CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

>> Switching of fuel from naphtha to natural gas at Essar Power Limited's 515 MW power plant in Hazira, Gujarat, India, for generation and supply of electricity to Gujarat Electricity Board Grid and to Essar Steel Limited.

A.2. Description of the project activity:

>> The project activity is to effect a change in primary fuel for power generation from naphtha to natural gas. The power plant has been using naphtha as *the primary fuel* and has shifted to partial use of natural gas from mid-December, 2002. The plant will run on both naphtha and natural gas up to end of 2005, and will fully shift to natural gas thereafter. The fuel shift has resulted in a capital investment of Rs 31.4 million. This switch in primary fossil fuel is envisaged as a CDM project activity. The project activity has resulted in a decrease in GHG emissions to the atmosphere.

The fuel switch project did not involve diversion of natural gas from some other existing use to the project activity. It involves at the outset, a tie up with an appropriate gas supplier[1] and laying of gas pipeline for supply of one million standard cubic meter per day (1 MMSCD) of gas to Essar Power Limited's (EPOL). Moreover, EPOL procures 0.25 MMSCD from Gujarat State Petroleum Corporation Limited ("GSPCL"), and Essar Steel Limited (ESTL) supplies another 0.75 MMSCD of natural gas.

For generation of electricity, several types of fuels with varying degrees of GHG intensity could be used. But in India, the cost of power generation is passed through to the power purchaser leaving the generator with no specific incentive to switch to low GHG intensity fuels, even if these have lower total fuel procurement costs. Also, it is not attractive for the power generators to switch to less GHG intensive fuels, since, the fuel prices for natural gas is volatile and its availability of natural gas is uncertain.

Further, the project activity includes development, design, engineering, procurement, financing, construction, ownership, operation and maintenance of appropriate facilities to switch to natural gas as primary fuel, including laying of appropriate gas pipelines and appurtenances and modifications in turbine. The power generated will provide electricity to both Gujarat Electricity Board ("GEB") grid and ESTL (a sister concern), under a long term PPA.

The proposed Project Activity meets several key objectives including:

- Contribute towards meeting the electricity supply deficit in the state of Gujarat;
- Contribute to improved electricity supply service delivery to a limited extent;
- Improve micro-economic efficiency of the power sector through improved availability and load factor;
- Reduce GHG emissions in power sector and reduce average emission intensity, average effluent intensity and average waste intensity of power generation in the system; and
- Develop the local economy and create jobs and employment, particularly in rural areas, which is a priority concern for Government of India.

[1] Gujarat Gas Company Limited "GGCL".

A.3. Project participants:

>> The project activity is being implemented by EPOL. Essar Power Limited is promoted by Rs. 17 billion (US$ 3.6 billion) Essar Group. The Essar Group has interests in steel, shipping, power, oil and gas, and telecom. ESTL has a 2.4 mtpa state of the art steel plant with an asset base of Rs 4.7 billion (US$ 1 billion). Similarly, Essar Shipping is one of the largest Indian shipping company with an asset base of Rs 1 billion (US$ 213 million).

EPOL has total assets worth Rs 25.884 billion (US$ 528 million) including a 515 MW power plant a Hazira in Gujarat. EPOL had a gross revenue of Rs 10.335 billion (US$ 210.92 million) for the 18 month period ending 30th September 2001 with a PAT of Rs 624 million (US$ 12.74 million). In the above period EPOL sold 3059 Million KWh to Gujarat Electricity Board and 2043 Million KWh to Essar Steel Limited. GEB and ESTL are the only two consumers that EPOL has. Details of the company and the promoters are available on the company website at www.essar.com.

PricewaterhouseCoopers (P) Ltd. (PwC) is assisting the project sponsor in developing the Project Design Document (PDD) and will also assist in the defense of the PDD during Host Government Approval and validation procedure. PwC, formed by the global merger of Price Waterhouse and Coopers & Lybrand in 1998, is the world's largest financial and professional services organization with 125,000 people in 142 countries and 867 offices worldwide. The contact information of project participants has been provided in Annex 1.

EPOL shall be the sole contact for the CDM Project Activity.

EPOL has been in discussions with some Parties in Annex I countries to participate in this project activity. The information on the same will be duly supplemented in this PDD before the registration of the project activity.

A.4. Technical description of the project activity:

A.4.1.1. Host Party(ies):

>> The Government of India.

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

>> Gujarat.

A.4.1.3. City/Town/Community etc:

>> Hazira, Surat District.

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

>> The project activity has been undertaken at Essar Power Limited plant at 27th Km on the Surat – Hazira Road in Hazira, Surat District of State of Gujarat, India.

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

>> The project activity is considered under Sectoral Scope 1 (Energy industries (renewable - / non-renewable sources) as per CDM-ACCR-06.

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

>> EPOL at full gas based generation shall require 0.67 billion cubic metres of natural gas per annum. The power plant has, prior to the switch in primary fossil fuel, been using natural gas to some extent, in a mixed fired operation with naphtha, which has been the primary fuel. The EPOL has undertaken initiatives to completely switch to natural gas from April 2002 onwards, which constitutes the CDM project activity discussed herein. The power plant comprises of 3 numbers GE Frame 9E gas turbines of 110 MW each. Further, there are 3 numbers heat recovery steam generators (HRSG) and one steam turbine of 185 MW. At full load, the power plant would consume 2.448 SCM/day of natural gas, which has a GCV of 9,300 kCal/SCM at an average heat rate of 1,777 kCal/KWh. The natural gas consumption shall be the principal source of GHG emissions on premises. The gas turbine generators output is at 11.5KV while that of steam turbine generator is at 15KV. These are stepped up to 220 KV for evacuation to grid. The evacuation to grid is at the 220 KV switch-yard maintained by EPOL. The electricity generated, net of the auxiliary consumption (2%) is fed into the grid at a 220KV.

