good working condition, which guarantees the continued operation of project without any significant impacts on the environment. Instead the project, by not using the conventional fuels that is coal/lignite, reduces emission of CO_2 and NO_x and avoids emission of SO_2 and SPM The project also avoids emission of excessive NOx unlike many similar power projects in India by using an advance technology. No industrial effluents with pollution potential will be discharged from the project.
Is the latest technology available being employed in the Project?	The project utilizes Advance class natural gas based combined cycle power generation technology having dry low NOx burner, and also having the higher efficiency.
Is there going to be an increase in pollution due to the Project?	The project does not use fossil fuels such as coal, diesel, naphtha, etc., and hence will not add to pollution load.
Will the project increase employment opportunities for the locals? What other benefits are being extended by the project to the locals?	The project employs local labour (directly and indirectly) during construction phase and operation phase. The Project is expected to employ suitably qualified people from the surrounding areas both for technical and non technical jobs during the operational phase. Torrent Power Limited (TPL) is actively involved in extending other benefits through this project for locals e.g. a medical center for locals.
Is there going to be an increase in noise level in the surrounding area due to the project activity?	There will be no major noise pollution due to the Project activity and the project would be complying with Gujarat Pollution Control Board (GPCB) norms
How do the impact of emission and waste generated from the project compare to generation of electricity from coal based plants? Is it possible to operate this project on coal?	It may be noted that due to clean fuel such as natural gas for power generation instead of conventional fuels like coal, harmful emission to the air are avoided and reduced. It also avoids generation of fly ash and other problems associated with handling of coal such as excess land requirement for storage and usage of coal, land degradation and effluents. No, this project cannot be operated on coal.
How much emission reduction is expected	This project is expected to reduce emissions by

from this project and is it possible to receive any funding through reduction in emission?	approximately 1 Million tonnes of CO_2 per year when compared to the existing average emissions of the power plants connected to the grid for same quantum of power as generated by the plant. Torrent Power Limited (TPL) has decided to set up this gas based project with advanced technology as opposed to less costly and business as usual scenario in India i.e. coal based power generation considering that the carbon credit received by project for reduction in emission compared to cheaper coal based power generation will provide much needed viability gap funding for the project.
What is NOx Emission? What is the controlling mechanism?	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 (up to about 30-40% load) and then changing over to "pre-mix" mode. This reduces the NOx level right from start load instead of from 45% load. Also the efficiency of the gas turbine is increased due to high combustion stability achieved by such burners. Also due to such burners the NOx emissions from project activity will be less than 25ppm when loads are greater than 50% against the Euro norms being 26.6 ppm ($50Mg/NM^3$) for loads greater than 70% and the Indian norm being 50ppm.
What will be the impact of this project on electricity supply situation?	The project will assist in reducing the power deficit both in Gujarat and in the Western Region. The project is likely to generate approx. 30 Crore units of power every year.
What is the projected life of the project?	Above 25 years.
What is the difference between Natural Gas and LNG?	LNG is called Liquefied Natural Gas. The natural gas is converted into liquid form from the gaseous state for ease of transportation through ship over long distance and then converted back to gaseous form at Regassification Terminal.

The chairman summarized the concerns articulated and clarifications provided.

Mr. Jinal Mehta from Torrent Power Limited (TPL) thanked the chair and also all the stakeholders participated in the meeting for their time and effort taken to come to the venue of the meeting and for sharing the opinion about the project.

No comments were received in writing from the various stakeholders in response to the notice dated 14/11/2011 by 30/11/2011 the date stipulated in the notice.

Annex 1: Contact information on participants in the project activity

Organization:	M/s Torrent Power Limited
Street/P.O.Box:	Ashram Road,
Building:	Torrent House
City:	Ahmedabad
State/Region:	Gujarat
Postfix/ZIP:	380009
Country:	India
Telephone:	+91-79-26585090/26583060
FAX:	+91-79-26582326
E-Mail:	ashokmodi@torrentpower.com
URL:	www.torrentpower.com
Represented by:	
Title:	Chief Operating Officer
Salutation:	Mr.
Last Name:	Modi
Middle Name:	
First Name:	Ashok
Department:	Site
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	ashokmodi@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	2006-07	2007-08	2008-09	2009-10	2010-11
Low Cost % of Total Generation in the Baseline Grid i.e. NEWNE	18.46%	19.04%	17.41%	15.94%	17.64%
Average Of Low Cost % For Past 5 Years	17.70%				

Data Source: CO_2 Baseline Database for the Indian Power Sector issued by Central Electricity Authority, Ministry Of Power, Government of India January, 2012)

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-2)	0.093884	t CO_2e/ GJ
Energy Efficiency (η_{BL}) (note-3)	37.78%	%
Emission factor of technology, identified		
as the most likely Baseline Scenario ($EF_{BL,CO2}$)	894.635	t CO_2/ GWh

Data Sources

note 1) CO_2 Baseline Database January,2012 issued by CEA, Ministry of Power, Government of India

note 2) Refer to "Working note-1:Calculation of CO_2 Emission Co-efficient ($COEF_{BL}$)"

note 3) Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009

Working note-1: Calculation of CO_2 Emission Co-efficient ($COEF_{BL}$)		
Particulars	Value	Unit
Net Calorific value (note-4)	3,624.52	Kcal/Kg
CO_2 Emission Factor (note-4)	95.80	t CO_2/ TJ
Oxidation factor (note-4)	0.98	
CO_2 Emission Co-efficient ($COEF_{BL}$) (note-5)	1.42	t CO_2e/ tonne
Net Calorific value	15.17	GJ/tonne
CO_2 Emission Co-efficient ($COEF_{BL}$)	**0.093884**	**t CO_2e/ GJ**

Data Sources

note 4) CO_2 Baseline Database January,2012 issued by CEA, Ministry of Power, Government of India

note 5) $COEF_{BL}$ = 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)	858.78	t CO_2/ GWh
Combined Margin Emission factor (note-1)	920	t CO_2/ GWh
Emission Factor of the most likely Baseline Scenario (note-2)	895	t CO_2/ GWh
Baseline Scenario Emission Factor ($EF_{BL, CO2, y}$) (least of the Above	**858.78**	**t CO_2/ GWh**

3 options)		

Data Sources

note 1) CO2 Baseline Database January,2012 issued by CEA, Ministry of Power, Government of India
note 2) **Table M.1- Calculation of Emission factor of technology, identified as the most likely Baseline Scenario**

C. **Calculation Of Project Emissions**

Table P1- Calculation of Project Emissions (PE_y)

Particular	Value	Unit
Net electricity evacuated to grid (note-1)	**2762.6522**	GWh
Annual gas requirement(note-2) $FC_{f,y}$	504,355,190.95	m^3
Emission Co-efficient for Gas(note-3) $COEF_{f,y}$	0.00200570	tCO_2/m^3
Project Emissions (PE_y) (as per equation no-1 of AM0029)	**1,011,585.70**	**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-officient for Gas "

Table 1-1 Net electricity evacuated to grid

Particular	Value	Unit
Capacity of the Power Plant (note-4)	382.5	MWh
Load Hours per annum (note-5)	7446.00	Hours
Average annual electricity production	2848	GWh
Auxiliary Consumption (note-6)	3	%
Auxiliary Consumption	85.44285	GWh
Net electricity evacuated to grid	**2,762.6522**	**GWh**
Net electricity evacuated to grid	**2,762,652.1500**	**MWh**

Data Source

note 4) Collected from the letter from Ministry of Environment and Forest
note 5) 85% based on Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009
note 6) Central Electricity Regulatory Commission (Terms & conditions of Tariff) Regulations, 2009

Table 1-2 Annual gas requirement ($FC_{f,y}$)

Particular	Value	Unit
Net Station Heat Rate on GCV (note 7)	1715.17	kCal/kWh
GCV of Gas (note 8)	9395.000	(kcal / m^3)
Net electricity evacuated to grid (from Table 1-1)	2,762.65	GWh
Annual gas requirement ($FC_{f,y}$)	**504,355,190.95**	**m^3**

Data Source

note 7)Based on EPC Contractors' guarantee
note 8) As given below and Conversion factor (NCV to GCV) of 1.1

Particulars	Weights	NCV (Kcal/m^3)
Domestic Gas*	0.5	8100.00
Imported LNG**	0.5	8981.82
Weighted Average NCV (Kcal/m^3)		**8540.91**

*ncv taken from http://www.indianexpress.com/news/govt-allocates-kgd6-gas-to-power-sector/445266/

**ncv taken from http://wtocentre.iift.ac.in/DOC/subsidies%20discipline%20final%20report-Natural%20resourse%20Pricing1.pdf

Table 1-3 Emission Co-officient for Gas ($COEF_{f,y}$)		
Weighted Average NCV of Gas (note-8)	8540.91	Kcal/ m^3
Weighted Average NCV of Gas (NCV_y)	0.035752	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-officient for Gas ($COEF_{f,y}$) = NCV_y* $EF_{CO2,f,y}$*$OXID_f$	**0.00200570**	**tCO2/m^3**

Data Source

note 9) Table 1-4 Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories

note 10) Current IPCC default values

D. **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)	30,822.56	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)	59,505.04	t CO_2 e
Leakage Emissions (LE_y) (Equation no-4 of AM0029)	**90,327.61**	**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)	504,355,190.95	M^3
Net Calorific Value of natural gas combusted (NCV_y) (note-4)	0.035752245	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)	2,762,652.2	MWh
Emission factor for upstream fugitive methane emissions occurring in the absence of project activity ($EF_{BL, upstream, CH4}$) (note-7)	0.000513040	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-5 of AM0029)	**30,822.56**	**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 -6

note 8) Data collected from IPCC Fourth Assessment Report: Climate Change 2007

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_y) (note-9)	9,917.51	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	tCO_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 ($LE_{LNG, CO2, y}$)	**59,505.04092**	**t CO_2 e**

Data Sources

note 9) Refer to "Working notes for calculating Leakages" Section -5

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)	504,355,190.95	m^3
Quantity of natural gas combusted in project plant (FC_y)	504,355,190.95	M^3
Section-2:Net Calorific Value of natural gas (NCV_y)		
Net calorific value of natural gas (note-1)	8540.909	$Kcal/m^3$

Net Calorific Value of natural gas (NCV_y)	0.035752245	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)	2,762.65215	GWh
Electricity generation in project plant ($EG_{PJ,y}$)	2,762,652.15	MWh
Section:5-Quantity of natural gas combusted in project plant (FC_y)		
Net Electricity evacuated to the grid (note-1)	2,762.65215	GWh
50% of the Electricity evacuated to the grid*	1,381.326075	GWh
GCV of LNG (note-3)	9,880.00	Kcal/m^3
Gross Station Heat rate (note-1)	1715	Kcal/ KWh
Total LNG requirement	23,979,8432.1	m^3
Gross Calorific value of Gas (note-1)	9,880.00	Kcal/ m^3
Total LNG requirement	2,369,208,509	Kcal *10^3
Quantity of natural gas (i.e. regasified LNG) combusted in project plant (FC_y)"*"	9,917.506821	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 LNG supplied by Reliance and GAIL. Calculated as NCV*1.1 Conversion factor

