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:

Electricity generation at 8 MW captive power plant using enthalpy of flue gases from blast furnace operations of Kalyani Steels Limited, in Karnataka state of India.

Version number: 3
Date: 17 August 2006

A.2. Description of the project activity:

The purpose of the project activity

The project activity involves generation of electricity from waste gases from existing iron manufacturing facilities of Kalyani Steels Limited (KSL). The generated electricity is used for captive consumption within the industrial facility thereby partially displacing electricity that would have otherwise been purchased from the grid or generated as captive power using fossil fuel.

KSL operates an integrated steel plant that involves use of 2 nos of mini blast furnaces (MBF) from where blast furnace gases are generated during the iron making process. A part of the MBF gases from each MBF is used to heat the blast air in the air pre-heater; the balance quantity is waste gases. These waste gases are ducted to a common duct with a tap-off provision to a boiler in the captive power plant (CPP). There is also provision to flare these waste gases if not used for boiler firing.

In the project activity, a portion of the waste gases that will not be required for pre-heating the air blast, will be collected and transported (through dedicated pipeline) to the CPP for electricity generation. The average heat rate at power plant is 2,680 kCal/kWh. The availability of waste gases to power plant will be about 40,000 Nm^3/h on a sustainable basis (56,000 Nm^3/h at a maximum). The temperature of the waste gases will be 40^oC, with average calorific value of 650 kCal/NM^3. These waste gases are subjected to heat treatment for additional heat gain using an auxiliary burner for stabilizing the boiler burner flame. This heat gain occurs due to combustion of MBF gases whereby the calorific value of these gases are utilised during the combustion process and its temperature gets raised. The technical details are included under section A.4.3 in this PDD.

The CPP is synchronised with the local grid of Karnataka Power Transmission Corporation Limited (KPTCL), and the grid serves to absorb any load/ voltage fluctuations due to power plant operations and safe-guards against power trips. The power plant will be normally operating in parallel with the KPTCL supply, with suitable protections to isolate the power plant in case of its failure, so that the plant operations continue to get power from the grid.

As mentioned above, the power generated by this project activity will replace/ substitute the major quantity of electricity purchased from the grid by KSL. The electricity generated by the CPP partially meets the power requirements of the integrated steel plant, whose total power requirement is about 20 MW. The balance power is procured from the connected grid.

The project activity envisages development, designing, engineering, procurement, financing, construction, ownership, and operation and maintenance of the MBF gas collection and transportation facilities from the existing industrial facility of KSL and utilization of the same to generate electricity.

The views of the project participant on contribution of the project activity to sustainable development

The National CDM Authority (NCDMA) which is the Designated National Authority (DNA) for the Government of India (GoI) in the Ministry of Environment and Forests (MoEF), has stipulated four indicators for sustainable development in the interim approval guidelines for Clean Development Mechanism (CDM) projects from India. The contribution of this project activity towards sustainable development as per these four indicators is provided below:

Social well being:

- The project activity contributes towards local socio-economic development around its area of operation through provision of employment opportunities (direct and indirect) for local population.
- It contributes towards improving the Karnataka State's power deficit situation by demonstrating potential for use of waste gases of low calorific value for generating power.

Environmental well being:

- The project activity causes sustenance and improvement in regional air quality by avoiding commonly used fossil fuels for power generation. It thereby, also, results in maintenance of the ecosystem and human health due to avoidance in the use of GHG emissive fuels such as coal.
- It also leads to conservation of natural resources such as coal.

Economic well being:

- By providing employment opportunities, this project activity leads to development in the local economy.
- Through bringing in revenue to India through CDM process, it demonstrates how certain real and perceived financial barriers can be overcome in power generation projects that use waste gases produced in steel manufacturing industries.

Technological well being:

- The successful implementation of the project activity will result in increasing the reliability of the technology used in the design of boilers that handle low calorific value waste gases from industrial processes.

Based on an evaluation of the project activity, the DNA has provided authorization on 26 December 2005 to KSL to participate in the CDM process.

A.3. Project participants:

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

Swedish Energy Agency on behalf of The Government of Sweden (Annex I Party)	Carbon Asset Services Sweden AB	No

The project activity is undertaken by the Kalyani Steels Limited (project participant). The KSL is part of the US $1 billion Kalyani Group. The Kalyani Group is one of the leading Industrial Houses in India, having core businesses in Steel and Steel based products, Forgings and Automotive Components. The Group's annual turnover is around USD 1.2 billion and has joint ventures with some of the world leaders such as Meritor, USA, Carpenter Technology Corporation, USA, Bosch, Germany, Hayes Lemmerz, Germany etc. Bharat Forge Limited, the flagship company of the group is the 2nd largest forging company in the world and the largest domestic player with a share of 80% in axle components and engine components. Apart from Bharat Forge Ltd., the other major companies in the group are Kalyani Brakes, Kalyani Steels, Kalyani Carpenter Special Steels, Kalyani Lemmerz, Automotive Axles, Kalyani Thermal Systems, BFL Utilities, Epicenter and Synise Technologies. The contact information on both the project participants is provided in Annex 1.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Government of India.

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

Koppal district in Karnataka state of India.

A.4.1.3. City/Town/Community etc:

Ginigera.

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

The project is located within the Kalyani Group's integrated steel manufacturing complex, with approximate geographical location of latitude 15°20'16"N and longitude 76°15'17"E. The site is at a distance of 130 km from Hubli and 340 km from Bangalore by road. The nearest railway station is at Ginigera about 1 km away.

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

The project activity is applicable to 'Scope Number 1, Sectoral Scope - Energy industries (renewable/ non-renewable sources).

This project activity relates to generation of energy (electricity) through use of waste gases (non-renewable source), and hence conforms to the category no. 1.

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

The technology applied to the project activity has been tailor-made to recover enthalpy of MBF generated gases in a boiler[1] specifically designed for the same, and all associated facilities for collection and transportation of these gases, and auxiliary firing of the gases to increase the heat content to facilitate generation of electricity. The technology involves fully PLC controlled state of the art equipment and control systems.

The technology employed by the project activity is based on Rankine Cycle for thermal power generation. In this technology, steam generated using MBF gases in high-pressure boiler, is allowed to expand in the steam turbine. Apart from utilizing the enthalpy of the MBF gases in the boiler, oil support is provided for continuous firing, though such support is not required during normal operating conditions. The energy obtained from the expansion of the steam in the steam turbine is utilized to generate power.

The following typical characteristics of the waste MBF gases, as described below, require specifically designed boiler mentioned earlier under this section.

- ***High Inerts and Low Calorific Value.*** These waste MBF gases contain very low amount of combustibles (20-22% CO) and high amounts of inerts such as Nitrogen and Carbon dioxide resulting in low calorific value. Due to low calorific value, combustion of these gases is carefully stabilized.

- ***Slow Burning:*** As a result of the low calorific value and high amount of inerts, the waste MBF gases burn slowly and hence in order to ensure complete combustion of these gases, higher residence time in the furnace is very essential. This higher residence time have been achieved by using larger boiler furnace and lower furnace volumetric heat release rate.

Due to such typical characteristics of the waste MBF gases, the success of the boiler largely depends on the burner design. In the project activity, a scroll burner has been used to provide spin to the waste MBF gases as they enter the furnace for ensuring high mixing energy at the point of air fuel mixing. The scroll burner also uses the principle of pre-mixing fuel with air for better combustion by injecting a stream of air into the waste MBF gas stream before it enters the furnace. The temperature of the waste MBF gases is then raised (~745 - 760^{0}C) by its combustion. The raised temperature so reached is used in the heat exchanger to produce steam and subsequently power.