Salient Features of the Technology Employed:

a) EPOL's GE frame 9E gas turbines (site rated 110 MW each) that have been installed were the first of their kind and size in the country. The turbines could fire gas/ naphtha/ HSD/ NGL as mixed fuel.
b) EPOL installed these in spite of the fact that GOI had not allocated gas for power generation purposes and incurred additional capital expenditure amounting to US$ 8 million to enable the turbine for mixed firing of gas and naphtha.
c) In order to upgrade the turbines and make it mixed fuel capable, EPOL had specific software and control systems designed and installed, which permit pure naphtha, pure gas and simultaneous naphtha and gas firing in the turbine.
d) Through operational efficiency, EPOL has succeeded in increasing the Cycle of Concentration (COC) for water consumed from 3.5 to 8. Thus, it has set new standards in water recycling and reuse which results in water savings of 140 m^3/hr.
e) The Power plant has optimized the boiler makeup water requirement and reduced it to 1% from the original 3% and the savings on this account work out to 13 m^3/hr.
f) Vertical pumps are preferred for High volume circulating water pumps (13,000 m^3/hr flow). However, EPOL has installed horizontal pumps for this purpose.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

>> The baseline scenario for this project activity is continuing with naphtha for power generation, due to several barriers to the project activity such as investment, technology, prevalence, etc., without making any efficiency or performance improvements in the existing project.

Such would have emitted higher quantum of CO2, since it has a higher specific CO2 emission factor (0.0733 $ktCO_2$/Tj) as compared to 0.0561 $ktCO_2$/Tj for natural gas.

Due to the project activity (power generation at same output level – 515 MW) would be achieved using lower GHG intensive fuel (natural gas).

Hence, the project activity will result in reduction in GHG emissions.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

>> The annual emission reductions work out to 241,867 tCO_2 the first three years (2003 – 2005) and to 310,033 tCO_2 for all remaining years up to 2012, aggregating to a total of 2,895,834 tCO_2 over the entire crediting period of 10 years.

A.4.5. Public funding of the project activity:

>> The project activity did not include any public funding or ODA.

SECTION B. Application of a baseline methodology

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

>> In the absence of an approved baseline methodology, a proposed new methodology called *"Industrial fuel switching from liquid to gaseous petroleum products in a power plant project without extension of capacity"* has been adopted. This new methodology is similar to the approved baseline methodology (AM0008)[2].

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

>> The adopted methodology is applicable for the project activity under consideration due to the following reasons:

- The local regulations do not constrain EPOL from using naphtha which is of a higher GHG intensity than natural gas.
- Any increase/ decrease in the cost of power generation, as per government policy, is passed through to the power purchaser and power generator/ project proponent does not get financially benefited by any decrease in the fuel price, if any, after the switch.
- There are risks due to price volatility and additional capital costs for undertaking project activity involving natural gas.
- The quantum of natural gas needed for the project activity have been sourced from independent sources, and not been diverted from any present use elsewhere.
- The EPOL power plant has not undergone major efficiency improvements, and is not planned for any such improvements during the crediting period.
- The project activity will not increase the capacity of power plant beyond its rated capacity of 515 MW at least during the crediting period).
- The project activity has not resulted in any integrated process changes within the project boundary (refer section B.4).

B.2. Description of how the methodology is applied in the context of the project activity:

>> In the absence of the project activity, the power plant would have continued to generate power using liquid petroleum fuel at least up to the end of the crediting period without any retrofit.

The power plant would not have switched to another cheaper fuel and more GHG intensive fuel like coal, since that would have needed meeting a larger change of technology and associated financial and compliance guided environmental requirements. Hence, the methodology has been applied to determine

[2] Industrial fuel switching from coal and petroleum fuels to natural gas without extension of capacity and lifetime of the facility.

and take into consideration all parameters that would contribute to emission of GHGs from continued operation of the power plant in the project activity under existing operating conditions (same power generation capacity and efficiency) until at least the end of the crediting period.

In order to calculate the baseline emissions, the following steps have been adopted:

Step 1. determine the baseline quantity usage of naphtha for a defined vintage;

Step 2. determine the emission factors for CO_2, CH_4 and N_2O (that could be emitted from burning of fuels in the baseline scenario); and

Step 3. calculate the total equivalent CO2 emissions.

The leakages have been estimated - due to production of fuel using IPCC factor, and for transportation the leakage is estimated as 50% of leakage due to production.

The additionality has been established as given in B.3. below.

The project emissions have been calculated for CO2, CH4 and N20 for the fuel combustion using IPCC factors.

B.3. 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:

>> In the absence of project activity, naphtha would have continued to be used as fuel for generation of electricity at the power plant. Since, naphtha is more GHG intensive than natural gas, by switching over to the new fuel, emission reductions would occur.

This project activity will be defined as additional[3] if anthropogenic emissions of GHGs by sources are reduced below those that would have occurred in the absence of the registered CDM project activity. Within the scope of the adopted new baseline methodology, additionality has been demonstrated using the Meth Panel recommended guidelines4 through the following steps:

Steps for Additionality Check	Description on Additionality Demonstration	Conclusion
Step 0: Preliminary screening based on the starting date of the project activity	✓ The power plant has been using naphtha as *the primary fuel* and has shift to natural gas from mid-December 2002, and there are available documentary evidence on the same. ✓ The management of EPOL had decided to go for the project considering the various advantages of CDM incentive under Kyoto Protocol. There is documentary evidence to such decision that could be verified by the validator.	The project activity has crossed step 0 of additionality demonstration and can proceed to step 1.

[3] As per 17/cp.7

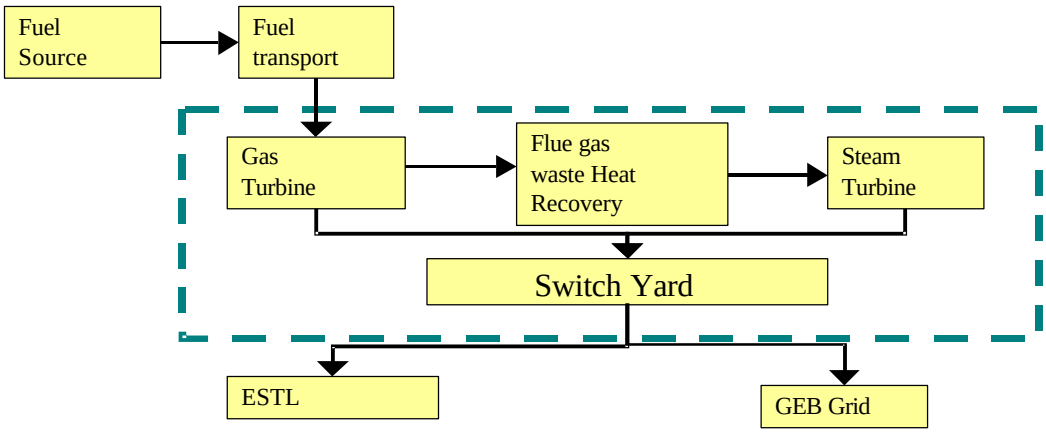
[4] As per "Annex 1: Tool for the demonstration and assessment of additionality" of CDM EB 16.