Section 6: Emission Factor for upstream fugitive methane emission occurring in the absence of project activity $EF_{BL, upstream, CH4}$ (tCH4 / MWh)

Section:6 Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in tCH4 per MWh electricity generation in the project plant ($EF_{BL,upstream,CH4}$)

Fuel Type	Coal			Lignite			Gas			Naptha		
	Value	Unit	Source	Value	Unit	Source	Value	Unit	Source	Value	Unit	Source
Net Electricity Generated	92,361	GWh		2,159	GWh		4,344	GWh		4,455	GWh	
Absolute Emissions	94,252,843	tCO2		2,811,984	tCO2		1,813,858	tCO2		1,667,304	tCO2	
GCV(Gross Calorific Value) of Fuel	3,755	kCal/kg	Note 1	3,500	kCal/kg	Note 2						
GCV(Gross Calorific Value) of Fuel	15.71843	TJ/ktCoal		14.651	TJ/ktCoal							
Carbon Emission Factor	92.5	tCO2/TJ	Note 1	102.5	tCO2/TJ	Note 1	49.4	tCO2/TJ	Note 1	66	tCO2/TJ	Note 1
Oxidation Factor	0.98	-	Note 1	0.98	-	Note 1	1.00	-	Note 1	1.00	-	Note 1
Energy Content of Fuel Consumed	1039744.542	TJ		27993.87206	TJ		36717.76772	TJ		25262.17457	TJ	
Quantity of Fuel Consumed	66148.11669	kton		1910.714085	kton							
Fugitive Methane Emission Factor	0.8	tCH4/kton	Note 3	0.8	tCH4/kton	Note 3	160	tCH4/PJ	Note 3	4.1	tCH4/PJ	Note 3
Emissions	52918.49	tCH4		1528.57	tCH4		5874.842835	tCH4		103.5749158	tCH4	
Total Emissions	60425.48	tCH4										
Total Generation in Build Margin	117779227	MWh										
Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity	**0.000513040**	**tCH4/MWh**										

Absolute emissions = Fuel consumption* GCV of fuel* Carbon emission factor* Oxidation factor (Source: CO2 Baseline Database for Indian Power Sector, published by Central Electricity Authority, Ministry of Power, Government of India, version 7, January 2012)

Source:

Note 1	CO_2 Baseline Database for Indian Power Sector, published by Central Electricity Authority, Ministry of Power, Government of India, version 7, January 2012
Note 2	Report on Gujarat Lignite Resources and Scope for Joint Sector Thermal Power and SSI Project (Annexure IV)
Note 3	Methodology AM0029, version 03

Absolute Emission calculation in tCO2 of Coal /Lignite based plants for Primarily Fuel

	Coal	Lignite	Source
Total Net Generation in GWh [A]	92,361	2,159	CO2 Baseline Database for Indian Power Sector, published by Central Electricity Authority, Ministry of Power,
Aux. Consumption in % [B]	8%	10%	Appendix B - CO2 Baseline Database for Indian Power Sector, published by Central Electricity Authority, Ministry
Total Gross Generation in GWh [C]=[A]/1-[B	100,392.36	2,398.43	
Specific secondary fuel oil Consumption in ml/kwh(gross) [D]	2.00	3.00	Appendix B - CO2 Baseline Database for Indian Power Sector, published by Central Electricity Authority, Ministry of Power, Government of India, version 7, January 2012
Total secondary fuel oil Consumption in ml [E]=[[C]*[D]*10^6	200,784,728,726	7,195,294,129	
Total secondary fuel oil Consumption in litre [F]=[E]/1000	200,784,729	7,195,294	
1 litre = kg [G]	0.95	0.95	Appendix B - CO2 Baseline Database for Indian Power Sector, published by Central Electricity Authority, Ministry
Total secondary fuel oil consumption in kg [H]=[F]*[G]	190,745,492	6,835,529	
Gross Calorific Value of Oil (kCal/kg) [I]	10,100	10,100	Appendix B - CO2 Baseline Database for Indian Power Sector, published by Central Electricity Authority, Ministry
Carbon Emission Factor tCO2/TJ [J]	71.90	71.90	Appendix B - CO2 Baseline Database for Indian Power Sector, published by Central Electricity Authority, Ministry
Oxidation Factor [K]	1.00	1.00	Appendix B - CO2 Baseline Database for Indian Power Sector, published by Central Electricity Authority, Ministry
Absolute Emission in tCO2 for secondary fuel (Oil) [L]=[H]*[I]*[J]*[K]*4.186/10^9	579,834	20,779	
Absolute Emission in tCO2 of Coal /Lignite based plants [M]	94,832,677	2,832,763	CO2 Baseline Database for Indian Power Sector, published by Central Electricity Authority, Ministry of Power, Government of India, version 7, January 2012
Absolute Emission in tCO2 of Coal /Lignite based plants (Primarily Fuel Only) [N]=[M]-[L]	94,252,843	2,811,984	It may be noted that absolute emissions in the database have been calculated by considering both primary and secondary fuels and directly provided in the database. As per the database, it is evident that the secondary fuel used in coal and lignite based power plants is oil. Hence, the absolute emission has been reduced to such extent of

Note:4 However, the secondary fuel mentioned for Naphtha based plants is natural gas. As the Fugitive Methane emission Factor of gas (160 tCH4/ PJ) is higher than that of Naphtha (4.1 tCH4/PJ), to be conservative the entire fuel consumption (including secondary fuel) has been considered as Naphtha only for the calculation of absolute emission of the Naphtha based plants (i.e. lower value of $EF_{BL,upstream,CH4}$ resulting in higher leakage emissions and thus lower emission reduction by the project activity).

Note-5: The CEA data based version 07 that gas base plants used in the build margin calculation do not involve secondary fuel.

E. Calculation Of Emissions Reduction (ER_y)

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

Particulars	Value	Unit
Emissions in the baseline scenario (BE_y) (note-1)	2,372,510.41	t CO_2e
Emissions in the project scenario (PE_y) (note-2)	1,011,585.70	t CO_2e
Leakages (LE_y) (note-3)	90,327.61	t CO_2e
Emissions Reduction (ER_y)	**1,270,597.11**	**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)	2762.65215	GWh
Baseline CO_2 emission factor ($EF_{BL,CO2,y}$) (note-5)	858.78	t CO_2/GWh
Emissions in the Baseline Scenario (BE_y)	**2,372,510.41**	**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 Plan

1. The monitoring plan

This document serves as the Monitoring Plan (MP) for the "UNOSUGEN Natural gas- based grid connected Combined cycle power generation project" in taluka Kamrej, 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 Power Limited (TPL) 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 Limited's (TPL's) CDM manager

It is the responsibility of Torrent Power Limited's (TPL'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 recording & collection on weekly basis
$NCV_{f,y}$	Net calorific value	Fuel transporter(s)	GJ/m^3	Daily measurement and collection on fortnightly basis.
$EF_{CO2,f,y}$	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	IPCC current	Number	Annually

ID	Data variable	Source of data	Data unit	Recording frequency
	Gas	default value		

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	Recording on fifteen minutes basis and collection of such recordings on weekly basis
$EF_{BM\ y}$ or $EF_{BL,CO2}$	Baseline Grid emissions factor using Build Margin	Latest CEA baseline database (Ministry of Power, Government of India). Such data if available shall be used. Otherwise, this parameter shall be calculated as provided in "Tool to calculate the emission factor for an electricity system version 2.2.0"	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 Transporter(s)	Terra Joules (available in m^3 to be converted in terms of Terra Joules)	Daily recording & collection on fortnightly basis
$EF_{BL,upstream,CH4}$	Emission factor for upstream fugitive methane emissions occurring in the absence of the project activity in t CH_4 per MWh electricity	This data will be computed consistent with the Build Margin emission factor i.e. the baseline emission factor based on latest available information from (a)	tCH_4/ MWh	Annually

ID	Data variable	Source of data	Data unit	Recording frequency
	generation in the project plant	Central Electricity Authority, Ministry of Power, Government of India, (b) AM 0029, version 03 and/or(c) other reliable data sources which are available in public domain.		

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, if any. 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.

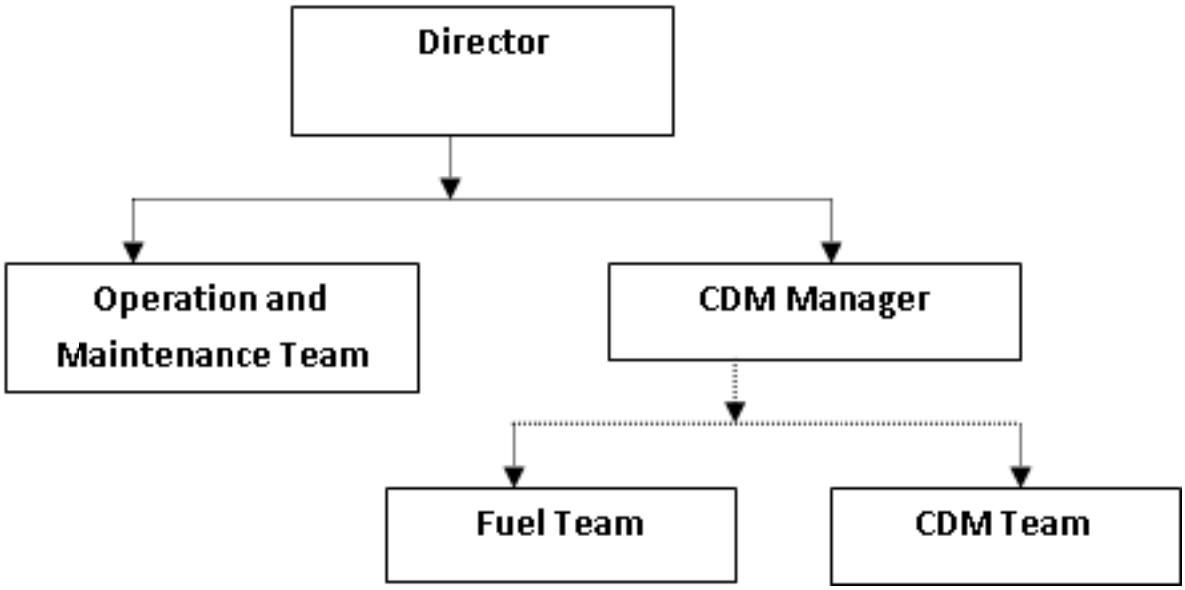
Section 6 presents the "Workbook for ER calculation and describes its functioning. For calculation of ERs this MP follows the formulae specified in AM0029. All formulae have been incorporated in the workbook.