Since the project activity occasionally uses furnace oil (FO) and LPG, the purposes of such uses are described below.

✓ **Purpose of using Furnace Oil as support fuel.** The waste MBF gases alone cannot reach the required flame temperature at the start-up. Hence, FO is required as a support fuel to initially raise the temperature to required levels. The combustion of CO is an exothermic reaction and is self sustaining by itself; however, when waste MBF gases, which is a lean CO gas is put into a hot furnace, it tends to cool down the furnace due to its lower temperature of 40-50°C. Hence, adequate re-radiation from hot refractory lining is required to sustain the high temperature (~745 - 760^{o}C) so reached. Therefore, in the design of the boiler, refractory lining are provided on the water wall tubes

[1] Specially designed to utilize gases with low calorific value; such gases require longer residence time in the boiler and elongated boiler shaft, compared to other gaseous fuels with higher heat content.

up to first 5 feet of the furnace heat transfer surface. This refractory re-radiates heat into the flame thereby enhancing the flame stability. Also, in the boiler design, for a load of less than 70% (where 100% load is 47 TPH), an oil support of only 5% is required. When operating within the boiler's maximum continuous rating (MCR) at 70 – 100% under stabilized operational conditions with waste MBF gases and subject to availability of these gases with adequate flow, consistent pressure and consistent quality in terms of gross calorific value (600-800 kCal/Nm^3), the boiler provided can be operated on waste MBF gases firing alone without any support fuel. Thus, the project activity in a steady state is not dependent on fossil fuel combustion for power generation but runs on waste MBF gases.

- ✓ **Purpose of using LPG for pilot flame.** LPG is used only for ignition of FO (i.e., to start the pilot flame). It is used only for 90 seconds of the total ignition cycle of 180 seconds. The consumption of LPG is solely required for boiler start up. This happens only after the shut-downs which are very infrequent. For example, statutory boiler shut-down happens once in a year. Hence the annual consumption of LPG is insignificant. The LPG used at site is stored in cylinders of capacity 19 kg, and not even a full single cylinder is expected to be consumed in a year.

Thus, the project activity is not dependent on use of FO and LPG but depends on the calorific value of the waste MBF gases. The enthalpy of the waste gases in the form of its calorific value (about 650 kCal/NM^3) is utilised for power generation.

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:

In the absence of the project activity, electricity generated by the power plant using waste gases and supplied to the KSL facility would have been generated using a fossil fuel in a CPP or would have been procured from the electricity grid that is dominated by fossil fuel based thermal power plants[2]. This would have resulted in higher GHG emissions than those emitted in the project activity.

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

The estimated emission reductions over the 10 year fixed crediting period would be 629,580 tCO_2 as per details on annual emission reductions provided below.

Years	Annual estimation of emission reduction in tonnes of CO_{2e}
February – December 2005	57,711
January – December 2006	62,958
January – December 2007	62,958
January – December 2008	62,958

[2] Thermal power, for instance, constitutes 56.3% of total generation during 2002-03, 57.7% during 2003-04 and 51.6% during 2004-05. Thus, about 52.2% of the recent (3-year average) power generated in the Karnataka grid is from power plants operating on coal and diesel sources, as per information published by the Central Electricity Authority.

Years	Annual estimation of emission reduction in tonnes of CO_{2e}
January – December 2009	62,958
January – December 2010	62,958
January – December 2011	62,958
January – December 2012	62,958
January – December 2013	62,958
January – December 2014	62,958
January 2015	5,247
Total estimated reductions (tonnes of CO_2)	629,580
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2)	62,958

As can be understood from the technology description provided under section A.4.3 in this PDD, the emission reductions result due to combustion of waste gases. It is difficult at this stage to determine exactly the progressive reduction in the FO consumption during crediting period. Hence, as a conservative estimate, the project emissions have been considered to be constant over the crediting period. However during periodic verification, the actual project emissions will be used. Therefore, the actual project emissions during verification are expected to be degressive.

A.4.5. Public funding of the project activity:

This CDM project activity has been funded through internal accruals and debts from banks. No public funding or ODA has been used on this project activity.

SECTION B. Application of a baseline methodology

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

Title: "Consolidated baseline methodology for waste gas and/or heat for power generation".

Reference: Approved consolidated baseline methodology ACM0004.

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

The adopted baseline methodology has been chosen for the project activity based on fulfilment of the applicability conditions as described below:

Sr. No.	Applicability Conditions as per ACM0004	Applicability to this Project Activity
1.	Applicable to project activities that generate electricity from waste heat or the combustion of waste gases in industrial facilities	This project activity generates electricity from combustion of waste gases from MBF operations of existing industrial facility of KSL.

Sr. No.	Applicability Conditions as per ACM0004	Applicability to this Project Activity
2.	Applicable to electricity generation project activities that displace electricity generation with fossil fuels in the electricity grid or displace captive electricity generation from fossil fuels, electricity	This project activity displaces import of electricity from the grid, and also displaces captive electricity generation using fossil fuel (one of the alternative baseline scenarios).
3.	Applicable to electricity generation project activities where no fuel switch is done in the process where the waste heat or the waste gas is produced after the implementation of the project activity	This project activity does not result in any fuel switch in the iron making process from where the waste gases are generated.
4.	The methodology covers both new and existing facilities; for existing facilities, the methodology applies to existing capacities, as well as to planned increases in capacity during the crediting period	This methodology has been applied on an existing industrial facility. No capacity additions have been envisaged during the crediting period.

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

The alternatives considered for determination of the baseline scenario in the context of the project activity includes all possible options that provide or produce electricity for in-house consumption only[3]. The baseline options considered do not include those options that:

- do not comply with legal and regulatory requirements; or
- depend on key resources such as fuels, materials or technology that are not available at the project site.

The **four** possible alternative baseline scenarios are the following:

(a) proposed project activity without CDM;
(b) import of electricity from the grid;
(c) new captive power generation on-site, using energy sources other than waste gas such as, coal, and
(d) new captive power generation on-site, using energy sources other than was gas such as, diesel.

The possible baseline scenarios do not include the option of “other uses of the waste gases”. The reason for such exclusion is that the waste gases that go to the CPP is the balance quantity after utilization of a requisite quantity (from those generated in the iron manufacturing process) for pre-heating air-blast to such manufacturing process and do not have any other use except that done in the project activity.

[3] The project activity does not involve sale of and/or supply of electricity to other consumers.

The most economically attractive alternative among the **four** alternatives mentioned above, has been selected as the baseline scenario, since such alternative is not expected to face any prohibitive barriers that could have prevented it from being taken up as the project activity. The prohibitive barrier is the capital investment required to implement an alternative that would provide at least 8 MW equivalent of electricity for meeting partial electricity requirements of KSL's existing industrial complex. The capital cost comparison for the alternatives are provided below:

Alternative Baseline Scenarios	Capital Costs (Rs. Crores)
(a) Project activity without CDM	25.42[4]
(b) Import of electricity from the grid	2.81[5]
(c) New captive power generation on-site, using energy sources other than waste gas such as, coal	32.00[6]
(d) New captive power generation on-site, using energy sources other than was gas such as, diesel	18.00[7]

Based on the above information it is evident that "Import of electricity from the grid" requires the minimum investment and hence is the most economically attractive baseline alternative available to KSL for obtaining power requirement in its industrial complex. Hence, **"Import of electricity from the grid"** has been considered as the baseline scenario in this project activity.