Steps for Additionality Check	Description on Additionality Demonstration	Conclusion
Step 1: Identification of alternatives to the project activity consistent with current laws and regulations	✓ Alternatives to project activity is power plant continues to generate power using naphtha at least up to the end of the crediting period without any retrofit, or it switches to a cheaper fuel such as coal. ✓ The Indian Electricity Act of 2003 does not restrict or empower any authority to restrict the fuel choice for power generation. ✓ There are no environmental regulations preventing the use of naphtha or promoting the use of natural gas for power. ✓ Use of other types of fuels such as coal is also allowed under the Indian regulations.	The project activity has crossed step 1 of additionality demonstration, and can proceed to step 2 or step 3. In this project activity, step 3 (barrier analysis) has been chosen for additionality demonstration.
Step 3: Barrier Analysis	✓ ***Investment*** - the project proponent had made investments on the project despite perceived risks to such investment such as un-assured availability of natural gas, price volatility for natural gas that could push up cost of electricity generation and high capital costs of investment (Rs. 31.4 million); the decision to take up the project activity has been made with an understanding the CDM incentive would help in overcoming the barriers to investment on the project; ✓ ***Technology*** - EPOL's GE frame 9E gas turbines (site rated 110 MW each) that have been installed were the first of their kind and size in the country at the time this project activity was conceived and implemented; and ✓ ***Prevalence*** - the project activity is not very common as only few gas based power projects have come in the recent past in India, and not many of the existing are running successfully; and ✓ ***Other Barriers***- due to lack of adequate infrastructure for transportation of the natural gas to the project site, the project proponent had to make provisions through the gas supplier to lay additional pipelines for such transportation.	The project activity has crossed step 3 of additionality demonstration, and can move to step 4.

Steps for Additionality Check	Description on Additionality Demonstration	Conclusion
Step 4: Common Practice Analysis	✓ The power plant is located in Gujarat in the western grid where as per 2003-04 annual report of the Western Regional Electricity Board (WREB), the total installed capacity for the same period in the western grid, which has a major share from Gujarat state, is 32,178.80 MW out of which gas based power projects contribute 5,035.72 MW, which is approximately 16% of the total. ✓ However, many of the projects have not been performing are reportedly facing operating problems due to non-availability of gas. The project sponsor, however, has made arrangements to avoid such problems and start the project.	The project activity has crossed step 4 of additionality demonstration, and can move to step 5.
Step 5: Impact of CDM Registration	✓ The CDM registration of this project activity will encourage other power plants in India using naphtha or other GHG intensive fuels to switchover to natural gas using the benefits of the CDM revenue.	Based on the additionality analysis, the project has demonstrated that it is not a business as usual case and is additional.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

>>



The project boundary is depicted above, based on the "one step upstream and one step downstream principle" that requires transport of fuel is included within the project boundary, and the switchyard for supply to ESTL and GEB Grid included on the downstream.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

>> The date of completion of the current draft of the baseline information is 14 February 2005.

Dr. P Ram Babu of PricewaterhouseCoopers (P) Limited, whose contact information is set out in Annex 1, has assisted the project proponent in determining the baseline methodology.

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:

>> The project activity is already been initiated, and the operations have commenced since mid December 2002.

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

>>The project activity is expected to be operational for a period of 30 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:

>>

C.2.1.2. Length of the first crediting period:

>>

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
1st January 2003.

C.2.2.2. Length:

>>
10years.

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

>> In the absence of an approved monitoring methodology, a proposed new methodology called *"Industrial fuel switching from liquid to gaseous petroleum products in a power plant project without extension of capacity"* has been adopted in line with the adopted new baseline methodology.

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

>> Based on the following reasons, the monitoring methodology applies to the project activity:

- The project activity have not increased quantum of power generated;
- the data required for the methodology can be monitored using available on-site project monitoring facilities; and
- no major efficiency improvements or any integrated process changes are expected during the crediting period of the project activity.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
QE_GFy (D.2.1.2)	Quantity of Natural Gas used	Power plant records	SCM	m	Daily	Annual	Electronic/ paper	--
GCV_GF (D.2.1.2)	Gross Calorific Value of Natural Gas	Power plant records	kCal/SCM	m/ e	Daily	Annual	Electronic/ paper	--
PA_NEW (D.2.1.2)	Power generated	Power plant records	MW	m/ c	Daily	Annual	Electronic/ paper	--
?GFy (D.2.1.2)	Fuel efficiencies for Natural Gas combustion	Power plant records	%	m/ c	Daily	Annual	Electronic/ paper	--
QE_P_LFy (D.2.1.2)	Quantity of Naphtha used	Power plant records	kg	m	Daily	Annual	Electronic/ paper	--
GCV_P_LF (D.2.1.2)	Gross Calorific Value of Naphtha	Power plant records	kCal/kg	m	Daily	Annual	Electronic/ paper	--

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>> The project emissions PEy (measured in ton of CO2 equivalents - tCO2e/yr)) during any year 'y' is expressed as:

PEy = QE_GFy * (EF_GF + FC_GF_CH4 * GWP_CH4 + FC_GF_N2O * GWP_N2O)……(1)

where:

QE_GFy = Quantity of gaseous gas used in the project scenario for replacing liquid fuel in the baseline scenario, and measured in energy units (e.g., Joule).

EF_GF = IPCC default CO2 emission factor per unit of gaseous fuel associated with fuel combustion (e.g., tCO2/Joule).

FC_GF_CH4 = IPCC default CH4 emission factor of gaseous fuel associated with fuel combustion, measured in tCH4/Joule.

FC_GF_N2O = IPCC default N2O emission factor of gaseous fuel associated with fuel combustion, measured in tN2O/Joule.

The quantity of gaseous fuel measured in energy units is calculated as:

QE_GFy = Q_GFy * GCV_GF * (4.1868 * 10^3)……..(2)

where:

Q_GFy,= Historical annual consumption of gaseous fuel (in SCM) during any year 'y'; and

GCV_GF = Gross Calorific Value of gaseous fuel in the baseline scenario (in kCal/SCM).