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 Limited (TPL)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)**	$EF_{BL,upstream,CH4}$
Monitoring of Raw data	Responsible person at Torrent Power Limited (TPL)	Head O & M	Fuel Manager	Fuel Manager	CDM Manager	Head- O&M	CDM Manager	Fuel Manager	CDM Manager
	Data source	Flow meter	Fuel 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 Transporter(s)	(i) Preferably calculated based on data collected from baseline database of Central Electricity Authority, Ministry of Power, Government of India. If unavailable, calculations from raw data of Central Electricity Authority (ii) AM0029 version 03 and/or (iii) Other reliable data sources which are available in public domain.

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)	$EF_{BL,upstream,CH4}$
	Frequency of data collection	Daily recording & collection on weekly basis	Daily measurement and collection on fortnightly basis.	Annually	Annually	Recording on fifteen minutes basis and collection of such recordings on weekly basis	Annually	Daily recording and collection on fortnightly basis	Annually
	Data format	Electronic	Electronic	Electronic	Electronic	Electronic	Electronic	Electronic /Paper	Electronic
	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 in line with CEA regulations	Not applicable	Not applicable	Not applicable
Data processing	Responsible person at Torrent Power Limited (TPL)	CDM Compiler	CDM Compiler	CDM Compiler	CDM Compiler	CDM Compiler	CDM Compiler	CDM Compiler	CDM Compiler
	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	Consistency check, validation and recording
	Frequency of processing	Weekly	Fortnightly	Annually	Annually	Weekly	Annually	Fortnightly	Annually
	Format after processing	Excel	Excel	Excel	Excel	Excel	Excel	Excel	Excel

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)	$EF_{BL,upstream,CH4}$
	Data storage at source	Note-2	Note-2	Note-2	Note-2	Note-2	Note-2	Note-2	Note-2
Data review	Responsible person at Torrent Power Limited (TPL)	CDM Auditor	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	As per data review protocol
Monthly/ Yearly aggregation of data	Responsible person at Torrent Power Limited (TPL)	CDM Compiler	CDM Compiler	Not Applicable	Not Applicable	CDM Compiler	Not Applicable	CDM Compiler	Not Applicable
	Description of procedure	Aggregates the daily measurements to monthly value and saves it in electronic format	Aggregates the fortnightly measurements to monthly value and saves it in electronic format	Not applicable	Not applicable	Aggregates the weekly measurements to monthly value and saves it in electronic format	Not applicable	Aggregates the fortnightly measurements to monthly value and saves it in electronic format	Not applicable
Storage of aggregated data	Responsible person at Torrent Power Limited (TPL)	CDM Manager	CDM Manager	CDM Manager	CDM Manager	CDM Manager	CDM Manager	CDM Manager	CDM Manager
	Frequency of storage	Monthly	Monthly	Annually	Annually	Monthly	Annually	Monthly	Annually

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)	$EF_{BL,upstream,CH4}$
	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	Electronic (Excel) and paper version
	Duration of storage	Note-2	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, whichever 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 monitored through metering equipment at the plant. 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 transporter(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 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) if such data is not available from CEA, it will be calculated from raw data of CEA (Ministry of Power, Government of India), IPCC and others sources. 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 his/her 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- workbook.

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. In addition, after each data entry and/or modification of the workbook, the updated electronic copies of the workbook shall be saved.

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.

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 A Fuel Availability

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

(A) Domestic:

Total more than 200 blocks are awarded under the New Exploration and Licensing Policy (NELP). Under NELP, 77 oil and gas discoveries have already been made by private / joint companies in 23 blocks. In the eighth round of NELP 70 exploration blocks were offered. The recent gas finds under this policy and other significant sources available for sourcing NG include the following:

a. Reliance Industries Ltd.

- The total reserves of KG D6 block is estimated around 40 TCF with recoverable reserves of 11.5 TCF. D6 block is currently providing about ~60 MMSCMD of gas. The total estimated production of the block is 80 MMSCMD in medium term and could be scaled up to ~120 MMSCMD in long term. [92]
- Niko Resources, the Canadian major holding 15 per cent stake in the D4 basin, with Reliance holding 85 per cent, has indicated that the potential from the D4 block of KG basin stands at 100 TCF[93]. However, if the same recovery rate is assumed for D4 block vis-a vis D6 block (D6 and D4 blocks being in same sedimentary basin) the estimated recoverable gas could be 30 TCF resulting in to more than 150 MMSCMD of production in long term.

b. Gujarat State Petroleum Corporation Limited

- GSPC had announced KG Basin Deendayal discovery with reserves estimated around 20 TCF. DGH has ratified 2 TCF of recoverable reserves and estimated 10-12 MMSCMD of production by 2012-13[94].

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[92] http://www.business-standard.com/india/news/rils-kg-d6-starts-production/353715/ (Copy of document is provided to DOE)

[93] Press note by the energy business titled "KG D4 find more than double of KG D6" on Gas discovery by NIKO Resources in D4 Block of KG Basin. (Copy of document is provided to DOE)

[94] http://articles.economictimes.indiatimes.com/2009-09-19/news/28435955_1_kg-8-tcf-gas-kg-basin (Copy of document is provided to DOE)

c. Oil & Natural Gas Corp (ONGC)

- ONGC is in the process of submitting proposal for commerciality of discovery in KG-DWN-98/2 block in same prolific KG basin. The block is estimated to hold 14 TCF of reserves. [95]
- ONGC led consortium of state-owned energy firms has also proved commercial viability of its Mahanadi gas find, paving the way to start production from the field having about 2.7 TCF natural gas recoverable reserves. [96]
- ONGC is also expecting to bring three new fields (The Western Offshore (WO), Cluster-7 and Vashista & S1 fields) into production and has projected its output to rise to 66 MMSCMD by 2012-13. Further, the discovery such as UD-1 find in ultra deep waters of Krishna Godavari basin which are under conceptualisation stage, the output will rise to 100 MMSCMD in 2014-15 and it would be at least 20 per cent more than the output in 2020-21. Besides, an estimated 200 BCM reserves lie to be realised in Mahanadi deepwater discoveries, 25 BCM in KG shallow waters and 15 BCM in B and C Series fields[97]. ONGC has already begun production from C-Series fields and is currently producing between 0.8 to 1.2 MMSCMD. Peak output of 2.8 MMSCMD will be reached once all the 15 wells are drilled.[98]

d. Rajasthan by Focus Energy Ltd

- 170 BCM gas discoveries is in Rajasthan by Focus Energy Ltd., which is billed as one of the largest ever land gas finds in recent times[99].

e. Unconventional Domestic Gas Supply

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[95] http://www.business-standard.com/india/printpage.php?autono=400972&tp (Copy of document is provided to DOE)

[96] Press note by the Energy business titled "ONGC proves commercial viability of Mahanandi gas field" on ONGC's Production detail from Mahanadi Gas Fields and A information note by infraline energy titled "Team ONGC proves commercial viability of its Mahanandi gas find – paving the way to start production from filed having 2.7 tcf gas reserve" on ONGC's Production detail from Mahanadi Gas Fields. (Copy of document is provided to DOE)

[97] http://www.business-standard.com/india/news/ongc-may-see-gas-output-jump-to-100-mmcmd-by-2015-16/61186/on (Copy of document is provided to DOE)

[98] http://www.business-standard.com/india/printpage.php?autono=99907&tp=on (Copy of document is provided to DOE)

[99] http://economictimes.indiatimes.com/articleshow/1612228.cms (Copy of document is provided to DOE)

- **Coal Bed Methane (CBM):** Large resources of coal are a prerequisite for viable CBM venture. Approximately 26 CBM blocks awarded with estimated resources of about 1354.45 BCM. So far, established proven reserve of ~ 250 BCM reserves have been established in 5 CBM blocks. CBM gas production in January 2010 was at the rate of 0.1 MMSCM. In the fourth round of CBM policy, Government has received 27 bids for 8 CBM blocks as against 10 offered blocks. The potential supply in long term would be approximately 13 MMSCMD. [100]
- **Shale Gas:** India has large shale deposits with good prospects in the Gangetic plain, Punjab, Rajasthan, Gujarat. Tamil Nadu, Andhra and the north-east. [101] National Oil companies like ONGC & OIL have already started exploiting shale gas potential in India. Further some of the recent discoveries as given below have reinforced the substantial potential of shale gas production in India.
    1. US-based multinational explorer, Joshi Technologies International (JTI), has made the first shale gas discovery along with shale oil in the Cambay basin at the company`s Dholka field which it has been operating for over fifteen years.[102]
    2. GSPC and Oilex had made a huge natural gas discovery in Gujarat that may 20 TCF of taped gas. Studies indicate a very good correlation between the Cambay Eocene reservoirs and the Eagle Ford and Haynesville "tight/shale" plays in the USA.[103]

(B) Imports:

a. Petronet LNG Limited

[100] Annual Report 2009-10 by MoPNG and Presentation on '**Development of CBM Industry in India'** during 6th Asia Gas Partnership Summit-2010 (Copy of document is provided to DOE)

[101] http://economictimes.indiatimes.com/articleshow/6001231.cms?prtpag (Copy of document is provided to DOE)

[102] http://www.business-standard.com/india/news/jti-plans-to-drill-5-wells-in-gujarat-this-yr/90247/on (Copy of document is provided to DOE)

[103]Press note by the Energy Business titled "Australia's Oilex strikes gas in Cambay" on Taped Gas capacity discovered by GSPC and Oilex in Gujarat and Press note by Indian Energy update dated 30/07/2010 on (Copy of document is provided to DOE)

- Petronet LNG Ltd (PLL) has already expanded its regasification capacity to 10 MMTPA (approx 40 MMSCMD) from initial capacity of 5.0 MMTPA. PLL has signed a fuel supply agreement with Rasgas of Qatar for supply of 7.5 MMTPA (approx 30 MMSCMD) for a period of 25 years. PLL is in negotiation with various parties including Rasgas of Qatar for sourcing additional 2.5 MMTPA of LNG (approx 10 MMSCMD) for the aforementioned expanded capacity.
- PLL is also setting up a facility for receiving and regasification capacity of 2.5 MMTPA (approx 10 MMSCMD) of LNG in Cochin which is expected to commission by 2013. Further, PLL has already signed a long-term contract with Exxon Mobil for LNG from the Gorgon field in Australia and there is a possibility of contracting more quantity. [104]

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

- Hazira LNG Port Ltd. (HLL) promoted by Shell and currently owned by Shell and Total has a regasification capacity of 3.5 MMTPA (approx. 14 MMSCMD) at Hazira. HLPL has plans of increasing this capacity to 10.0 MMTPA (approx. 40 MMSCMD), 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[105].