It should also be noted here that of the three (excluding first alternative shown above) alternatives baseline scenarios available to the project activity, "import of electricity from grid" would provide the most conservative estimate of baseline emissions, due to presence of a generation mix of several types of power generating sources, compared to exclusive use of high GHG emissive fuels in the remaining two alternatives.

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:

The additionality of the project activity has been demonstrated below. This is followed by descriptions of baseline and project scenarios and why the emissions in the baseline scenario would exceed those in the project activity scenario.

Demonstration of Additionality for the project activity[8]

As required in ACM0004, additionality has been demonstrated and assessed using the latest version of the *"Tool for the demonstration and assessment of additionality"* (version 2 - 28 November 2005).

[4] Includes cost of CPP, facilities for collecting and transporting the waste gases to CPP, and any additional testing facilities needed for the waste gas characterisation, etc.

[5] The expenditure incurred by KSL for setting up infrastructure to connect to the KPTCL grid.

[6] Estimated cost of setting up 8 MW coal based power plant.

[7] Estimated cost of setting up 8 MW diesel based power plant.

[8] Available at: <http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>.

Steps	Additionality Requirements	Status of Additionality Check
Step 0: Preliminary screening based on the starting date of the project activity	(1) The construction of the power plant has started during August 2003, and operation had started in February 2005. Evidence on the same available with KSL for verification by the DOE for project validation. (2) The KSL management seriously considered CDM incentive, if available, for the project activity at the planning stage. Documented proofs which show the same available with KSL for verification by the DOE for project validation.	The additionality check has crossed Step 0, and may proceed to Step 1.
Step 1: Identification of alternatives to the project activity consistent with current laws and regulations		
Sub-step (1a): Define Alternatives to the project activity *Sub-step (1b): Enforcement of applicable laws and regulations*	The baseline alternatives to the project activity include such possible options that provide or produce as much electricity as produced in the project activity while complying with all applicable laws and regulations. The baseline alternatives are already defined and discussed earlier under Section B.2.	The additionality check has crossed Step 1, and may proceed to Step 2 (Investment Analysis) followed by Step 3 (Barrier Analysis), or directly to Step 3. In the present case, Step 2 has been used as the next step for additionality check.

Steps	Additionality Requirements	Status of Additionality Check
Step 2. Investment analysis		
Sub-step (2a): Determine appropriate analysis method	The capital investment needed on the project activity (Rs. 25.69 crores) is around 9 times more than that would have been needed for the baseline scenario, i.e., import from grid (Rs. 2.81 crores), and hence KSL has no immediate incentive to go for such higher capital investments. However, the project activity results in other economic benefit in the form of savings in cost of power. Hence, benchmark analysis (Option III) approach has been adopted.	The additionality check has crossed Step 2(a), and may proceed to Step 2(b) – Option III.
Sub-step (2b) – Option III: Apply benchmark analysis	An IRR based benchmark has been used. In the Indian power sector, a 16% return on equity has been an established benchmark for a long time, whether in the public or private sector. This has recently been revised downwards to 14% return on equity by the Central Electricity Regulatory Commission (CERC). Hence, 14% has been taken as the benchmark for project activity IRR. The IRR[9] for the project activity without CDM revenue is about 11.49% whereas with CDM revenue IRR improves to 20.31% at 100% PLF. Therefore, the project activity had non-attractive returns even at full utilisation with 100% PLF. A financial comparison has been performed followed by a sensitivity analysis for the IRR of the CDM project activity based on variations in PLF from 100% to 85%.	The additionality check has crossed Step 2(b), and may proceed to Steps 2(c) and 2(d).

[9] The CER rate assumed during the conception of the project was US$5 at 1US$ = INR 44.

<table>
<tr><th>Steps</th><th>Additionality Requirements</th><th>Status of Additionality Check</th></tr>
<tr><td>Sub-step (2c) – Calculation and comparison of financial indicators

and

Sub-step (2d) – Sensitivity analysis</td><td>
The following basis and assumptions were made for the financial comparison and the sensitivity analysis:

Grid cost per unit = Rs. 3.80 per kwh

<table>
<tr><th>Operating Expenses</th><th>15.02.2005 - 31.12.2007</th><th>01.01.2008 - 31.12.2011</th><th>01.01.2012 - 14.12.2015</th></tr>
<tr><td>- Furnace Oil</td><td>0.75</td><td>0.70</td><td>0.65</td></tr>
<tr><td>- Salary, Wages, Admin etc.</td><td>0.40</td><td>0.55</td><td>0.70</td></tr>
<tr><td>- Operation & Maint cost</td><td>1.00</td><td>1.07</td><td>1.14</td></tr>
<tr><td>- Interest</td><td>1.20</td><td>0.75</td><td>0.50</td></tr>
<tr><td>Total Operating Expenses</td><td>3.35</td><td>3.07</td><td>2.99</td></tr>
</table>

<table>
<tr><td>Net Saving per unit</td><td>0.45</td><td>0.73</td><td>0.81</td></tr>
<tr><td>No of Months</td><td>34.50</td><td>48.00</td><td>37.50</td></tr>
<tr><td>Total Savings</td><td>15.53</td><td>35.04</td><td>30.38</td></tr>
</table>

<u>Assumptions:</u>

(1) Mandatory shutdown of power plant has been considered at 7 days.
(2) Auxillary consumption has been considered at 7%.
(3) Furnace oil consumption will reduce over a period of time, but at the same time purchase cost of furnace oil will increase over a period of time due to inflation.
(4) Net impact of the above has been assumed that there will be a minor decrease in F/oil cost by about Rs. 0.10 over a period of 10 years.
(5) Salaries & wages will increase by 15% and Opr. & maintenance cost will increase by 7%.
(6) Interest cost will also reduce and entire loan availed to set up the power plant will get liquidated by 2009.

<u>Findings from Financial Comparison:</u>

<table>
<tr><th rowspan="2">Plant Load Factor (%)</th><th colspan="3">IRR%</th></tr>
<tr><th>Without CER Revenue</th><th>Benchmark</th><th>With CER Revenue</th></tr>
<tr><td>100</td><td>11.49</td><td>14</td><td>20.31</td></tr>
</table>
</td><td>The additionality check has crossed Step 2(d), and may proceed to Step 3.</td></tr>
</table>

<table>
<tr><th>Steps</th><th>Additionality Requirements</th><th>Status of Additionality Check</th></tr>
<tr><td></td><td>
<table>
<tr><td>95</td><td>10.19</td><td>14</td><td>19.08</td></tr>
<tr><td>90</td><td>8.87</td><td>14</td><td>17.83</td></tr>
<tr><td>85</td><td>7.52</td><td>14</td><td>16.57</td></tr>
</table>
The above findings based on reasonable variations in the PLF for the project activity and realistic range of assumptions provided above provide a robust demonstration that the CDM project activity is unlikely to be financially attractive.
Hence in absence of the CDM revenue, KSL would not have considered implementing the project activity.
</td><td></td></tr>
<tr><td colspan="2">Step 3. Barrier analysis</td><td></td></tr>
<tr><td>Sub-step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity

Sub-step 3b. Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity)</td><td>
The project activity overcomes “technological barriers” as well as “barriers due to prevailing practice”, as described below.
Technological Barriers:

The waste gases generated from MBF operations in the existing industrial facility have high quantity of inert materials and low calorific value, that makes stabilization of flame in the burner difficult and results in slow burning, that could lead to explosion from accumulated combustible components in the gases. This makes operation of the technology a risky proposition; the tailor-made design used here has overcome such attendant risks.
The inert materials are generally cleaned in wet scrubbers; this reduces the gas temperature and results in carry-over of moisture, resulting in low flame temperature in the boiler and lower heat availability; the moisture also generates water vapour making the flame less reliable.