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
QE_B_LFy (D.2.1.4)	Quantity of Naphtha used	Power plant records	kg	m	Daily	Annual	Electronic/ paper	Average of 2 years data (prior to start of project activity)
GCV_B_LF (D.2.1.4)	Gross Calorific Value of Naphtha	Power plant records	kCal/kg	m	Daily	Annual	Electronic/ paper	Average of 2 years data (prior to start of project activity)
PA_OLD (D.2.1.4)	Power generated in the baseline	Power plant records	MW	m/ c	Daily	Annual	Electronic/ paper	Average of 2 years data (prior to start of project activity)
? LFy (D.2.1.4)	Fuel efficiencies for Naphtha combustion	Power plant records	%	m/ c	Daily	Annual	Electronic/ paper	Average of 2 years data (prior to start of project activity)

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>> The baseline emissions *BEy* (measured in ton of CO2 equivalents - tCO2e/yr)) during any year 'y' is expressed as:

BEy = QE_LFy * (EF_LF_CO2 + FC_LF_CH4 * GWP_CH4 + FC_LF_N2O * GWP_N2O)….(3)

where:

QE_LFy, = Quantity of liquid fuel used in the baseline scenario during any year 'y', measured in energy units (e.g., Joule).
EF_LF = CO2 equivalent emission factor per unit of energy of liquid fuel (e.g., tCO2e/Joule).

FC_LF_CH4 = IPCC default CH4 emission factor of liquid fuel associated with fuel combustion, measured in tCH4/Joule.
FC_LF_N2O = IPCC default N2O emission factor of liquid fuel associated with fuel combustion, measured in tN2O/Joule.
GWP_CH4 = Global warming potential of CH4 set as 21 tCO2e/tCH4.
GWP_N2O = Global warming potential of N2O set as 310 tCO2e/tN2O.

The parameter QE_LFy in the baseline emissions formula are calculated by using parameters monitored ex ante or ex post.

The quantity of liquid fuel measured in energy units is calculated as:

QE _LFy = QE_B _LFy * GCV_LF * (4.1868 * 10^3)……..(4)

where:

QE_B_LFy, = Historical annual consumption of liquid fuel (in kg or liters) during any year 'y'; and
GCV_LF = Gross Calorific Value of liquid fuel in the baseline scenario (in kCal/kg or kCal/liters).

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

>> Not opted for.

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

>> Not applicable.

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>> Not applicable.

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
QE_B_LFy (D.2.1.4)	Quantity of Naphtha used	Power plant records	kg	m	Daily	Annual	Electronic/ paper	Average of 2 years data (prior to start of project activity)
QE_P_LFy (D.2.1.2)	Quantity of Naphtha used	Power plant records	kg	m	Daily	Annual	Electronic/ paper	--
QE_GFy (D.2.1.4)	Quantity of Natural Gas used	Power plant records	SCM	m	Daily	Annual	Electronic/ paper	--

>> Leakage emissions could occur due to the project activity due to the following conditions:

1. Fugitive CH4 emissions from fuel production; and

2. CO2 emissions from fuel transportation based on mode of transportation. Emission from transportation in pipeline could be considered negligible in case of properly managed project activity.

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>> The leakage emission due to fuel production is expressed as:

LE_FPy = [(QE_GFy * FE_GF_CH4) – (QE_LFy * FE_LF_CH4)] * GWP_CH4…….(5)

where:

FE_LF_CH4 = IPCC default CH4 fugitive emission factor of liquid fuel, measured in tCH4/Joule.

FE_GF_ CH4 = IPCC default CH4 fugitive emission factor of gaseous fuel, measured in tCH4/Joule.

In case of this project activity, leakages due to production have been calculated using IPCC default values[5].

The leakage emission due to fuel transportation is expressed as:

LE_FTy = [(QE_GFy * EF_GF_TF) - (QE_LFy * EF_LF_TF)]……..(6)

where:

EF_LF_TF = IPCC default CO2 emission factor of liquid fuel transportation (e.g. by road tanker), measured in tCO2/Joule.

EF_GF_TF = IPCC default CO2 emission factor of liquid fuel transportation (e.g., through pipeline), measured in tCO2/Joule.

[5] IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3: Reference Manual (1996), Table 1-64, Page 1.131. Fugitive emission factor for methane due to natural gas production is taken as that for “gas”; and fugitive emission factor for methane due to naphtha production is taken as that for “oil”.

Since, the above values are not available for India, in keeping with the chosen baseline methodology, the leakage emission due to fuel transportation has been taken as 50% of that due to fuel production.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>> The annual emission reductions during any year 'y' will be calculated using equations (1), (3), (5) and (6):

ERy = BEy - PEy – (LE_FPy + LE_FTy)…….(7)

The variables in the baseline emissions (QE_LFy) and the project emissions (QE_GFy) are linked with the energy efficiency constraint relation:

QE_LFy * ?LFy = QE_GFy * ?GFy……(8)

Here "?LFy" and "?GFy" are fuel efficiencies for use of liquid and gaseous fuels, respectively, and ensures a check that during any year 'y' the energy efficiencies are not changed due to use of the new fuel.

In case, QE_LFy * ?LFy < QE_GFy * ?GFy, then the emission reduction would be discounted by a factor equal to the following:

*Discount Factor = (QE_LFy * ?LFy / QE_GFy * ?GFy)…….(9)*

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
QE_GFy (Table D.2.1.1)	Low	Monitoring is covered under existing quality management system of the project proponent, and hence additional QA/QC checks are not required.
GCV_GF (Table D.2.1.1)	Low	As above.
PA_NEW (Table D.2.1.1)	Low	As above.
?GFy (Table D.2.1.1)	Low	As above.
QE_P_LFy (Table D.2.1.1)	Low	As above.
GCV_P_LF (Table D.2.1.1)	Low	As above.

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
QE_B_LFy (Table D.2.1.3)	Low	As above.
GCV_B_LF (Table D.2.1.3)	Low	As above.
PA_OLD (Table D.2.1.3)	Low	As above.
?LFy (Table D.2.1.3)	Low	As above.