c. Mundra LNG Terminal (Adani-GSPC Group)

- Adani-GSPC group has made a move to set up 5 MMTPA (approx. 20 MMSCMD) LNG terminal at Mundra Port and SEZ. [106]

d. Dabhol LNG

- Dabhol LNG with a regasification capacity of 5 MMTPA (approx. 20 MMSCMD) is expected to be commissioned by December 2010. GAIL is targeting to receive first spot LNG cargo at

[104] http://www.thehindubusinessline.com/todays-paper/article1013908.ece (Copy of document is provided to DOE)

[105] http://www.thehindubusinessline.com/2005/04/22/stories/2005042202690300.htm (Copy of document is provided to DOE)

[106] http://www.business-standard.com/india/news/gspc-adani-to-pump-in-rs-500-cr-for-lng-terminal-land-in-mundra/355191/ (Copy of document is provided to DOE)

Dabhol by December 2010 for commissioning and, thereafter, LNG would be sourced through regular tie-up.[107]

e. IOCL Ennor LNG

- Tamil Nadu Industrial Development Corporation Ltd.(TIDCO) has entered into a joint venture with Indian Oil Corporation Ltd. (IOCL) to set up a 5 MMTPA (approx. 20 MMSCMD) LNG terminal close to the Ennore Port, to the north of Chennai.[108]

f. Other Import Terminals

- As Published in Platts LNG Terminal Tracker dated 20/07/2010. Following regasification capacity is also at various stages of planning. [109]

Location	In MMTPA	In MMSCMD
Pipavav (Essar)	5	20
Mangalore (ONGC)	5	20
Haldia (Spice)	2.5	10
Kandla (KPT)	2.5	10
Karwar (Karnataka Power)	2.5	10
Total	17.5	70

g. Transnational Pipeline

- Heads of Agreement for the proposed gas sales purchase agreement for the 1680 Km Turkmenistan-Afghanistan-Pakistan-India (TAPI) Pipeline has been signed by Partner countries. The project envisages building 1680 KM of pipeline with a total gas capacity of 90 MMSCMD with funding support from Asian Development Bank. India would get approximately 38 MMSCMD. [110]

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[107] http://www.business-standard.com/india/news/dabhol-lng-terminal-runs-behind-schedule/375935/ (Copy of document is provided to DOE)

[108] http://www.thehindubusinessline.com/2010/05/04/stories/2010050450690200.htm (Copy of document is provided to DOE)

[109] www.platts.com (Available on Subscription bases)

[110] http://www.igu.org/html/wgc2009/papers/docs/wgcFinal00776.pdf (page 32) and http://www.thehindubusinessline.com/industry-and-economy/uniform-transit-fee-for-tapi-a-possibility/article2831460.ece (Copy of document is provided to DOE)

- Iranian Khatam-ol-Anbia Construction will carry out the second phase of the proposed Iran-Pakistan-India (IPI) gas pipeline project, dubbed as the Peace Pipeline. The first phase of the project has already been put into operation in July-2010. The IPI pipeline would carry 2.4 BCF (~70 MMSCMD) of gas a day, to be shared equally by Pakistan and India. [111]

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

(C) Summary of Gas Availability (MMSCMD)

Source	**Existing Availability**	**Medium Term estimation[#] (2014-15)**	**Long Term estimation[##] (2015-2018)**
ONGC + OIL	70.37	36	30
RIL KG D6	82.48	120	50
Other NELP Production		56	206
JV producers (**Rava, Rava Satellite, C Series, marginal/nominated, etc.**)		30	30
Other domestic Source (CBM, Shale, etc.)		5	20
LNG	35.60	65	135
Transnational pipelines	--	--	73
Total	188.45	307	544

* Source: MOPNG – Monthly Statistic for June 2010 for domestic gas production and for LNG import - the article published on 04/06/2010 titled "Royal Dutch Shell imports 2nd LNG cargo at $5.2/mmBtu"
# Based on above mentioned domestic and imported gas availability (deletion of existing production of ONGC & OIL to ~ 36 MMSCMD and new production of ~ 30 MMSCMD from ONGC's marginal fields, KG D6 peak production (~120 MMSCMD), startup of GSPC & ONGC NELP block's production (i.e. ~50 MMSCMD from ONGC and ~10-12 MMSCMD from GSPC), addition of Dabhol (~ 20 MMSCMD) and Kochi LNG Terminal (~ 10 MMSCMD) for RLNG)
Based on above mentioned domestic and imported gas availability for Long Term (KG D6, ONGC & OIL depleted production, startup of RIL D4 gas production of ~ 150 MMSCMD & NELP block's , addition of LNG capacity mentioned in Point (f) and Transnational Pipeline volume as mentioned in Point(g) and likely Shale Gas production)

(D) Domestic Natural Gas Pipeline Network

[111] Article by Tehran times dated 26/07/2010 titled " Iran to inaugurate cross-country gas pipeline" on Iran Pakistan India (IPI) Pipeline and Line mint article dated 12/07/2010 titled "India, Iran to hold gas pipeline talks" on IPI pipeline (Copy of document is provided to DOE)

a. The existing trunkline network is approx. 9000 Km and is having capacity to carry ~ 220 MMSCMD of natural gas. Further, approx. 15300 Km natural gas trunkline network having capacity to carry ~340 MMSCMD is already under various stages of implementation as notified by Ministry of Petroleum and Natural Gas and PNGRB.

b. Such natural gas pipeline network (i.e. existing and under implementation) would provide aggregate capacity of ~ 556 MMSCMD in sync with gas availability of ~ 543 MMSCMD mentioned above in Point (C). [112]

Operator	Pipeline Name	In Km	Capacity in MMSCMD	Status
GAIL	HVJ	2887	18.5	Existing
GAIL	DVPL	770	23.9	Existing
GAIL	Dadri - Vijaipur	565	14.9	Existing
GAIL	DUPL	744	19.2	Existing
GAIL	Dadri-Bawan-Nangal	700	31	Under Implementation
GAIL	Chhainsa-Gurgaon-Jhajjiar-Hisar	454	35	Under Implementation
GAIL	Jagdishpur-Haldia	2050	32	Under Implementation
GAIL	Dabhol-Bangalore	1114	16	Under Implementation
GAIL	Kochi-Bangalore-Mangalore	1389	16	Under Implementation
GAIL	DVPL-II (Expansion)	770	25	Under Implementation
RGTIL	EWPL	1385	80	Existing
RGTIL	Kakinada-Chennai	600	26.67	Under Implementation
RGTIL	Chennai-Tuticorin	670	13.3	Under Implementation
RGTIL	Chennai-Bangalore-Mangalore	660	13.3	Under Implementation
RGTIL	Kakinada-Basudevpur	1100	27	Under Implementation
GSPL	Gujarat Gas Grid	2424	50	Existing
GSPL	Mallavaram-Bhilwara	1584	30	Under Implementation
GSPL	Mehasana-Bhatinda	1670	30	Under Implementation
GSPL	Bhatinda-Srinagar	740	15	Under Implementation
IOCL	Dadri-Panipat	132	10	Existing
	Surat-Paradip	1724	30	PNGRB EOI Proposed
Total		**24132**	**556.77**	

(E) To sum up

[112] Map of Gas Pipelines in India (Copy of document is provided to DOE)

India currently has gas sales of about 188.45 MMSCMD including indigenous gas sale of ~153 MMSCMD and LNG gas sale of ~35 MMSCMD. Additional supplies to the tune of approximately 360 MMSCMD (three fold of existing gas availability) are expected by 2015/18. The expected additional supplies of ~ 360 MMSCMD during the first four/five years of the crediting period of the project activity can support approx 80,000 MW of power generation. Most of the current gas sold/consumed in India is currently in the Northern/ Western Region (In which the project activity is located). The Bombay High Gas production , Panna, Mukta & Tapti, 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 Imported Natural gas viz Qatar, Iran & Turkmenistan are also to the North/ West of India. A good part of the Krishna Godavari Gas is being brought to the Northern/ Western region through the grand East West pipeline of approx. 1400 km in length. All the regasification terminals in the Western Region are connected to the trunk lines of Gail (Dahej-Uran pipeline, HVJ pipeline) and GSPL (Gujarat Gas Grid). Therefore in the future also a major part of the additional supplies of natural gas is expected to be available in the Northern/ 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.

Abbreviations

TCF	Trillion cubic feet
TCM	Trillion cubic metre
BCF	Billion cubic feet
BCM	Billion cubic metre
MMTPA	Million tonnes per annum
MMSCM	Million standard cubic metre
MMSCMD	Million standard cubic metre per day
MMSCF	Million standard cubic feet per day
MMSCF	Million standard cubic feet
BTU	British thermal unit

Appendix-1 B Fuel Availability

1. Projection of LNG supply scenario in Asia

As published by Platt's in its 23//06/2010 LNG Daily.

- "The Asian LNG market would likely be pretty well supplied even through 2020, if expected new projects come online 2014-2017", according to a report from FACTS.
- "The reality is that we have an additional 50 million mt/year of LNG from Australia and PNG, plus some 20-30 million mt/year of divertible volumes from Qatar, plus at least 10-15 million mt/year from other suppliers—roughly some 90-100 million mt/year of LNG to feed the needs of the buyers" FACTS said in the report.

Addressing the Singapore International Energy Week, the Emirates Deputy Prime Minister, Abdulla Bin Hamad Al-Attiyah, said – "Qatar is negotiating to supply four to five million tonnes per annum of liquefied natural gas (LNG) to India". Mr Al-Attiyah also said negotiations were underway to supply some 7 million tonnes per annum year of additional LNG to China (Source: http://www.business-standard.com/india/news/qatar-negotiates-5-mn-tonnesyear-lng-contractindia/114266/on).

2. Actual LNG supply in Asia (major LNG buyers)

As published by Platt's in its 21/09/2010 LNG Daily.

- "LNG imports by the world's "major buyers" were up 28% in the first half of 2010 compared with the same period in 2009." - Energy economics group Energy Quest.
- North Asian imports rose 18% to 60 million mt. In Asia, Japan saw "record LNG imports of 34.7 million mt and China's LNG imports doubled" in the first half of 2010, Energy Quest said. In contrast to Europe, average LNG prices into North Asia increased in the first half of this year, up to $9.43/GJ, Bethune said. "However, the biggest growth was in one of the cheapest sources of gas," he added. "Average Russian prices were $6.82/GJ," he added. Russia's Sakhalin 2 LNG project increased sales to North Asia by 4.3 million mt in the first half of 2010 compared with the first half of 2009, the firm said. The project started producing in April 2009.—Jonty Rushforth

3. Actual LNG supply in India

As published by Platt's in its 28/06/2010 in its LNG Daily.