Also, the flame is unstable due to wide fluctuations in gas supply pressure and flow and low calorific value.
Due to such inherent problems related to the use of waste gases from MBF operations, specially designed boiler with longer residence time and elongated shaft was required to be designed in the project activity; this also increased the cost of the new type of boiler by about 20% compared to use of conventional boilers using any other gas.
There has been lack of experience for designing such type

</td><td>The additionality check has crossed Step 3, and may proceed to Step 4.</td></tr>
</table>

Steps	Additionality Requirements	Status of Additionality Check
	of boilers with appropriate PLC and successfully operating the same. The uniqueness or uncommonness of the boiler design is that unlike other boilers in several industries, this boiler is a stand-alone system using very low calorific value without permanent furnace oil support. The boiler design uses a low calorific value waste gas (650 kCal/ Nm^3) compared to other industries who use waste gases with caloric value of at least around 800 – 900 kCal/Nm^3. In this project activity, the use of oil is short-term and may not be required after 1-2 years of operation. There was clear lack of available skill and experience to operate this type of boiler. - The tailor-made design used here has overcome such attendant technological problems that cause barriers to implementation of the project activity. • **Barriers due to prevailing practice:** o KSL is the only steel-grade pig-iron manufacturer in India that uses lesser quantity of coke compared to any other similar industrial facility (e.g., TISCO), resulting in generation of low calorific value waste gases from which electricity generation has not been tried earlier in the country. The barriers identified above, do not exist for any other three project alternatives, and hence will not prevent implementation of any of such project alternatives.	

Steps	Additionality Requirements	Status of Additionality Check
Step 4. Common practice analysis		
Sub-step 4a. Analyze other activities similar to the proposed project activity. *Sub-step 4b. Discuss any similar options that are occurring.*	There are five other steel manufacturers in Karnataka[10] state who recover heat content from waste gases from blast furnace and coke ovens to generate electricity. Of these 5 units, only 3 other steel manufacturers utilise MBF waste gases for power generation. However in such cases, the available heat content in the waste gases is much higher, and hence designing of power plant is easier and capital cost is comparatively lower than the project activity. The project activity does not enjoy such advantages, and thus faces barriers to its implementation, as mentioned earlier in step 3.	The additionality check has crossed Step 4, and may proceed to Step 5.
Step 5. Impact of CDM registration	The approval and registration of the project activity as a CDM activity would result in the following benefits: ✓ reduction in GHG emissions; ✓ significantly improve the project activity returns (IRR increases to 20.31%) through CDM revenue and bring financial benefits to KSL which would not have been obtained in the absence of the project activity; ✓ encouraging other steel industries operating under similar circumstances/ barriers to try utilize low calorific value waste gases for heat content recovery to generate power, since CDM revenues would alleviate the technological barrier and barriers due to prevailing practice; ✓ reduce financial risks faced by KSL due to lack of experience in operating a new tailor-made technology not used previously.	Since Step 5 is satisfied, the project activity is not a baseline scenario, and hence is additional.

Description of Baseline Emission Scenario

As explained earlier under section B.3, the baseline scenario is import of electricity from the southern regional electricity grid. As per ACM0004, the baseline emission sources considered are fossil fuel fired power plants connected to the relevant electricity system (grid). The reason for not selecting the Karnataka grid is that actual fuel consumption data for state grids are not publicly available for all types of fuels consumed in such a grid; this would result in inaccurate emission factor estimation.

[10] (1) M/s Kirloskar Ferrous Industries at Bevanahalli, Ginigera of Koppal Dist., (2) M/s Sathavahana Industries at Bellary Dist., (3) M/s Unimetal at Siruguppa, (4) M/s Jindal Vijayanagar Steels Limited and (5) M/s Kudremukh ISCO Ltd.

As required under ACM0004, the baseline emissions are calculated as per combined margin (CM) approach described under ACM0002, both in terms of relevant grid definitions and the emission factors. The simple operating margin (OM) in the baseline emissions is calculated using equation (1) described in ACM0002. The Simple OM method has been used since low-cost/must run resources constitute less than 50% of total grid generation in average of the five most recent years (2001-2005), as required under ACM0002. For calculating the simple OM, data vintage of 3-year average (based on the most recent publicly available statistics available at the time of PDD submission) has been used. The build margin (BM) calculations have been completed with most recent information available on plants already built at the time of PDD submission. The CM calculation is based on straight average of simple OM and BM. The detailed algorithms are described later under sections D.2.1.3 and D.2.1.4 in this PDD.

Description of Project Emission Scenario

As described in ACM0004, the project emissions (CO_2) result due to combustion of auxiliary fuel (furnace oil) in the project activity. The auxiliary fuel is fired for generation startup, in emergencies, or to provide additional heat gain before entering the Waste Heat Recovery Boiler.

With reference to ACM0004, no leakage emissions have been considered towards contribution to the overall project emissions. The detailed algorithms are given later under sections D.2.1.1 and D.2.1.2 of this PDD.

Justification of Emission Reductions

In the absence of the project activity, the waste gases will not be despatched to the CPP for generation of electricity, resulting in the following:

1. waste gases would have been flared in the atmosphere resulting in CO_2 emissions; and

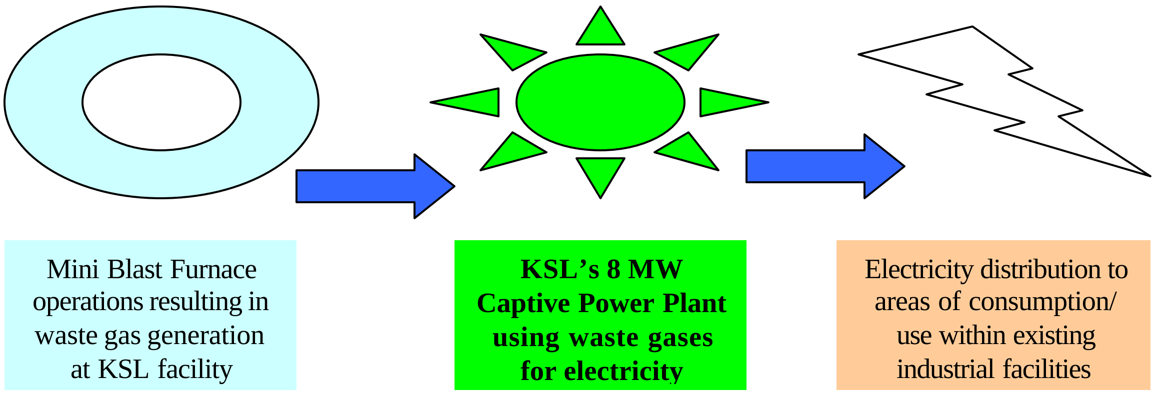
2. power that is produced in the project activity, would have otherwise been generated by operation of power plants connected in the electricity grid leading to CO_2 emissions.

The project activity results in avoidance, reduction or delay of the above. Hence, due to the project activity, there is no net change in CO_2 emission from the project boundary due to use of surplus MBF waste gases (i.e. pre and post project activity) but a relocation of the combustion point for such waste gases. Hence, the emission reduction is on account of the avoided emissions to the extent of the electrical energy generated in the local grid (of equivalent measure as generated by the project activity). The emission reductions have been worked out as difference between baseline and project emissions as shown under section D.2.4 of this PDD.