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

>>

The project will be operated and managed through a dedicated team of environmental professional and plant operators, who are conversant with the QA/QC protocols of power plant operations and requirements of the CDM project. The team will be responsible for and will ensure safety in operation of the plant. The relevant HAZOP studies and measures against risks have been identified and routinely addressed.

D.5 Name of person/entity determining the monitoring methodology:

>>

Dr. Ram Babu of PricewaterhouseCoopers whose contact information is set out in Annex 1 has assisted the Sponsor in determining the monitoring methodology.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>>

The project emission in the first three years works out to 1,482,210 tCO_2 while that from the fourth year onwards works out to 1,428,800 tCO_2.

E.2. Estimated leakage:

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The leakage emission in the first three years works out to 55,452 tCO_2 while that from the fourth year onwards works out to 51,716 tCO_2.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

>>

The total emissions in the first three years work out to **1,537,662 tCO_2** per year, while that from the fourth year onwards works out to **1,480,516 tCO_2** per year for rest of the crediting period.

Hence, the total project emission for the 10-year crediting period works out to be **14,976,597 tCO_2**.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

>>

The total baseline emission for the 10-year crediting period works out to be **18,459,932 tCO_2**.

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

>>

The emission reductions for the 10-year crediting period (difference between E.4 and E.3) work out to **3,483,335 tCO_{2e}**.

E.6. Table providing values obtained when applying formulae above:

>>

Particulars	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	TOTAL (tCO2)
Baseline (tCO2/yr)	1,845,993	1,845,993	1,845,993	1,845,993	1,845,993	1,845,993	1,845,993	1,845,993	1,845,993	1,845,993	18,459,932
Project Emissions (tCO2/yr)	1,537,662	1,537,662	1,537,662	1,480,516	1,480,516	1,480,516	1,480,516	1,480,516	1,480,516	1,480,516	14,976,597
Emission Reduction (tCO2/yr)	308,332	308,332	308,332	365,477	365,477	365,477	365,477	365,477	365,477	365,477	3,483,335

SECTION F. Environmental impacts

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

>>

Thirty-two categories of activities with a certain investment criteria are required to undertake an Environmental Impact Assessment (EIA) under the Environmental Impact Notification of Government of India. This project activity is not covered under this notification. However, an initial exercise on sustainable

development due to the project activity has already been completed and the details are included under Appendix 1.

F.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:

>>
Shall be included.

SECTION G. Stakeholders' comments

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

>>
Shall be included.

G.2. Summary of the comments received:

>>
Shall be included.

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

>>
Shall be included.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Essar Power Limited
Street/P.O.Box:	11, Keshav Rao Khadye Marg
Building:	14th Floor Essar House,
City:	Mahalaxmi, Mumbai
State/Region:	Maharashtra
Postfix/ZIP:	400 034
Country:	India
Telephone:	+91-22-2495 0606
FAX:	+91-22-2495 4787
E-Mail:	aksrivastava@essar.com
URL:	www.essar.com
Represented by:	
Title:	Managing Director
Salutation:	Mr.
Last Name:	Srivastava
Middle Name:	K.
First Name:	A.
Department:	Managing Director
Mobile:	
Direct FAX:	+91-22-2495 4787
Direct tel:	+91-22-2495 0606
Personal E-Mail:	aksrivastava@essar.com
Organization:	PricewaterhouseCoopers (P) Ltd.
Street/P.O.Box:	Veer Savarkar Marg, Shivaji Park, Dadar (West)
Building:	252
City:	Mumbai
State/Region:	Maharastra
Postfix/ZIP:	400 028
Country:	India
Telephone:	+91-22-5669-1500
FAX:	+91-22-5654-7804
E-Mail:	ram.babu@in.pwcglobal.com
URL:	www.pwcglobal.com
Represented by:	
Title:	Associate Director
Salutation:	Mr.
Last Name:	Ram Babu
Middle Name:	
First Name:	P
Department:	Sustainability Business Solutions
Mobile:	+91-9820135929
Direct FAX:	-

Direct tel:	+91-22-5669-1302
Personal E-Mail:	ram.babu@in.pwcglobal.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding or ODA contribution is involved in the project activity.

Annex 3

BASELINE INFORMATION

Parameter	Parameter ID	Value	Units
Capacity of the Power Plant		515.00	MW
Plant Load Factor (Expected)	PLF	0.75	
Plant Availability Factor (Expected)		0.93	
Load Hours per annum		6570.00	Hrs
Average annual electricity production at above PLF		3383.55	GWh
Auxiliary Consumption		2.00	%
Auxiliary Consumption		67.67	GWh
Net electricity evacuated to grid at expected PLF		3315.88	GWh
Current Naptha consumption rate at Base load (per turbine)		27.00	Tonnes/Hr
Number of Turbines		3.00	nos
Total naphtha consumption rate		81.00	T/Hr
Total annual naphtha consumption at expected PLF	Q_LF	532170.00	Tonnes
GCV of naphtha	GCV_LF	11300.00	kCals/Kg
Annual Naptha consumption at expected PLF		25136.52	Tjoules
Annual consumption of naphtha in baseline	QE_LF	2.51365E+16	J
IPCC emission factor for Naphtha		0.07	Ktonnes/Tj
CO2 emission factor for naphtha per unit of energy of fuel	EF_LF_CO2	7.33E-11	tof CO2e/J
IPCC default CH4 emission factor of liquid fuel associated with fuel combustion		0.7	kg/Tj
CH4 emission factor for naphtha per unit of energy of fuel	FC_LF_CH4	7E-16	tCO2e/J
Global warming potential of CH4	GWP_CH4	21	tCO2e/tCH4
IPCC default N2O emission factor of liquid fuel associated with fuel combustion		0.4	kg/Tj
N2O emission factor for naphtha per unit of energy of fuel		4E-16	tCO2e/J
Global warming potential of N2O		310	tCO2e/tCH4
CO2 equivalent emissions in the baseline	**BEy**	**1845993.188**	**tCO2e**

Annex 4

MONITORING PLAN

The general conditions set out for metering, recording, meter readings, meter inspections, Test & Checking and communication shall be applicable for both electrical energy and gas, where relevant and applicable.

Metering: The Delivered Energy shall be metered by the Parties at the high voltage side of the step up transformer installed at the Project Site.