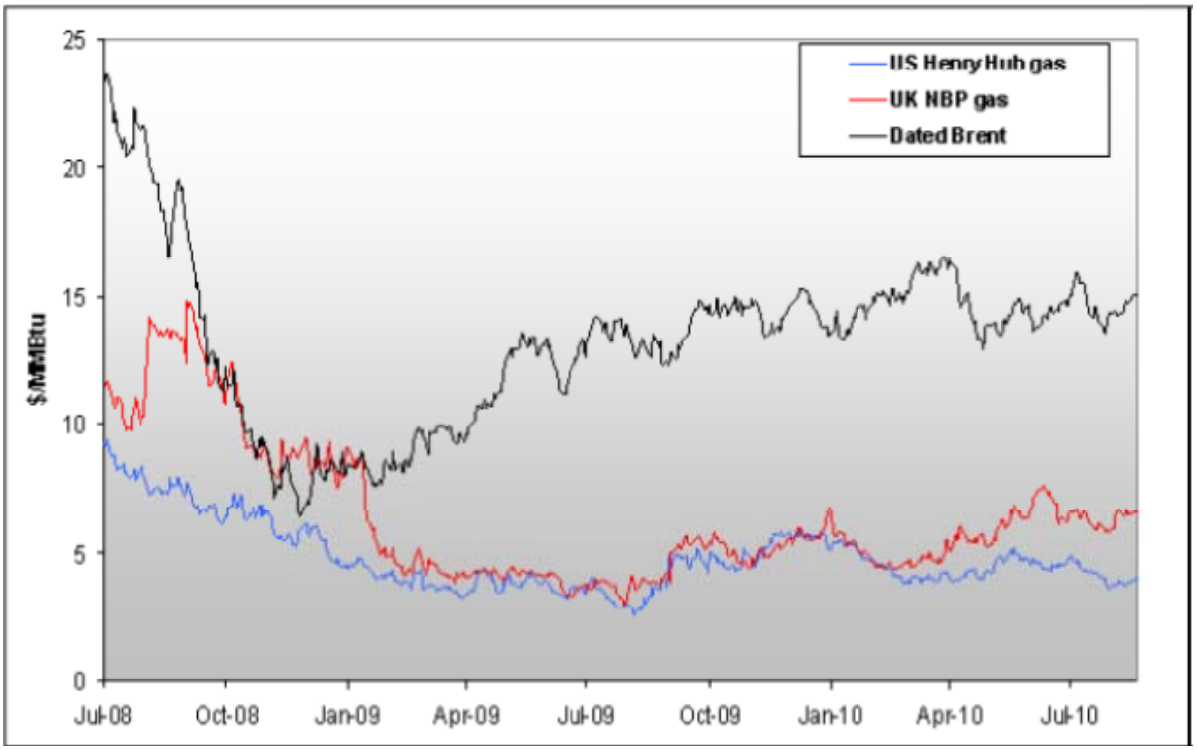
- India imported 1.232 million mt of LNG (equivalent to 57.5 Bcf of gas) in April and 1.281 million mt last month, sharp increases from monthly import totals in the first quarter ranging from about 500,000 mt to 700,000 mt, according to latest data from the Oil Ministry.
- Successful sourcing of LNG (spot) by various Indian gas supplier

Importers	Cargoes imported	Import Terminal	Period
GSPC	9	PLL-Dahej / Shell Hazira located in western region of India (where the project activity is located)	Up to Dec 2010
GAIL	3		In 2010
Shell	3		From April to August 2010

- Successful sourcing of LNG (medium term) by GAIL
  - GAIL has successfully booked 0.5 MTPA (~ 2000 MW) with Japanese trading house Marubeni beginning in 2011 (Source:http://www.gailonline.com/final_site/lng.html).
- Successful sourcing of LNG (long term) by GAIL
  - PLL has successfully booked 1.5 MTPA (~6000 MW) with ExxonMobil for the purchase of LNG from Australia's Gorgon project for 20 years (Source: www.petronetlng.com)

Appendix-2 Natural Gas and Oil prices

Source: Presentation on **'Asia LNG Market 2010 and Beyond'**, organised by Platts on 19/10/2010



Source: Presentation on **'Asia LNG Market 2010 and Beyond'**, organised by Platts on 19//10/2010

Appendix-3 Environmental Impact Assessment Report

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
Construction Phase						
Land	•Soil erosion •Loss of trees •Habitat fragmentation •Interference with natural drainage pattern	•Soil excavation •Mobilization of plant and heavy machinery •Construction of civil structures	• No tree is required to be cut / felled during construction. • No natural nalla or streams passes through the project area. Hence there will be no impact on the drainage pattern of the area. •Greenbelt and horticulture development will create natural habitat and will also prevent soil erosion. • Dust generated due to earthwork including excavation and transportation activities, especially during dry weather conditions, would be controlled by water sprinkling. The earth generated during excavation would be used in refilling and landscaping the area.. •Using the excavated soil for greenbelt and horticulture and landscaping purpose will improve the general aesthetics of the landscape. The project will not create habitat fragmentation.	Long-term positive impact		
Surface water	•Ground water contamination •Waterborne	•Defective sewers •Wastewater generated	•Canteen, toilet and washroom facility will be provided to all construction staff. •Safe drinking water	Short-term, localized, reversi	• Online water quality monitoring for parameters viz., turbidity, conductivity, temperature and pH.	EMD of Torrent Power

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
	diseases	from domestic services	will be provided to workers. •Domestic sewage generated from plant and staff colony will be led to septic tanks and soak pits. •The waste water will be taken to sewage treatment plant (STP) for treatment. Treated water will be used for dust suppression inside the construction site. •No waste water will be discharged out of the plant premises during the construction stage. •Preventive measures will be taken while designing and laying the sewers meant for conveying wastewater from the generation point to STP. To safeguard the sewer network from collapsing brick foundation will be used. Sulphate resistant lining and cement lining will prevent corrosion of the sewers. All joints of sewers will be properly sealed and supported with bed concrete.	ble impact	Flow will also be measured using online meter.	Limited (TPL)

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
Air quality	•Dust nuisance from site due to vehicular movement and windborne surface dust	•Vehicular movement of trucks, dumpers and construction machinery	•Regular water sprinkling will be done for dust suppression. •Suitable surface treatment will be provided to ease the traffic flow •Service road will be suitably stabilized for smooth traffic flow. •Road surface will be cleaned regularly.	Short-term, localized, reversible impact	•The ambient air quality will be monitored at three locations (120^o to each other) at the plant boundary. Parameters monitored will be SPM, RSPM, SO_2, NOx and CO.	EMD of Torrent Power Limited (TPL)
Noise	•Noise nuisance	•Earth moving equipments and material handling traffic. Movement of vehicles and construction equipments.	•The noise generation will be confined within the surrounding areas of the construction site. •Construction equipments and transport vehicles will be properly maintained. Regular maintenance schedule will be adopted.	Short-term, localized, reversible impact	• Noise monitoring at the plant boundary and work areas would be monitored at periodic intervals. Noise level at nearby habitation would be also monitored.	EMD of Torrent Power Limited (TPL)
Socio-economic and cultural environment	•Direct job creation for people during construction period •The gross economic yield will increase due to market multiplier effect. •Creation of infrastructure facilities	•Deployment of construction workers •Development of infrastructure facilities like roads and residential quarters •Deployment of contract vehicles	• Local entrepreneurs would be fostered by handing out various contracts such as housekeeping contracts, vehicle hire contracts, horticulture contracts, small-medium scale civil contracts, electrical manpower support contract, security services etc.	Long-term, positive impact	•Torrent Power Limited (TPL) will ensure that locals are deployed during the construction phase to the extent feasible.	

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
Ecology	No wild life sanctuary, national park, forest, lakes and wetlands are located within 10 km of the project site.	Construction activities	•Impact due to construction activities on the ecology of the area will be confined to the construction site itself.	Insignificant		EMD of Torrent Power Limited (TPL)
Operation Phase						
Land	• Landslides and soil erosion • Disposal of solid wastes	•Soil excavation •Operation of the plant	•Lawns have been developed inside the plant area and maintained. Asphalted road has been developed inside and outside the plant boundary. •There is no problem of landslides or soil subsidence in the project area or its immediate surroundings. Hence soil erosion from project site is not anticipated. •No industrial solid waste will be generated from the plant. Therefore there will be no disposal of solid wastes on land.	Long-term positive impact	• Quantity and quality of spent oil and lubricants will be disposed and records kept as per authorization obtained from GPCB.	EMD of Torrent Power Limited (TPL)
Hydrology	• No Stress on existing users of river water	•Plant operation (cooling, service water and steam generation)	•Not required as the water requirement for the project activity will be out of 15 MGD water allocated from Tapi river to Torrent Power Limited (TPL) by the Government of Gujarat. No additional water allocation is required for the project	Nil		

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
			activity.			
Surface water quality	• Discharge of treated Wastewater into Dokhar nala, which ultimately joins Tapi River after traveling 10 kilometers.	• Boiler and Cooling water blow down. •Demineralised water plant regeneration •Filter backwash •Sludge from the clarifiers included in the raw water pre-treatment. •Plant area drains	•Blow down will be done from the boiler drums to maintain the concentration of salts within allowable limits, while cooling tower blow down will have the quality of clarified water with higher dissolved solid content. •The waste from the DM plant and filter backwash will be led to the DM plant neutralizing pit and pumped to guard pond. •The sludge from the raw water pre-treatment plant will be collected in a sludge sump to be treated in a sludge handling plant and the separated water from the sludge will be pumped back to the clarifier. •The sewer will collect the drain water from the main plant area and such other areas from where there are possibilities of contamination by oil and fed to an oil/water separator from where	Impact on the water quality of Dokhar nala is felt upto 5 km distance. Insignificant impact on Tapi River water quality.	•Treated waste water at the outlet of guard pond will be continuously monitored for flow, pH conductivity and temperature using online instruments. •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 Power Limited (TPL)

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
			the clear wastewater will be discharged to the guard pond, while the oily water sludge will be collected separately and disposed off in drums. •The effluent coming out of the guard pond is partially used for gardening and balance is disposed 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.			
Ground water	•Ground water pollution due to seepage of pollutants through soil column •Water reservoir will improve the quality and quantity of groundwater.	• No solid waste is generated from the power generation process.	• The sludge and muck from raw water treatment plant and internal drains would be mixed with soil and used as soil conditioner to grow vegetation. The sludge and muck do not contain any toxic metals. •Internal sewer network would be developed with sealed leak free joints. Treated wastewater, free of metals, coliform and organic pollution, is used for gardening.	Nil	• Ground water quality inside plant and nearby villages will be monitored. Water quality of nearby streams, at upstream and downstream points will be monitored.	EMD of Torrent Power Limited (TPL)