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

As required in ACM0004, for the purpose of determining **baseline emissions**, the emission sources contributing to CO_2 emissions from fossil fuel fired power plants connected to the electricity grid (southern region) have been included. The combined margin in the baseline emission determination has been calculated as described in ACM0002 and specified in ACM0004, in terms of southern region electricity grid and relevant emission factors. For the purpose of determining **GHG emissions of the project activity**, CO_2 emissions from combustion of furnace oil (auxiliary fuel) have been included.

Thus, the spatial extent of the project boundary comprises waste gas sources (MBF operations), captive power generating equipment, any equipment used to provide auxiliary heat to the waste heat recovery process, and power plants connected physically to the electricity grid that the project activity will affect. Hence, all equipment and facilities necessary for collection and transportation of MBF flue gases to the captive power plant and export of electricity generated using these gases through the connected grid to locations of captive use within the KSL facility are included within the project boundary. Thus, all direct sources of emissions are covered; there is no in-direct source of emission due to the project activity.



PROJECT BOUNDARY

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 current version of baseline study was completed on 16 November 2005.

Dr. P Ram Babu of PricewaterhouseCoopers (P) Limited has assisted the project sponsor 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 construction start date for the project activity (August 2003) is taken as the project start date; the commercial operation of the project activity commenced from February 2005.

Construction Start Date: 4 August 2003
Commercial Operation: 11 February 2005.

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

Not opted for.

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

Not applicable.

C.2.1.2. Length of the first crediting period:

Not applicable.

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

11 February 2005.

C.2.2.2. Length:

10 years.

SECTION D. Application of a monitoring methodology and plan

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

The adopted monitoring methodology called *"Consolidated monitoring methodology for waste gas and/or heat for power generation"* [11] has been used.

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

The adopted monitoring methodology has been chosen based on the following reasons:

- ✓ project activity involves electricity generation from combustion of waste gases produced in existing industrial facility;
- ✓ it displaces alternate potential for electricity generation with fossil fuels in the electricity grid or captive electricity generation with fossil fuels;
- ✓ it has provisions to use more of waste gases in future, if there is a planned capacity increment to the existing industrial facility;
- ✓ there is no fuel switch in the industrial process from which waste gases are produced; and
- ✓ the monitoring methodology can be used in conjunction with approved baseline methodology ACM0004.

[11] Approved consolidated monitoring methodology ACM0004.

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
1. Q_i	Quantity of furnace oil (auxiliary fuel) used by project activity	Power Plant records	tonnes	m	Continuously	100%	Electronic/ paper	To be measured and used for estimation of project emissions. The quantity of furnace oil is measured on-line, and is reported daily in liters that is converted to tonnes for project activity calculations.
2. NCV_i	Net calorific Value of furnace oil	CEA and IPCC	TJ/tonne	m	Monthly	Random	Electronic/ paper	To be measured and used for estimation of project emissions.
3. EF_i	Carbon emission factor for furnace oil	IPCC	tC/TJ	m	Monthly	Random	Electronic/ paper	In the absence of India specific values, IPCC recommended values have been used.

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 are calculated for use of furnace oil as auxiliary fuels for generation startup, in emergencies, provision of additional heat gain to waste gases before entering the Waste Heat Recovery Boiler. The project emission (**PE_y**) during any year will be using the following formulae:

PE_y = ? Q_i * NCV_i * EF_i * (44/12) * $OXID_i$……………………………………………………..…………………………….(1)

LPG is used in insignificant quantities (expected to be about 10 kg per year) in the project activity for emergency purposes only. Hence, project emission due to this is not considered.

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
4. EG_{GEN}	Total Electricity Generated	Power Plant records	MWh/yr	m	Continuously	100%	Electronic	Meters at plant and DCS will measure the data. Manager in-charge will be responsible for regular calibration of meter.
5. EG_{AUX}	Auxiliary Electricity	Power Plant records	MWh/yr	m	Continuously	100%	Electronic	Same as above.
6. EG_y	Net Electricity supplied to KSL facility	Power Plant records	MWh/yr	c	Continuously	100%	Electronic	Calculated from the above measured parameters.
7. $EF_{OM,y}$	Simple OM emission factor for relevant grid	Estimated	tCO_2/MWh	c	Yearly	100%	Electronic	Calculated as per ACM0002.
8. $EF_{BM,y}$	BM emission factor for relevant grid	Estimated	tCO_2/MWh	c	Yearly	100%	Electronic	Same as above.
9. $F_{i,j,y}$	Amount of fossil fuel consumed by each fossil fuel based power plant in relevant grid	Official records of grid, electricity boards, CEA	t	e	Yearly	100%	Electronic	Used for calculating emission coefficients in Simple OM and BM.

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
10. $COEF_{i,k}$	CO_2 emission coefficient for each fossil fuel based power plant in relevant grid	Estimated with above data	tCO_2/t	e	Yearly	100%	Electronic	Same as above.
11. $GEN_{i,y}$	Electricity generation by each fossil fuel based power plant in relevant grid	Official records of grid, electricity boards, CEA	MWh/yr	e	Yearly	100%	Electronic	Same as above.
12. EF_y	CM CO_2 emission factor for relevant grid	Estimated with above data	tCO_2/MWh	c	Yearly	100%	Electronic	Calculated as weighted average of OM and BM.

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

As mentioned earlier under section B.3, a combined margin approach has been used to calculate the baseline emissions for the various electricity grids considered. The emission factor is calculated as follows:

$$BE_y = EG_y * EF_y \qquad (2)$$

$$EF_y = (EF_{OM,y} + EF_{BM,y}) / 2 \qquad (3)$$

$$EF_{OM,Y} = [\sum (F_{i,j,y} * COEF_{i,,j}) / \sum GEN_{j,y}] \qquad (4)$$

$$COEF_{i,,j} = NCV_i * EF_{CO2,i} * OXID_i \ldots\ldots (5)$$

$EF_{BM,y}$ is also calculated as in equations (4) and (5) above.

A 3-year average, based on the most recent statistics available at the time of PDD submission has been used in the operating margin calculations.

For build margin calculations, power generation by project types based on fuel used from recent capacity additions to the system for which capacity additions defined as the greater of most recent 20% of existing plants or the 5 most recent plants, have been used.

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

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

No leakage is considered, as per adopted baseline methodology.

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

Not applicable.

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 emission reduction (**ER_y**) by the project activity during a given year ***y*** is the difference between the baseline emissions though substitution of electricity generation with fossil fuels (**BE_y**) and project emissions (**PE_y**), as follows:

$$ER_y = BE_y - PE_y \qquad (6)$$

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.
1, 2, 3	Low	This data will be required for the calculation of project emissions.
4, 5, 6	Low	This data will be used for the calculation of project electricity generation.
7, 8, 12	Low	This data is calculated, so does not need QA procedures.
9, 10, 11	Low	This data will be required for the calculation of baseline emissions (from grid electricity) and will be obtained through published and official sources.

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 by KSL who is also the project proponent. KSL will ensure safety in operation of the plant as per environmental management plan prepared for the site. The site also has an ISO 14000 based Environmental Management System (EMS) in place. Accordingly, the monitoring plan used herein will become an integral part of the Environmental Management Programmes and would be constituent of operational and management structure of this EMS.