Metering Equipment: Metering equipment shall be electronic trivector meters of accuracy class 0.2% required for the Project (both main and check meters). The main meter shall be installed and owned by the Company, whereas check meters shall be by the Corporation. Dedicated core of both CT's and PT's of required accuracy shall be made available by the Company to Corporation. The metering equipment shall be maintained in accordance with electricity standards. Such equipment shall have the capability of recording half-hourly and monthly readings. The Company shall provide such metering results of the Corporation. The meters installed shall be capable of recording and storing half hourly readings of all the electrical parameters for a minimum period of 35 days with digital output.

Meter Readings: The monthly meter readings (both main and check meters) shall be taken jointly by the parties on the first day of the following month at 12 Noon. At the conclusion of each meter reading an appointed representative of the Corporation and the Company shall sign a document indicating the number of Kilowatt-hours indicated by the meter.

Inspection of Energy Meters: All the main and check energy meters (export and import) and all associated instruments, transformers installed at the Project shall be of 0.2% accuracy class. Each meter shall be jointly inspected and sealed on behalf of the Parties and shall not be interfered with by either Party except in the presence of the other Party or its accredited representatives.

Meter Test Checking: All the main and check meters shall be tested for accuracy every calendar quarter with reference to a portable standard meter which shall be of any accuracy class of 0.1%. The portable standard meter shall be owned by the Corporation at its own cost and expense and tested and certified at least once every year against an accepted laboratory standard meter in accordance with electricity standards. The meters shall be deemed to be working satisfactory if the errors are within specifications for meters of 0.25 accuracy class. The consumption registered by the main meters alone will hold for the purpose of billing as long as the error in the main meters is within the permissible limits.

If during the quarterly tests, the main meter is found to be within the permissible limit of error and the corresponding check meter is beyond the permissible limits, then billing will be as per the main meter as usual. The check meter shall, however, be calibrated immediately.

If during the quarterly tests, the main meter is found to be beyond permissible limits of error, but the corresponding check meter is found to be within permissible of error, then the billing for the month up to the date and time of such test shall be as per the check meter. There will be a revision in the bills for the period from the previous calibration test up to the current test based on the readings of the check meter. The main meter shall be calibrated immediately and billing for the period thereafter till the next monthly meter reading shall be as per the calibrated main meter.

If during the quarterly tests, both the main meters and the corresponding check meters are found to be beyond the permissible limits of error, both the main meters shall be immediately calibrated and the correction applied to the reading registered by the main meter to arrive the correct reading of energy supplied for billing purposes for the period from the last month's meter reading up to the current test. Billing for the period thereafter till the next monthly reading shall be as per the calibrated main meter.

If during any of the monthly meter readings, the variation between the main meter and the check meter is more than the permissible for meters of 0.2% accuracy class; all the meters shall be re-tested and calibrated immediately.

Interconnection and Metering Facilities: The Company shall provide dedicated core for the check metering.

Communication Facilities: The Company shall install and maintain at its cost communication facilities such as fax and telecommunication facilities to the Project to enable receipt of data at Corporation's Load Dispatch Centre.

In addition to the above, the following will be done:

- The proponent may send an annual written declaration of an independent third party such as an external accountant/auditor that the above documents have been verified and audited.
- The quantitative details indicating the net exported electrical energy to the Grid certified by an independent external auditor shall be used, for verification of the CERs. Further, the joint energy meter reading signed by GEB/ESTL (the Power Purchasers) as accepted by purchasers and the invoices raised on purchasers based on the joint energy meter readings shall be the base audit document for verification protocol.
- All meter readings shall be taken jointly by the parties involved as per the schedule in the Monitoring Plan. The joint meter readings shall be taken in a Four Copy Manifest wherein one copy shall be retained by EPOL, one Copy by GEB, one Copy for sending to UNFCCC at the time of CER Registration and one copy for ESTL.
- Since the power for auxiliary consumption shall be drawn from the grid, the same shall also be metered. Accordingly, the auxiliary consumption shall be arrived at through a review of the joint energy meter reading signed by the GEB.
- Since the natural gas is also to be metered, the procedure for measuring and recording shall be same as that for power. The meters shall be of approved ASME/BIS class.
- The recording shall be as per accepted norms and though the measurements shall not be carried out by an accredited body and additionally all the meters shall be calibrated by an accredited third party annually.
- A third party certified annual monitoring reports shall be furnished to CDM EB before 1st of October of the current and 1st April of the following year. The verification report by a Designated Operating Entity shall be furnished once every year before 1st April of the following year. The verification and the subsequent registration of CERs shall be carried out by an accredited third party annually.
- The statistical techniques used where relevant shall conforms to BIS standards and shall be in conformance with the QC & QA procedures set out for the same. In case of any missing data, last 3 months average shall be used to close the gap.

APPENDIX 1

PROJECT'S CONTRIBUTION TO SUSTAINABLE DEVELOPMENT

The strategic objectives identified by the project activity to achieve the stated goals include increased profitability & energy efficiency in steel making, increased rural incomes, reduced vulnerability and empowerment of the vulnerable sections of society. More specifically, the project shall contribute to the sustainable development of the region and country by addressing the following broad issues:

1.0 Policy and Development

a) The power plant is situated in a rural area, though the area is a notified industrial area, the plant itself is at one end of the area, 27 Km from Surat, bordering Hazira village. The plant has thus created employment opportunities in the rural areas in operation and maintenance of the power plant. Creation of employment opportunities in rural areas has long been recognized as a major concern for sustainable development and to stem the mass exodus from rural to urban areas. This concern has formed the cornerstone of most of Government of India's rural development programmes. To that extent, the activity directly addresses a core national concern.

b) The installed capacity of gas based power plants by end of 1998 is about 9000 MW, 13% of the total thermal power plant capacity. Government of India has as a short term measure, to bridge the demand supply gap, permitted installation of an additional 12,000 MW of power plants based on alternative fuels like naphtha, other liquid fuels and gas, in view of the short gestation period and environmentally sound power generation (*Source:* Power Sector Status Paper by CEA, NTPC). Thus the proposed fuel shift is in line with GOI policies.

c) The power policy of Government of Gujarat has a clearly articulated preference for maximal utilization of locally available natural gas and lignite in power generation. Hence, the project is aligned with the state's power policy.