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
Air quality	• Air emissions in the form of oxides of nitrogen in excess of stipulated limits	• Firing of Natural Gas (including LNG)	•NOx emissions from turbines will be limited to 50 parts per million By the use of low NOx dry type hybrid burners in the gas turbines. 70 m tall stack will be provided for wide dispersion of exhaust flue gases.	Insignificant impact on existing ambient air quality	•Ambient air quality at upwind and downwind direction (at three locations 120^{o} to each other) will continuously be monitored using online monitoring station. Parameters monitored will be SPM, RSPM, SO_2, NOx and CO. Instantaneous and 24-hourly average values would be available. Calibration facilities would also be available. •Online monitoring of meteorological parameter like wind speed, wind direction, relative humidity, ambient temperature, solar radiation and rainfall will be carried on. •Monitoring will be done as per the guidelines of CPCB. • On-line monitoring systems would be installed in all the 3 stacks; parameters monitored would be SPM, SO2, NOx and CO. Instantaneous values would be recorded and stored in computer. Calibration facilities would also be available.	EMD of Torrent Power Limited (TPL)

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.	• Turbines and air, compressors	•The noise level will decrease with increase in distance from the source due to wave divergence. •The gas turbine generators will be housed in closed building, which would considerably reduce the transmission of noise from the gas turbine generator to the outside environment. •The inlet air and exhaust gas stream would be provided with silencers for noise reduction. Maintenance personnel working within the gas turbine generator building would be provided with adequate protection against noise e.g. ear plug, ear muffs, etc will be provided.	Insignificant impact	•Noise monitoring at the plant boundary, work areas and nearby habitation will be monitored at periodic interval as per CPCB guidelines.	EMD of Torrent Power Limited (TPL)
Solid waste	•No solid waste will be generated during operation activity, except some water treatment plant sludge	•Water treatment plant sludge, spent oil, and lubricants	•Sludge from water treatment plant will be dewatered in sludge drying beds and used as landfill material inside the premises. Such sludge is not hazardous or toxic. •Domestic sewage generated from plant and staff colony will be sent to septic tanks. •Domestic garbage will be disposed as per MSW rules. •Spent oil and lubricants will be	Insignificant impact	•Quantity and Quality of spent oils and lubricants will be disposed off and records will be kept as per authorization obtained from GPCB.	EMD of Torrent Power Limited (TPL)

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
			collected in drums and given to authorized recyclers for reprocessing as per rules.			
Biological environment	•There will be insignificant impact because there is no ecologically sensitive area, no forest cover, no national park, no wildlife sanctuaries, and no sensitive or endangered species in and around the project area.	• Plant operation	• Development and maintenance of greenbelt and greenery on a good part of the land within the plant boundary would be done.	Positive impact on the biodiversity.	• Visual checks by the Ecologists. Frequent interaction with the forest officials.	EMD of Torrent Power Limited (TPL)
Public health and safety	•Exposure to NOx generated from the plant, as per the prevailing wind direction. •Accident and damage to life and property due to handling flammable gas	• Natural Gas (including LNG) receipt and use in power generation.	•Air quality dispersion modeling predicted that the ambient air quality would remain within the national standards. •Medical check-ups of all the employees' pre and post employment at regular intervals. •Providing safety equipments to the workers. •First aid facility, slogans and signboards at prominent places, distribution of pamphlets and leaflets to the workers and	Long-term negative	•Engaging Occupational Health Specialist in the Health Centre. •Organizing health camps in surrounding villages with qualified doctors and supporting staff. Inviting surrounding people for health check up. •CPCB Protocol to be followed during the health camps. •During accident the onsite and offsite disaster management plan would be initiated. In order to monitor the	Hazard control and disaster management of Torrent Power Limited (TPL)

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
			surrounding villagers. •Covering the workers and their family under the health insurance policy. •Fire fighting systems would be checked at regular intervals. Fire extinguishers would be refilled and certified.		effectiveness of the plans, mock drills at regular intervals would be carried out. .	
Socio-economic and cultural environment	•Threat to traditional agriculture and fishery practices •Livelihood generation for people •No human settlement will be displaced. •No impact on public access places as the activity will be confined within the plant boundary and access road to plant site already exists.	•Project development and operation	•Kakrapar canal water is already available for irrigation purpose in the surrounding villages, though the Dokhar nala water is also fit for agriculture. •Fish is available in Tapi river. •Mathematical modeling study proved that there will be negligible impact due to treated wastewater discharge on the water quality of Tapi river after confluence of Dokhar nala, (also the treated wastewater is presently being discharged from the existing CCPP which has reflected no qualitative change) •Several direct and indirect employment opportunities will be created by the project activity which will improve the living standard of local people. • Handing out various contracts will encourage local	Insignificant impact on fishery and agriculture production Long-term, positive		

Parameter	Potential Impact (Without Mitigating Measures)	Activities	Mitigating Measures	Overall Impact	Monitoring Requirement	Responsible Entities
			entrepreneurship; provide employment to locals depending upon their skills. •Training programs for developing self-sufficiency among the local youths will be organized. •Torrent Power Limited (TPL) will provide teaching kits/ school bags/ library materials/ other study materials to the school children and will provide financial assistance for school building renovation. Further development schemes like tree planting, free health checkup and distribution of medicines will be done.			

EMD = environmental management department, EMU = environmental management unit, EPC = engineering, procurement, and construction, GPCB= Gujarat Pollution Control Board, CPCB= Central Pollution Control Board, GCC = general conditions of contract; MoEF= Ministry of Environment and Forests LNG = liquefied natural gas, NO2 = nitrogen dioxide, NOx = nitrogen oxides, PRO = public relations officer, SO2 = sulfur dioxide,.

Appendix-4 List of Plants for Common Practice Analysis

CASE-1

NAME	CAPACITY	TYPE	FUEL 1	Source for CDM Registration / validation
BARAUNI	310	THERMAL	COAL	
KAHALGAON	210	THERMAL	COAL	
KAHALGAON	210	THERMAL	COAL	
KAHALGAON	210	THERMAL	COAL	
KAHALGAON	210	THERMAL	COAL	
KAHALGAON	500	THERMAL	COAL	
KAHALGAON	500	THERMAL	COAL	
KAHALGAON	500	THERMAL	COAL	
TENUGHAT	210	THERMAL	COAL	
TENUGHAT	210	THERMAL	COAL	
JOJBERA	427.5	THERMAL	COAL	
CHANDRAPURA	250	THERMAL	COAL	
CHANDRAPURA	250	THERMAL	COAL	
DURGAPUR	210	THERMAL	COAL	
BOKARO B	210	THERMAL	COAL	
BOKARO B	210	THERMAL	COAL	
BOKARO B	210	THERMAL	COAL	
MEJIA	210	THERMAL	COAL	
MEJIA	210	THERMAL	COAL	
MEJIA	210	THERMAL	COAL	
MEJIA	210	THERMAL	COAL	
MEJIA	250	THERMAL	COAL	
MEJIA	250	THERMAL	COAL	
TALCHER	470	THERMAL	COAL	
I.B.VALLEY	210	THERMAL	COAL	
I.B.VALLEY	210	THERMAL	COAL	
TALCHER STPS	500	THERMAL	COAL	
TALCHER STPS	500	THERMAL	COAL	
TALCHER STPS	500	THERMAL	COAL	
TALCHER STPS	500	THERMAL	COAL	
TALCHER STPS	500	THERMAL	COAL	
TALCHER STPS	500	THERMAL	COAL	
BANDEL	210	THERMAL	COAL	
SANTALDIH	250	THERMAL	COAL	
KOLAGHAT	210	THERMAL	COAL	
KOLAGHAT	210	THERMAL	COAL	

KOLAGHAT	210	THERMAL	COAL	
KOLAGHAT	210	THERMAL	COAL	
KOLAGHAT	210	THERMAL	COAL	
KOLAGHAT	210	THERMAL	COAL	
BAKRESWAR	210	THERMAL	COAL	
BAKRESWAR	210	THERMAL	COAL	
BAKRESWAR	210	THERMAL	COAL	
BAKRESWAR	210	THERMAL	COAL	
BAKRESWAR	210	THERMAL	COAL	
D.P.L.	300	THERMAL	COAL	
TITAGARH	240	THERMAL	COAL	
BUDGE BUDGE	250	THERMAL	COAL	
BUDGE BUDGE	250	THERMAL	COAL	
BUDGE BUDGE	250	THERMAL	COAL	
FARAKKA STPS	200	THERMAL	COAL	
FARAKKA STPS	200	THERMAL	COAL	
FARAKKA STPS	200	THERMAL	COAL	
FARAKKA STPS	500	THERMAL	COAL	
FARAKKA STPS	500	THERMAL	COAL	
MUZAFFARPUR	220	THERMAL	COAL	
SAGARDIGHI TPP	300	THERMAL	COAL	
SAGARDIGHI TPP	300	THERMAL	COAL	
KATHALGURI GT	291	THERMAL	GAS	
BADARPUR	210	THERMAL	COAL	
BADARPUR	210	THERMAL	COAL	
I.P.GT	270	THERMAL	GAS	
PRAGATI CCGT	330.4	THERMAL	GAS	
PANIPAT	210	THERMAL	COAL	
PANIPAT	210	THERMAL	COAL	
PANIPAT	250	THERMAL	COAL	
PANIPAT	250	THERMAL	COAL	
F_BAD CCGT	431.59	THERMAL	GAS	
GNDTP(BHATINDA)	440	THERMAL	COAL	
GHTP (LEH.MOH.)	210	THERMAL	COAL	
GHTP (LEH.MOH.)	210	THERMAL	COAL	
GHTP (LEH.MOH.)	250	THERMAL	COAL	
GHTP	250	THERMAL	COAL	

(LEH.MOH.)				
ROPAR	210	THERMAL	COAL	
ROPAR	210	THERMAL	COAL	
ROPAR	210	THERMAL	COAL	
ROPAR	210	THERMAL	COAL	
ROPAR	210	THERMAL	COAL	
ROPAR	210	THERMAL	COAL	
KOTA	210	THERMAL	COAL	
KOTA	210	THERMAL	COAL	
KOTA	210	THERMAL	COAL	
KOTA	195	THERMAL	COAL	
KOTA	195	THERMAL	COAL	
N.A.P.S	220	NUCLEAR	NUCLEAR	
N.A.P.S	220	NUCLEAR	NUCLEAR	
R.A.P.S.	200	NUCLEAR	NUCLEAR	
R.A.P.S.	220	NUCLEAR	NUCLEAR	
R.A.P.S.	220	NUCLEAR	NUCLEAR	
R.A.P.S.	220	NUCLEAR	NUCLEAR	
R.A.P.S.	220	NUCLEAR	NUCLEAR	
SURATGARH	250	THERMAL	COAL	
SURATGARH	250	THERMAL	COAL	
SURATGARH	250	THERMAL	COAL	
SURATGARH	250	THERMAL	COAL	
SURATGARH	250	THERMAL	COAL	
SURATGARH	250	THERMAL	COAL	
ANTA GT	419.33	THERMAL	GAS	
OBRA	200	THERMAL	COAL	
OBRA	200	THERMAL	COAL	
OBRA	200	THERMAL	COAL	
OBRA	200	THERMAL	COAL	
OBRA	200	THERMAL	COAL	
PANKI	210	THERMAL	COAL	
H_GANJ B	220	THERMAL		
PARICHA	210	THERMAL	COAL	
PARICHA	210	THERMAL	COAL	
ANPARA	210	THERMAL	COAL	
ANPARA	210	THERMAL	COAL	
ANPARA	210	THERMAL	COAL	
ANPARA	500	THERMAL	COAL	
ANPARA	500	THERMAL	COAL	
SINGRAULI STPS	200	THERMAL	COAL	