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

Dr. P Ram Babu of PricewaterhouseCoopers (P) Limited, has assisted the Sponsor in determining the baseline and monitoring methodology. PricewaterhouseCoopers (PwC) are assisting the project sponsor in developing the Project Design Document (PDD) and defence of the PDD in Host Government Approval (HGA) and validation procedure. PwC, formed by the global merger of Pricewaterhouse and Coopers & Lybrand in 1998, is the world's largest financial and professional services organisation with 125,000 people in 142 countries and 867 offices worldwide.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

The GHG emissions (CO_2) due to the project activity during February 2005 – January 2015 will be 44,800 tCO_2.

E.2. Estimated leakage:

Not applicable, as per adopted baseline methodology.

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

The total project emissions during February 2005 – January 2015 will be 44,800 tCO_2.

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

The GHG emissions (CO_2) in the baseline during February 2005 – January 2015 will be 674,380 tCO_2.

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

The total emission reduction during February 2005 – January 2015 will be 629,580 tCO_2.

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

Year	**Estimation of project activity emissions** (tonnes of CO_{2e})	**Estimation of baseline emission reductions** (tonnes of CO_{2e})	**Estimation of leakage** (tonnes of CO_{2e})	**Estimation of emission reductions** (tonnes of CO_{2e})
Feb – Dec 2005	4,107	61,818	0	57,711
2006	4,480	67,438	0	62,958
2007	4,480	67,438	0	62,958
2008	4,480	67,438	0	62,958
2009	4,480	67,438	0	62,958
2010	4,480	67,438	0	62,958
2011	4,480	67,438	0	62,958
2012	4,480	67,438	0	62,958
2013	4,480	67,438	0	62,958
2014	4,480	67,438	0	62,958
Jan 2015	373	5,620	0	5,247
Total	**44,800**	**674,380**	**0**	**629,580**

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. As part of the EIA study of the integrated steel operations, the operations of the project activity were also covered. No trans-boundary impacts have been identified in the EIA study; the project activity is located in the interior part of India and hence such impacts are not anticipated. The detailed EIA report is available for checking by the designated operational entity for the purpose of validation.

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:

No significant environmental impacts have been identified from the project activity. The other normal (negative/ positive) environmental impacts assessed due to the activity are summarized below:

1. project activity is located within the existing boundary limits of KSL complex, and no major structures were proposed in the project; hence, no changes in the topography was anticipated;
2. additional tree plantations were provided for the project will act as CO_2 sinks, as well as act as barriers to noise levels;
3. no trans-boundary impacts due to emissions from the project activity has been identified; the project activity does not produce any additional emission due to waste gas utilization other than emissions due to use of furnace oil (in limited quantity as and when required) for auxiliary heating and hence trans-boundary impacts or major stress on the air environment are not anticipated;
4. no significant increase in air pollutants such as SPM, NOx or SO_2 was expected;
5. no impact on surface and groundwater sources was anticipated;
6. slurry water from flue gas cleaning plant (GCP) is treated in a thickener and the treated wastewater is re-circulated in GCP again; the sludge is disposed in sludge drying beds, and the under-drained water is transported to the thickener; hence, no impacts due to waste water is anticipated;
7. no significant noise impacts was identified to areas within and outside the project boundary; and
8. no impacts of ecology – flora and fauna, were expected.

As mentioned earlier in section A.2, this CDM initiative would contribute towards:

- Maintenance of regional air quality, and subsequently ecosystem and human health.
- Conservation of natural resources such as coal and water, as these will not be used for power generation.
- Contribute towards regional developmental goals.
- Contribute to Karnataka State's power deficit facilitating industrial growth.
- Socio-economic development through provision of employment opportunities for local population.

In view of above positive impacts and contribution towards the nation's goal of sustainable development and improvement in quality of life of local population, the development and implementation of systems for flue heat recovery of MBF Gas and utilisation in power generation were recommended. The clearance of this CDM initiative by KSL would facilitate the process of sustainable energy production.

SECTION G. Stakeholders' comments

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

Local stakeholder consultation meeting to discuss stakeholder concerns on the proposed Clean Development Mechanism (CDM) project - *Blast furnace generated excess waste gas recovery and utilization for power generation at Kalyani Steels Limited's grid-connected power plant in Karnataka state of India,* was held at 11.30 a.m. on 4 February 2005 at Hotel Harsha International, Koppal District, Karnataka state, India.

The objective of the meeting was introduced by Mr. Siddappa of the KSL. He further suggested the participants to elect a chairman to conduct the meeting. Mr. R. Sampat Kumar, Chief Executive of Hospet Steels Ltd had proposed the name of Mr. G. L. Chandrasekharayya (I.A.S.), Dy. Commisssioner, Koppal, and Mr. Suhas of the KSL seconded the proposal. Accordingly, the meeting was further conducted by Mr. Chandrasekharayya. Mr. Chandrasekharayya approved the agenda set in the notification and obtained the consent of the participants to the agenda.

Subsequently, Mr. Siddappa provided a brief on the CDM project cycle and the role of local stakeholders. Mr. Siddappa briefed the participants about the Kyoto Protocol (KP) and mechanisms there-in. He made an informative presentation on CDM and benefits that the CDM project involving power generation with waste gases developed by the KSL would catalyse sustainable development in the area. He outlined that the local stakeholders concern are to be internalized in any project under clean development mechanism of the Kyoto Protocol. He elucidated the likely environmental and social impacts of the project. He enumerated the salient technical and environmental features of the project and how the project would reduce greenhouse gas (GHG) emission to the atmosphere. He also mentioned that the project would also result in preventing of emission of carbon monoxide emission to the atmosphere making the process safer from occupational health concerns of workers.

Dr.RamBabu said the project would greatly benefit from the local stakeholder's suggestions and expressed concerns at this stage.

Mr. Chandrasekharayya stressed the need for doubling efforts to reduce green house gas emissions that could cause climate `variability and irreversible impacts. He appreciated the initiative that would improve the global as well as local environment, and at the same time generate power that would otherwise have been produced by burning of natural resources like coal. However, he said that local stakeholders can contribute to improving the project benefits by articulating their concerns/apprehensions at this meeting.

Mr. Chandrasekharayya also urged the local stake-holders present in the consultation process (Annexure – I) to express their views on the project. The Chairman encouraged the participants to seek clarifications on the project, its environmental and social impacts, CDM project cycle, UNFCCC, and Kyoto Mechanisms. Participants were also requested to go through the project information available with the KSL. The chairman invited the participants to voice their concerns regarding environmental, social, economic, institutional, cultural impacts of the project and seek any clarifications.

Mr. B. Rudresh, regional officer from the Karnataka State Pollution Control Board also highlighted the positive impacts of the project and congratulated KSL for the initiative.

The stakeholders viewed KSL as a reputed company contributing to local environmental benefits and socio-economy. Overall there was unanimous agreement that the project activity was a beneficial project from the local sustainable development.

The evidences on the list of participants, the notice inviting participation to interested stake-holders and photographic record of the stake-holder meeting proceedings were verified by the DOE during site visit.