d) Western Region, at the end of the 9th plan, was expected to have a peaking deficit of 12.4% and an energy deficit of 2.6%. The power plant contributes to bridging the gap between the supply and demand of power in the state and the region. In light of the likely shortfall of the plan targets by nearly 30%, the state and the regional shortfalls are likely to be accentuated at the end of the 9th plan. The fuel shift shall contribute to mitigation of the shortfall to some extent through improved generation efficiencies and higher plant availability.

e) The power plant is located at dispersed rural location, thereby contributes to reducing the T&D losses to some extent. The T&D losses in Gujarat, as per 16th CEA Survey report, was projected to be 21.14% by 2000-01 but the actual as per the GEB annual report for the year 2000-01 was 20.47%. The improvement in T&D losses is partly a result of such dispersed power plants and an increased off take from such power plants shall reduce T&D losses further.

f) The power plant though located at a rural location is also close to the Hazira Industrial Area where some of Gujarat's major electrical load centers are located. Hence, the power plant by virtue of its location contributes to reduced T&D losses. With the fuel switch, the power evacuation by GEB is likely to increase and consequently the PLF is expected to improve, thereby the contribution of the power plant towards reduced T&D losses shall also increase.

2.0 Environment Improvement

a) The bridging of demand-supply gap shall be by the use of a cleaner fuel as compared to naphtha as also compared to the predominant fuel in the country for energy generation i.e. coal. The fact that natural gas has lesser climate change implication as compared to naphtha is of particular importance.

b) Gas base energy contributes to reduction in specific emissions (emissions of pollutant/unit of energy generated) of pollutants for the country as a whole. Comparison of emissions from various fuels in power generation as also a comparison between emissions from naphtha and gas in the GE frame 9 turbine has been included at annex 7 to indicate the emission reduction that may be expected.

c) The plant is situated in a rural area, 27 Km from the nearest urban habitation, thereby contributing to reduction in pollution of urban areas where conventional power generation units are often sought to be situated. Moreover, the risks associated with piping of natural gas to the power plant are lower on account of it being situated in an area with low population density as compared to an urban area.

d) The power plant is situated on a 16 hectare land area whereas other similar plants are usually setup in areas of up to 60 hectares. Thereby, the unit contributes significantly to optimal utilization of land.

e) Gas based power plants address the increasingly insurmountable problem of solid waste disposal encountered by most of the other sources of power, as they generate nearly no solid waste. Coal has 30-40% of ash while even bio-mass has ash content of up to 5%. Ash disposal is one of the most significant current concerns associated with power generation. Leading coal based power units on an average generate 1368 tonnes/year/ MW installed capacity of ash while bio-mass based units generate up to 420 tonnes/year/MW of installed capacity (approximately a third of coal based units). The need to handle and dispose such large quantities of environmental overburden is avoided in gas based power plant.

f) Gas based power plants are cleaner as compared to naphtha based plants also because gas based plants generate much lower/insignificant amounts of waste whereas, naphtha based units have to handle and dispose, albeit occasionally, hazardous sludge from naphtha tanks.

g) Large coal based power plants have a water consumption rate of 130.8 m3/day/MW installed capacity. The unit even with naphtha as fuel consumed only 31.92 m3/day/MW installed capacity. This prevents diversion of an increasingly scarce resource to energy generation and the consequent pollution.

h) Gas based power plants are safer from an environmental hazard perspective as compared to naphtha based power plants as they are not required to store large quantities of a hazardous chemical naphtha on a continual basis on their premises.

i) In light of the fact that at the time the power plant was conceptualized and designed, gas was preferred over coal, even though coal is by far the more cost effective but more polluting power generation option, is in itself an environmental additionality.

j) EPOL opted for naphtha over coal, even when gas was not allocated for the project. Further, EPOL made appropriate provisions at additional cost, to ensure that the turbine could be mix fired (both naphtha and gas) as and when gas is made available in varying quantities.

k) An analysis of the recent proposed projects in Gujarat reveals that 55% of the proposals are coal based, to that extent, gas is still not the most preferred fuel, and thus the fuel switch from naphtha to gas continues to be an environmental additionality.

3.0 Socio-economic contribution

a) The power plant directly employs about 70 persons on premises. Additionally local labour is hired approximately 8760 person days per annum for miscellaneous work.
This is of particular significance because the average main employment rate for Gujarat is 33.66%, which though higher than the national average of 30.55% is still very low. Large part of the skilled and semi skilled manpower is sourced from all over Gujarat, which contributes to improving the employment situation in the state.
The main employment rate of Surat District is 39%, which though better than the state average still is inadequate. The unit thus through the above direct employment as also through outsourcing of goods and services, contributes to improvement in the employment situation in the state and district.
The rural main employment pattern of Surat district indicates that nearly 54% of the main workers are agricultural workers. Since, income from agricultural labour is cyclic and uncertain; availability of any sustained employment opportunity contributes significantly to enhancing income security.

b) The average annual income generation opportunity created by the power plant for the local economy, comprising Surat District and Hazira, on account of services and Annual Maintenance Contracts is Rs. 1.1 Crores. This also contributes significantly to indirect employment generation as these services and contracts are essentially labour intensive in nature.

c) The power plant on an average annually sources consumables and small tools from the local manufacturers worth Rs. 25 Lakhs. This also is a direct contribution to the local economy.

d) EPOL employs at least 5 vehicles belonging to locals on an ongoing basis. This translates into a monthly income for the owners (all 5 together) of Rs. One Lakh.

e) The fuel shift involves laying of gas pipelines from Laxmi oil fields (about 7 Km) to EPOL power plant. This would create further employment opportunities for the local community.

f) Essar group's employees stay in a small township constructed close to the power plant where nearly 700 employees and their families stay. This township has created numerous opportunities for employment and income generation for the local community.

g) Increased income security shall contribute to the empowerment of the most vulnerable sections of the society. The setting up of the unit shall provide some amount of income security to agricultural and marginal laborers in the region.
A study of the employment pattern of Surat District reveals that it has a higher proportion of rural main workers employed as agricultural labourers at 54%. It is also pertinent to mention, that a higher number of women (245,782) are employed as agricultural labourers as compared to men (216,218). Further, 133,365 women as compared to 39,227 men are marginal workers. The power plant does not directly employ women labour but by creating avenues for male labour, the power plant contributes to increasing transition of marginal workers to main workers, which in effect is enhanced employment for women.