SINGRAULI STPS	200	THERMAL	COAL	
SINGRAULI STPS	200	THERMAL	COAL	
SINGRAULI STPS	200	THERMAL	COAL	
SINGRAULI STPS	200	THERMAL	COAL	
SINGRAULI STPS	500	THERMAL	COAL	
SINGRAULI STPS	500	THERMAL	COAL	
RIHAND	500	THERMAL	COAL	
RIHAND	500	THERMAL	COAL	
RIHAND	500	THERMAL	COAL	
RIHAND	500	THERMAL	COAL	
UNCHAHAR	210	THERMAL	COAL	
UNCHAHAR	210	THERMAL	COAL	
UNCHAHAR	210	THERMAL	COAL	
UNCHAHAR	210	THERMAL	COAL	
UNCHAHAR	210	THERMAL	COAL	
DADRI (NCTPP)	210	THERMAL	COAL	
DADRI (NCTPP)	210	THERMAL	COAL	
DADRI (NCTPP)	210	THERMAL	COAL	
DADRI (NCTPP)	210	THERMAL	COAL	
DADRI (NCTPP)	490	THERMAL	COAL	
TANDA	440	THERMAL	COAL	
GIRAL	250	THERMAL	LIGN	
DHOLPUR	330	THERMAL	GAS	
YAMUNANAGAR TPP	300	THERMAL	COAL	
YAMUNANAGAR TPP	300	THERMAL	COAL	
DHUVARAN	220	THERMAL	OIL	
UKAI_Coal	200	THERMAL	COAL	
UKAI_Coal	200	THERMAL	COAL	
UKAI_Coal	210	THERMAL	COAL	
GANDHI NAGAR	210	THERMAL	COAL	
GANDHI NAGAR	210	THERMAL	COAL	
GANDHI NAGAR	210	THERMAL	COAL	
DHUVARAN CCPP	218.62	THERMAL	GAS	http://cdm.unfccc.int/Projects/DB/BVQI1190262498.56/view

WANAKBORI	210	THERMAL	COAL	
WANAKBORI	210	THERMAL	COAL	
WANAKBORI	210	THERMAL	COAL	
WANAKBORI	210	THERMAL	COAL	
WANAKBORI	210	THERMAL	COAL	
WANAKBORI	210	THERMAL	COAL	
WANAKBORI	210	THERMAL	COAL	
SIKKA REP.	240	THERMAL	COAL	
KUTCH LIG.	290	THERMAL	LIGN	
ESSAR GT IMP.	515	THERMAL	GAS	http://cdm.unfccc.int/Projects/DB/BVQI1187767050.75/view http://cdm.unfccc.int/Projects/DB/BVQI1250060108.72/view
TORR POWER SAB.	310	THERMAL	COAL	
G.I.P.C.L. GT	305	THERMAL	GAS	
SURAT LIG.	500	THERMAL	LIGN	
PAGUTHAN	250	THERMAL	GAS	
GANDHAR GT	224.49	THERMAL	GAS	
KAKRAPARA	220	NUCLEAR	NUCLEAR	
KAKRAPARA	220	NUCLEAR	NUCLEAR	
SATPURA	200	THERMAL	COAL	
SATPURA	210	THERMAL	COAL	
SATPURA	210	THERMAL	COAL	
SATPURA	210	THERMAL	COAL	
KORBA-V	250	THERMAL	COAL	
KORBA-V	250	THERMAL	COAL	
KORBA-WEST	210	THERMAL	COAL	
KORBA-WEST	210	THERMAL	COAL	
KORBA-WEST	210	THERMAL	COAL	
KORBA-WEST	210	THERMAL	COAL	
AMAR KANTAK EXT	210	THERMAL	COAL	
SANJAY GANDHI	210	THERMAL	COAL	
SANJAY GANDHI	210	THERMAL	COAL	
SANJAY GANDHI	210	THERMAL	COAL	
SANJAY GANDHI	210	THERMAL	COAL	
SANJAY GANDHI	500	THERMAL	COAL	

KORBA STPS	200	THERMAL	COAL	
KORBA STPS	200	THERMAL	COAL	
KORBA STPS	200	THERMAL	COAL	
KORBA STPS	500	THERMAL	COAL	
KORBA STPS	500	THERMAL	COAL	
KORBA STPS	500	THERMAL	COAL	
VINDH_CHAL STPS	210	THERMAL	COAL	
VINDH_CHAL STPS	210	THERMAL	COAL	
VINDH_CHAL STPS	210	THERMAL	COAL	
VINDH_CHAL STPS	210	THERMAL	COAL	
VINDH_CHAL STPS	210	THERMAL	COAL	
VINDH_CHAL STPS	210	THERMAL	COAL	
VINDH_CHAL STPS	500	THERMAL	COAL	
VINDH_CHAL STPS	500	THERMAL	COAL	
VINDH_CHAL STPS	500	THERMAL	COAL	
VINDH_CHAL STPS	500	THERMAL	COAL	
NASIK	210	THERMAL	COAL	
NASIK	210	THERMAL	COAL	
NASIK	210	THERMAL	COAL	
KORADI	200	THERMAL	COAL	
KORADI	210	THERMAL	COAL	
KORADI	210	THERMAL	COAL	
K_KHEDA II	210	THERMAL	COAL	
K_KHEDA II	210	THERMAL	COAL	
K_KHEDA II	210	THERMAL	COAL	
K_KHEDA II	210	THERMAL	COAL	
PARAS	250	THERMAL	COAL	
PARAS	250	THERMAL	COAL	
BHUSAWAL	210	THERMAL	COAL	
BHUSAWAL	210	THERMAL	COAL	
PARLI	210	THERMAL	COAL	
PARLI	210	THERMAL	COAL	
PARLI	210	THERMAL	COAL	
PARLI	250	THERMAL	COAL	
PARLI	250	THERMAL	COAL	

CHANDRAPUR_ Coal	210	THERMAL	COAL	
CHANDRAPUR_ Coal	210	THERMAL	COAL	
CHANDRAPUR_ Coal	210	THERMAL	COAL	
CHANDRAPUR_ Coal	210	THERMAL	COAL	
CHANDRAPUR_ Coal	500	THERMAL	COAL	
CHANDRAPUR_ Coal	500	THERMAL	COAL	
CHANDRAPUR_ Coal	500	THERMAL	COAL	
TROMBAY	500	THERMAL	OIL	
TROMBAY_Coal	500	THERMAL	COAL	
TROMBAY_Coal	250	THERMAL	COAL	
DHANU	250	THERMAL	COAL	
DHANU	250	THERMAL	COAL	
TARAPUR	540	NUCLEAR	NUCLEAR	
TARAPUR	540	NUCLEAR	NUCLEAR	
RATNAGIRI GAS	240	THERMAL	NAPT	
RATNAGIRI GAS	240	THERMAL	NAPT	
RATNAGIRI GAS	225	THERMAL	NAPT	
RATNAGIRI GAS	240	THERMAL	NAPT	
RATNAGIRI GAS	240	THERMAL	NAPT	
RATNAGIRI GAS	260	THERMAL	NAPT	
RATNAGIRI GAS	240	THERMAL	NAPT	
RATNAGIRI GAS	240	THERMAL	NAPT	
RATNAGIRI GAS	260	THERMAL	NAPT	
AKRIMOTA LIG	250	THERMAL	LIGN	
SIPAT STPS	500	THERMAL	COAL	
SIPAT STPS	500	THERMAL	COAL	
RAIGARH TPP	250	THERMAL	COAL	
RAIGARH TPP	250	THERMAL	COAL	
RAIGARH TPP	250	THERMAL	COAL	
RAIGARH TPP	250	THERMAL	COAL	
BHILAI TPP	250	THERMAL	COAL	

BHILAI TPP	250	THERMAL	COAL	
SUGEN CCCP	382.5	THERMAL	GAS	http://cdm.unfccc.int/Projects/DB/RWTUV1178549495.9/view
SUGEN CCCP	382.5	THERMAL	GAS	http://cdm.unfccc.int/Projects/DB/RWTUV1178549495.9/view
SUGEN CCCP	382.5	THERMAL	GAS	http://cdm.unfccc.int/Projects/DB/RWTUV1178549495.9/view
CHHABRA TPS	250	THERMAL	COAL	
CHHABRA TPS	250	THERMAL	COAL	
UTRAN CCCP EXT	374	THERMAL	GAS	http://cdm.unfccc.int/Projects/Validation/DB/TP14F4CC0OSI6UXIHZUGNVD6TIATKY/view.html
ROSA TPP PH - 1	300	THERMAL	COAL	
ROSA TPP PH - 1	300	THERMAL	COAL	
PATHADI TPS PH -I	300	THERMAL	COAL	
PATHADI TPS PH -I	300	THERMAL	COAL	
MUNDRA TPP PH-I	330	THERMAL	COAL	
MUNDRA TPP PH-I	330	THERMAL	COAL	
JALLIPPA KAPURDI TPP	270	THERMAL	LIGN	
BARSINGAR LIGNITE	250	THERMAL	LIGN	
WARDHA WARORA	405	THERMAL	COAL	
K_GUDEM NEW	250	THERMAL	COAL	
K_GUDEM NEW	250	THERMAL	COAL	
VIJAYWADA	210	THERMAL	COAL	
VIJAYWADA	210	THERMAL	COAL	
VIJAYWADA	210	THERMAL	COAL	
VIJAYWADA	210	THERMAL	COAL	
VIJAYWADA	210	THERMAL	COAL	
VIJAYWADA	210	THERMAL	COAL	
RAYAL SEEMA	210	THERMAL	COAL	
RAYAL SEEMA	210	THERMAL	COAL	
RAYAL SEEMA	210	THERMAL	COAL	
RAYAL SEEMA	210	THERMAL	COAL	
VIJESWARAN GT	272.3	THERMAL	GAS	
R_GUNDEM STPS	200	THERMAL	COAL	