G.2. Summary of the comments received:

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

Stakeholder concerns / question / comment	Answer / clarifications
Environment	
Does this project lead to increase in discharge of gaseous, liquid and/or solid wastes? If yes, what are the impacts?	No. Instead the project helps in avoiding emission of carbon dioxide from power generation since Kalyani Steels Limited can avoid purchase/ generation of 8 MW of power due to waste gas utilization. It also avoids generation of fly ash, emission of SPM that are associated with power generation from conventional fuels like coal. No additional industrial effluents with pollution potential will be generated from the project activity.
Will the emissions from the project affect the life of flora in the region?	No. There will be no additional emissions from the project activity.
How do carbon dioxide emissions contribute to global warming?	Carbon dioxide emission when present in the atmosphere prevent escape of solar heat energy from the earth's surface, resulting in heat build-up and global warming.
Economic	
Does this project lead to cost savings in energy production as compared to conventional fossil fuel projects?	Higher operational costs are expected to be incurred by KSL due to use of unconventional technology for power generation. The additional costs will be compensated through funds generated from the CDM project.
Which technology to be employed?	The project utilizes a technology that aims at maximizing efficiency of turbines and boilers using excess waste gases with utilizable heat content (calorific value). The technology is procured from vendors who source it from reputed European companies and customized to Indian conditions.

Stakeholder concerns / question / comment	Answer / clarifications
How many CDM projects have happened in India so far?	Around 75 projects in various stages of development.
Social	
Does the project increase employment opportunities in the area?	The project requires labour during construction phase and operation phase (at designated areas of operation and utilities, such as green-belt maintenance, house-keeping, etc).
What are the safety practices to be adopted for this project?	Fire fighting facilities with water reservoir reservoirs, pumps and hydrant networks, detailed and documented on-site and off-site emergency plant, active and passive accident control equipment and risk mitigation measures will be implemented. Continuous preventive measures, training and mock-drills will be implemented as per disaster management plan for the project.
Does this project require new skills and how are you going to provide them?	The engineers and technicians to be employed for the project will undergo enhancement of skill through appropriate training as required for the type of activity to be performed.
Are there any occupational health impacts from this project?	No. Every employee will be regularly covered under mandatory health check-up as per requirements of Factories Act.
What are the contributions of the project activity to the sustainable development of around the project area?	The project will lead to sustainable development around the project area by contributing to the development of local economy and create jobs and employment in and around the project site. It will also bring many other indirect employment opportunities in the region due to development of infrastructure (roads), housing colony, shops and other associated developments around the project site.

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

This is included as part of information provided above under section G.1.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Host Country Project Participant

Contact 1:

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding has been used in this CDM project activity.

Annex 3

BASELINE INFORMATION

2003-2004

Type of FUEL	Net Calorific Value ($TJ/ 10^3$ tonnes or TJ/Mcum)	Carbon Emission Factor (t C/ TJ)	Fraction of Carbon Oxidised - Oxidation Factor	Emission Coefficient ($tCO_2/ 10^3$ tonnes or tCO2/Mcum)
Steam Stations				
Coal	15.99	26.2	0.980	1505.6
Furnace diesel	43.39	21.1	0.990	3323.7
Light Oil	43.13	20.0	0.990	3131.3
LSHS/HHS/ oil/HSD	43.13	20.2	0.990	3162.6
Lignite	11.46	27.6	0.980	1136.4
Gas Stations				
Natural Gas (TJ/Mcum)	34.60	15.3	0.995	1931.4
HSD	42.64	20.2	0.990	3127.0
Naphtha	45.01	20.0	0.990	3267.7
Diesel Stations				
LSHS	43.13	20.2	0.990	3162.7
Diesel Oil	42.65	20.2	0.990	3127.1

2002-2003

Type of FUEL	Net Calorific Value ($TJ/ 10^3$ tonnes or TJ/Mcum)	Carbon Emission Factor (t C/ TJ)	Fraction of Carbon Oxidised - Oxidation Factor	Emission Coefficient ($tCO_2/ 10^3$ tonnes or tCO2/Mcum)
Steam Stations				
Coal	17.46	26.2	0.980	1644.0
Furnace diesel	44.91	21.1	0.990	3439.4
Light Oil	44.06	20.0	0.990	3198.7
LSHS/HHS/ oil/HSD	44.06	20.2	0.990	3230.7
Lignite	11.25	27.6	0.980	1115.3
Gas Stations				
Natural Gas (TJ/Mcum)	34.60	15.3	0.995	1931.4
HSD	40.86	20.2	0.990	2996.2
Naphtha	45.01	20.0	0.990	3267.7
Diesel Stations				
LSHS	44.06	20.2	0.990	3230.9
Diesel Oil	40.86	20.2	0.990	2996.3

2001-2002

Type of FUEL	Net Calorific Value ($TJ/ 10^3$ tonnes or TJ/Mcum)	Carbon Emission Factor (t C/ TJ)	Fraction of Carbon Oxidised - Oxidation Factor	Emission Coefficient ($tCO_2/ 10^3$ tonnes or tCO2/Mcum)
Steam Stations				
Coal	20.28	26.2	0.980	1909.7
Furnace diesel	43.95	21.1	0.990	3366.0
Light Oil	43.78	20.0	0.990	3178.4
LSHS/HHS/ oil/HSD	43.78	20.2	0.990	3210.2
Lignite	10.99	27.6	0.980	1089.9
Gas Stations				
Natural Gas (TJ/Mcum)	34.60	15.3	0.995	1931.4
HSD	43.09	20.2	0.990	3159.8
Naphtha	45.01	20.0	0.990	3267.7
Diesel Stations				
LSHS	43.78	20.2	0.990	3210.3
Diesel Oil	43.09	20.2	0.990	3160.0

Data sources

**Calorific values	
Coal, HSD, LSHS, FO,Lignite	Table 6.3, Central Electricity Authority general review of corresponding years
Naphtha	Default values obtained from Table 1-3 of Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook
Natural gas	www.ocean.washington.edu/ courses/envir202/energy-numbers.pdf www.evworld.com/library/energy_numbers.pdf
* Carbon emission factor	Default values obtained from Table 1-4 of Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook
*** Oxidation factor	Default values obtained from Table 1-6 of Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook

OPERATING MARGIN - YEAR 2001 - 2002

Fuel	Units	Consumption	Density (kg/Lt)	Density 10^3 MT	Emission factor ($tCO_2/10^3$ tonnes)* NG =TCO_2/M Cu.m)	Gross Emissions (tCO_2)	Gross Electricty generation	Auxiliary consumption	Net supply to grid (GWh)
Steam Stations									
Coal	000 MT	52607	1	52607	1910	100461020	84031	8.44	76938.78
Furnace Oil	KL	129339	0.93	120.2853	3366	404882			
Light Oil	KL	6849	0.827	5.664123	3178	18003			
LSHS/HHS/HSD	KL	8324	0.827	6.883948	3210	22099			
Lignite	000 MT	17318.25	1	17318.25	1090	18875627			
Gas stations									
Natural Gas	M Cu M	1782	1	1782	1931	3441674	10330.65	3.241	9995.83
HSD	KL	5429	0.827	4.489783	3160	14187			
Naphtha	KL	222352	0.76	168.9875	3268	552205			
Diesel Stations									
LSHS	KL	0	0.827	0	3210	0	4154.98	2.3	4059.42
Diesel	KL	770168	0.827	636.9289	3160	2012673			
Total						**125802369**			**90994.03**