Women are perhaps the most vulnerable section of rural Indian populace and the unit shall contribute to their empowerment, as income security though not sufficient, is definitely a necessary criterion for empowerment.

The units shall contribute to empowerment of the other vulnerable sections of the society, the scheduled caste and scheduled tribes. These sections of the society are usually the dispossessed and form a large section of both the agricultural as also the marginally employed workers. Hence,

employment opportunities created directly or indirectly (as in case of women) results in empowerment of this section.

h) Increased availability of electrical energy shall in the long run reduce dependence on bio-mass based energy sources for domestic consumption. This has besides GHG implications, also implications for health as Indoor air pollution annually kills 150,000 women in India.

i) The development of a region from the Human Development perspective would result from improvements in life expectancy at birth, infant mortality, literacy/education, health, infrastructure, ability to cope with shocks and empowerment/ having a voice in the institutions of state and society. It has been the experience of this country that industrial activity and income security often brings with it empowerment and allied infrastructure that benefit the peripheral areas. Essar group, of which Essar Power is a part, has undertaken several initiatives in this direction.

j) Essar township has a school where of the 430 students, 110 students are not wards of Essar Group employees.
- The township has a hospital to cater to emergencies. The hospital caters to emergencies in the neighbouring regions also. This is reflected in the fact that nearly 28% of the cases attended by the hospital were from the local community.
- Essar group has undertaken a renovation of school building in Hazira village.
- Essar Group has set up a community centre for women where self employment skill development programmes are conducted at an annual cost of Rs. 15,000/- while additional expenditure is incurred on various community activity and functions amounting to Rs. 12,000 per annum.
- Essar Group supplies potable water, 950 m3/day to Hazira village through a dedicated pipeline (4 Km from plant to village) laid for the purpose at an annual cost of Rs. 14 Lacs. This benefits up to 15,000 persons in the village.
- Repair of damaged water pipelines and proposed laying of 6 inch dia. Pipeline to deliver water at the farthest edges of the village involved a one time expenditure of Rs 15 Lacs.
- Repair of open wells, repair of approach road to Gundadi village, installation of 11 hand pumps at Hazira etc. at an estimated one time expenditure of Rs 11 Lacs.
- Scholarship scheme at an annual expense of Rs 58,000/- has been instituted for meritorious students from the community.
- Motivational schemes for secondary and primary teachers to improve teaching levels in the community schools at an annual cost of Rs 3000/-
- Event celebrations with children and recreational programmes for Ankur Bal Kendra in the village involving an estimated expenditure of Rs 29,000/- per annum.
- Projects like provision of garbage bins for healthy and hygienic environs in the village, construction of a community lake using Essar Steel Slag for rain water harvesting etc. are proposed.

k) In recognition of these initiatives, the organization was awarded ‘Outstanding Social welfare performance award’ by South Gujarat Chamber of Commerce.

l) Further, the group contributes significantly to the society through appropriate care of employees. Essar power limited besides the facilities already discussed above, annually spends Rs 1 crore on employee benefits. Some of the benefits offered to employees includes
- Hospitalization scheme at several hospitals in the city.
- Subsidized education for children in the township school.

- Employee scholarship scheme for meritorious students as also for outstanding performers in sports.
- Death benevolent fund, wherein the employees collect a benevolent fund on the death of an employee and EPOL contributes an amount equal to the employee's total contribution.

Care for employees is also evidenced in the fact that EPOL has been, besides numerous other safety related awards, awarded the 'Sword of Honour' the highest safety award by the British Safety Council in the year 1999-2000.

It is expected that the project activity shall result in widening of the skill base of the local community. Several O&M work is proposed to be outsourced to local contractors and the local labour and workmen shall thus acquire new skills through a type of "on the job training".

The exposure to, together with an increased income potential in construction, operation and maintenance of a state of the art operating facility, shall result in capacity development of all persons involved in these phases of the project.

A stakeholder consultation based on the requirements for a public hearing as delineated in the EIA notification of 1994 of the Government of India is proposed together with an Environmental Impact Assessment prior to commissioning of the project.

4.0 Technology & development

a) The reported (as in 1999-00) reserves of gas in the country, was 647 billion cubic metres and an anticipated life of the reserves is 24 years. The annual net gas production at the end of 1999-00 in the country was 26.89 billion cubic metres. EPOL at full gas based generation shall require 0.65 billion cubic metres of natural gas per annum. Hence, availability of adequate quantity of domestic gas should not be a concern in the medium term, though due to increasing pressure from competing uses, price may of gas may tend to increase. The project contributes to technological sustainability through higher energy conversion efficiency, as recognized earlier by GOI also which as per the Hydrocarbon Vision 2025, provides for preferential allocation of natural gas to power and fertilizer sector by the proposed Petroleum Sector Regulatory Agency.

b) EPOL is ideally located as regards Laxmi Gas Field, which is approximately 7 Km from the plant, GSPCL/Nicco gas field, which is 4 Km and the ONGC gas supply station which is only 15 Km from power plant. These fields have recently started commercial production and natural gas, is proposed to be piped directly to EPOL from these fields. This has resulted in savings as regards the need to transport gas over large distances to inland plants.

c) EPOL GE frame 9E gas turbines (site rated 110 MW each) that have been installed were the first of their kind and size in the country. The turbines could fire gas/naphtha/HSD/NGL as mixed fuel.

d) EPOL installed these in spite of the fact that GOI had not allocated gas for power generation purposes and incurred additional capital expenditure amounting to US$ 8 million to enable the turbine for mixed firing of gas and naphtha.

e) In order to upgrade the turbines and make it mixed fuel capable, EPOL had specific software's and control systems designed and installed, which permit pure naphtha, pure gas and simultaneous naphtha and gas firing in the turbine.

f) Through operational efficiency, EPOL has succeeded in increasing the Cycle of Concentration (COC) for water consumed from 3.5 to 8. Thus it has set new standards in water recycling and reuse which results in water savings of 140 m^3/hr.

g) The Power plant has optimized the boiler makeup water requirement and reduced it to 1% from the original 3% and the savings on this account work out to 13 m^3/hr.

h) Vertical pumps are preferred for High volume circulating water pumps (13,000 m^3/hr flow). This would have required deep sea drawal or digging/dredging at drawl point. EPOL has installed horizontal pumps for this purpose, thus the need to dredge or deep sea drawal has been circumvented. This is also a first for EPOL.

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