R_GUNDEM STPS	200	THERMAL	COAL	
R_GUNDEM STPS	200	THERMAL	COAL	
R_GUNDEM STPS	500	THERMAL	COAL	
R_GUNDEM STPS	500	THERMAL	COAL	
R_GUNDEM STPS	500	THERMAL	COAL	
R_GUNDEM STPS	500	THERMAL	COAL	
SIMHADRI	500	THERMAL	COAL	
SIMHADRI	500	THERMAL	COAL	
JEGURUPADU GT	216.824	THERMAL	GAS	http://cdm.unfccc.int/Projects/Validation/DB/82ORS4DFFAE3F7JI64VMOSYQEYXGCB/view.html
GODAVARI GT	208	THERMAL	GAS	
KONDAPALLI GT	233	THERMAL	GAS	http://cdm.unfccc.int/Projects/Validation/DB/8R97MD9UQX5SS7LLZHIIDRWM2L8PAM/view.html
PEDDAPURAM CCGT	220	THERMAL	GAS	
RAICHUR	210	THERMAL	COAL	
RAICHUR	210	THERMAL	COAL	
RAICHUR	210	THERMAL	COAL	
RAICHUR	210	THERMAL	COAL	
RAICHUR	210	THERMAL	COAL	
RAICHUR	210	THERMAL	COAL	
RAICHUR	210	THERMAL	COAL	
RAICHUR	250	THERMAL	COAL	
KAIGA	220	NUCLEAR	NUCLEAR	
KAIGA	220	NUCLEAR	NUCLEAR	
KAIGA	220	NUCLEAR	NUCLEAR	
TORANGALLU IMP	260	THERMAL	COAL	
TANIR BAVI	220	THERMAL	GAS	
KAYAM KULAM GT	350	THERMAL	GAS	
ENNORE	450	THERMAL	COAL	
TUTICORIN	210	THERMAL	COAL	
TUTICORIN	210	THERMAL	COAL	
TUTICORIN	210	THERMAL	COAL	
TUTICORIN	210	THERMAL	COAL	

TUTICORIN	210	THERMAL	COAL	
METTUR	210	THERMAL	COAL	
METTUR	210	THERMAL	COAL	
METTUR	210	THERMAL	COAL	
METTUR	210	THERMAL	COAL	
NORTH CHENNAI	210	THERMAL	COAL	
NORTH CHENNAI	210	THERMAL	COAL	
NORTH CHENNAI	210	THERMAL	COAL	
VALUTHUR GT	246	THERMAL	GAS	
B. BRIDGE D.G	200	THERMAL	OIL	
P.NALLUR CCGT	330.5	THERMAL	GAS	
NEYVELI ST II	210	THERMAL	LIGN	
NEYVELI ST II	210	THERMAL	LIGN	
NEYVELI ST II	210	THERMAL	LIGN	
NEYVELI ST II	210	THERMAL	LIGN	
NEYVELI ST II	210	THERMAL	LIGN	
NEYVELI ST II	210	THERMAL	LIGN	
NEYVELI ST II	210	THERMAL	LIGN	
NEYVELI FST EXT	210	THERMAL	LIGN	
NEYVELI FST EXT	210	THERMAL	LIGN	
NEYVELI TPS(Z)	250	THERMAL	LIGN	
M.A.P.P.	220	NUCLEAR	NUCLEAR	
M.A.P.P.	220	NUCLEAR	NUCLEAR	
VEMAGIRI CCCP	388.5	THERMAL	GAS	http://cdm.unfccc.int/Projects/Validation/DB/R6JCKXWNYC9LJFX2PQ13OLGTQT8FNE/view.html
BELLARY TPS	500	THERMAL	COAL	
VIJAYWADA TPP-IV	500	THERMAL	COAL	
GAUTAMI CCCP	468.57	THERMAL	GAS	http://cdm.unfccc.int/Projects/Validation/DB/T75O751QXNTM82IQ0KN5FUQNSRZ155/view.html
TORANGALLU EXT	300	THERMAL	COAL	
TORANGALLU EXT	300	THERMAL	COAL	
KONASEEMA CCCP	445	THERMAL	GAS	
KAKATIYA TPP	500	THERMAL	COAL	

CASE-2

NAME	DT_ COMM	CAPACITY MW	SECTOR	TYPE	FUEL 1	Source for CDM Registration / validation
KATHALGURI GT		291	CENTER	THERMAL	GAS	
I.P.GT		270	STATE	THERMAL	GAS	
PRAGATI CCGT		330.4	STATE	THERMAL	GAS	
F_BAD CCGT		431.59	CENTER	THERMAL	GAS	
ANTA GT		419.33	CENTER	THERMAL	GAS	
DHOLPUR		330	STATE	THERMAL	GAS	
DHUVARAN CCPP		218.62	STATE	THERMAL	GAS	http://cdm.unfccc.int/Projects/DB/BVQI1190262498.56/view
ESSAR GT IMP.	10-Aug-95	515	PVT	THERMAL	GAS	http://cdm.unfccc.int/Projects/DB/BVQI1187767050.75/view http://cdm.unfccc.int/Projects/DB/BVQI1250060108.72/view
G.I.P.C.L. GT		305	PVT	THERMAL	GAS	
PAGUTHAN	11-Dec-98	250	PVT	THERMAL	GAS	
GANDHAR GT	30-Mar-95	224.49	CENTER	THERMAL	GAS	
SUGEN CCCP	20-Nov-08	382.5	PVT	THERMAL	GAS	http://cdm.unfccc.int/Projects/DB/RWTUV1178549495.9/view
SUGEN CCCP	7-May-09	382.5	PVT	THERMAL	GAS	http://cdm.unfccc.int/Projects/DB/RWTUV1178549495.9/view
SUGEN CCCP	8-Jun-09	382.5	PVT	THERMAL	GAS	http://cdm.unfccc.int/Projects/DB/RWTUV1178549495.9/view
UTRAN CCCP EXT		374	STATE	THERMAL	GAS	http://cdm.unfccc.int/Projects/Validation/DB/TP14F4CC0OSI6UXIHZUGNVD6TIATKY/view.html
VIJESWARAN GT		272.3	STATE	THERMAL	GAS	

JEGURUPADU GT		216.824	PVT	THERMAL	GAS	http://cdm.unfccc.int/Projects/Validation/DB/82ORS4DFFAE3F7JI64VMOSYQEYXGCB/view.html
GODAVARI GT		208	PVT	THERMAL	GAS	
KONDAPALLI GT	5-Dec-09	233	PVT	THERMAL	GAS	http://cdm.unfccc.int/Projects/Validation/DB/8R97MD9UQX5SS7LLZHIIDRWM2L8PAM/view.html
PEDDAPURAM CCGT	8-Nov-02	220	PVT	THERMAL	GAS	
TANIRBAVI		220	PVT	THERMAL	GAS	
KAYAMKULAM GT		350	CENTER	THERMAL	GAS	
VALUTHUR GT		246	STATE	THERMAL	GAS	
P.NALLUR CCGT	22-Feb-01	330.5	PVT	THERMAL	GAS	
VEMAGIRI CCCP		388.5	PVT	THERMAL	GAS	http://cdm.unfccc.int/Projects/Validation/DB/R6JCKXWNYC9LJFX2PQ13OLGTQT8FNE/view.html
GAUTAMI CCCP		468.57	PVT	THERMAL	GAS	http://cdm.unfccc.int/Projects/Validation/DB/T75O751QXNTM82IQ0KN5FUQNSRZ155/view.html
KONASEEMA CCCP		445	PVT	THERMAL	GAS	

(Source: http://www.cea.nic.in/reports/planning/cdm_co2/cdm_co2.htm - version 7.0)

Appendix-5 Sustainable Development Action Plan

Torrent Power Ltd. (TPL) is a highly ecology conscious Company making efforts towards maintaining proper balance with environment. Torrent Power Limited (TPL) recognizes that environmental and social considerations are the two fundamental pillars which sustain long-term business survival and growth.

Torrent Power Limited (TPL) strives to become a responsible corporate citizen and stands firmly committed towards the betterment of society. Apart from significant involvement in Earthquake Rehabilitation, Institution Building, Environment Care, Community Welfare and Slum Electrification, Torrent's other notable contributions include establishment and financial support to dispensaries, health foundations & community centres along with setting up of hostels for meritorious students.

Over the years, Torrent Power Limited (TPL) has been actively involved in several community welfare projects that are run with the highest standards in humanitarian service such as:-

- Realizing the need for specialized hospitals, Torrent Power Limited (TPL) has established and manages medical institutions such as the Institute of Cardiology and Research Centre and the U. N. Mehta Heart Institute.

- The reconstruction of Parimal garden (in Ahmedabad) by Torrent Power Limited (TPL) has revived a great community spirit. Now a great recreation spot resembling a tranquil oasis - the Parimal garden is the greenest example of Torrent's exemplary commitment to environment care and community welfare

As part of Torrent Power Limited (TPL) and mindful of its social obligations as also being a responsible corporate citizen, UNOSUGEN is fully committed to the concept of Corporate Social Responsibility (CSR). TPL is pursuing the Corporate Social Responsibility activities by dedicated CSR team. An essential component of TPL's Corporate Social Responsibility is to care for the community. TPL has already been pursuing various activities in the areas of healthcare, education, socio-economic and public awareness at its SUGEN Mega Power project which is in proximity to UNOSUGEN Project. Such activities would also be supported and reinforced by UNOSUGEN Project.

TPL has already identified and commenced undertaking CSR activities at UNOSUGEN including some new initiatives such as:

- "Shiksha Setu" in the area of education needs (as part of its overall education initiative) which is aimed to achieve visible and measurable improvement in learning of students (primary education classes) targeting four schools in the immediate vicinity of the plant.
- Construction and operation of a complete medical centre to cater for healthcare of the locals.
- A Bio gas plant assisting in waste disposal in the surroundings as part of community health program.

Further, TPL would also like to undertake some other programs towards sustainable development based on the needs and concern of local community and area. These may include providing assistance for development of public amenities in the areas such as construction and operations of School and sanitation facilities, establishing educational scholarship, free distribution of educational books and school uniforms, vocational training, annual eye camps / health check up centres for villagers etc. However the exact activities would be subsequently finalized.

TPL has already allocated INR 68 million initially for the projects mentioned above and is committed to spend INR 14 million per annum as recurring expenditure for such Corporate Social Responsibility activities. Further, TPL is also committed to spend any additional amount, if required, for ensuring that at

least 2% of CER revenue realized is spent towards society / community development activities of local areas.

A periodic review will be carried out against the funds deployed in above-mentioned sustainable development activities and CER revenue realised based on CER sale rate (realised), actual CERs generated and sold at such price.