Simple OM = 1382.53 tCO_2/GWh

Source of data:
* Table 6.1, CEA general Review
** Table 5.5, CEA general review

OPERATING MARGIN - YEAR 2002 - 2003

Fuel	Units	Consumption	Density (kg/Lt)	Density 10^3 MT	Emission factor ($tCO_2/10^3$ tonnes)* NG =TCO_2/M Cu.m)	Gross Emissions (tCO_2)	Gross Electricty generation	Auxiliary consumption	Net supply to grid (GWh)
Steam Stations									
Coal	000 MT	65997	1	65997	1644.0	108498729	92053.1	8.47	84256.20
Furnace Oil	KL	115914	0.93	107.8	3439.4	370772			
Light Oil	KL	8407	0.827	6.952589	3198.7	22240			
LSHS/HHS/HSD	KL	6093	0.827	5.038911	3230.7	16279			
Lignite	000 MT	17738	1	17738	1115.3	19782388			
Gas Stations									
Natural Gas	M Cu M	3130	1	3130	1931.4	6045140	13950.1	2.25	13636.22
HSD	KL	275122	0.827	227.5259	2996.2	681711			
Naphtha	KL	485496	0.76	368.977	3267.7	1205716			
Diesel Stations									
LSHS	KL	0	0.827	0	3230.9	0	4379.4	1.61	4308.89
Diesel	KL	865938	0.827	716.1	2996.3	2145766			
						138768741			**102201.32**

Simple OM = 1357.80 tCO_2/GWh

Source of data:
* Table 6.1, CEA general Review
** Table 5.5, CEA general review

OPERATING MARGIN - YEAR 2003 - 2004

Fuel	Units	Consumption	Density (kg/Lt)	Density 10^3 MT	Emission factor ($tCO_2/10^3$ tonnes)* NG $=TCO_2/M$ Cu.m)	Gross Emissions (tCO_2)	Gross Electricty generation	Auxiliary consumption	Net supply to grid (GWh)
Steam stations									
Coal	000 MT	52985	1	52985	1506	79776792			
Furnace Oil	KL	56498	0.93	52.54314	3324	174637			
Light Oil	KL	33031	0.827	27.31664	3131	85536	98434.61	8.46	90107.04
LSHS/HHS/HSD	KL	5310	0.827	4.39137	3163	13888			
Lignite	000 MT	20755	1	20755	1136	23586614			
Gas Stations									
Natural Gas	M Cu M	2010	1	2010	1931	3882023			
HSD	KL	226981	0.827	187.7133	3127	586973	14214.02	2.83	13811.76
Naphtha	KL	719694	0.76	546.9674	3268	1787340			
Diesel Stations									
LSHS	KL	647451	0.827	535.442	3163	1693457	3294.75	1.74	3237.42
Diesel	KL	14903	0.827	12.32478	3127	38541			
Total						**111625800**			**107156.23**

Source of data: **Simple OM = 1041.71 tCO_2/GWh**

* Table 6.1, CEA general Review

** Table 5.5, CEA general review

Name of the plant	State	Date of Addition to Grid	Installed capacity (MW)	PLF	Gross Geneeration (GWh)	Auxillary Consumption (%)	Net supply to grid (GWh)	Emissin factor (tCO_2/GWh)	Total tCO_2
Steam									
Neyveli FST	TN	22-Jul-03	210	0.77	1416	8.46	1297	1150	1629192
Raichur	KAR	11-Dec-02	210	0.88	1619	8.46	1482	1150	1861933
Neyvelli TPS (1,2)	TN	21-Oct-02	210	0.77	1416	8.46	1297	1150	1629192
Neyvelli TPS (Zero unit)	TN	11-Oct-02	250	0.77	1686	8.46	1544	1150	1939514
Simadhri	AP	24-Aug-02	500	0.88	3854	8.46	3528	1150	4433175
Simhadri TPS	AP	22-Feb-02	500	0.88	3854	8.46	3528	1150	4433175
Diesel									
Kasargode DG	KAR	3-Mar-02	21.84	0.88	168	1.74	165	535	90072
Belgaum DG	KAR	4-Mar-02	81.3	0.88	627	1.74	616	535	335294
LVS DGPP	AP	18-Oct-01	36.8	0.86	277	1.74	272	535	148320
Samayanallue DGPP	TN	22-Sep-01	106	0.77	715	1.74	703	535	382515
Samapalpatti DG	TN	1-Mar-01	105.66	0.78	722	1.74	709	535	386240
Bellary DG (Unit 1 & 2)	KAR	22-Sep-00	25.2	0.78	172	1.74	169	535	92119
Kozhikode DG Power (Unit 8)	KER	6-Nov-99	16	0.78	109	1.74	107	535	58488
Kozhikode DG Power (Unit 7)	KER	25-Oct-99	16	0.78	109	1.74	107	535	58488
Kozhikode DG Power (Unit 6)	KER	11-Oct-99	16	0.78	109	1.74	107	535	58488
Kozhikode DG Power (Unit 5)	KER	30-Sep-99	16	0.78	109	1.74	107	535	58488
Kozhikode DG Power (Unit 4)	KER	23-Sep-99	16	0.78	109	1.74	107	535	58488
Gas									
Kuttalam CCPP	TN	24-Mar-04	37	0.78	253	2.83	246	453	114517
Kuttalam CCPPGT	TN	26-Nov-03	63	0.78	430	2.83	418	453	194989
Valthur (ST)GTPP	TN	13-Mar-03	34	0.78	232	2.83	226	453	105232
Valthur GTPP	TN	24-Dec-02	60	0.78	410	2.83	398	453	185704
Peddapuram CCGT	AP	26-Jan-02	142	0.86	1070	2.83	1039	453	484576
Pillaiperumalanallur CCGT (st U-1)	TN	4-May-01	105.5	0.78	721	2.83	700	453	326529
Tanir Bavi CCGT (Unit1,2,3,4)	KAR	5-Aug-01	170	0.88	1310	2.83	1273	453	593617
Tanir Bavi CCGT (St-10	KAR	21-Nov-01	50	0.88	385	2.83	375	453	174593
Kovikalappal GT (Unit-ST-1)	TN	30-Mar-01	38	0.78	260	2.83	252	453	117612
Kovikalappal GT (Unit-ST-2)	TN	5-Feb-01	69	0.78	471	2.83	458	453	213559
Pillaiperumalanallur CCGT (U-1)	TN	22-Feb-01	225	0.78	1537	2.83	1494	453	696389
Cochin CCGT (ST - Unit-St-1)	KER	20-Nov-00	39	0.78	266	2.83	259	453	120707
Kondapalli CCGT (Unit 1)	AP	22-Jun-00	112	0.78	765	2.83	744	453	346647
Kondapalli CCGT (Unit 2)	AP	19-Sep-00	112	0.78	765	2.83	744	453	346647
Kondapalli CCGT (ST 1)	AP	18-Oct-00	126	0.78	861	2.83	837	453	389978
Kayamkulam CCGT (Unit-3 ST)	KER	30-Oct-99	119.4	0.78	816	2.83	793	453	369551
Cochin CCGT (Unit-1)	KER	4-Dec-99	45	0.78	307	2.83	299	453	139278
Total					**27937**		**20776**		**19950550**

BM= 960 tCO_2/GWh

Total Gross Electricity Generated (GWh) for Southern Regional grid (2003-2004) = **139451.12**

Total Gross Electricity Generation from power plants recently added to the elecricity system = **20.03%**

* Source:table2.7, CEA, General Review 2005,2002-2003,2001-2002,2000-2001,1999-2000,1998-1999,1997-1998

** Source:tTable 6.6, CEA General Review 2003-2004

** Source:table2.4,3.4,6.6, CEA, General Review 2005

COMBINED MARGIN

Particulars	Specific emission (tCO_2/MWh)
Operating Margin	1.261
Build Margin	0.960
Combined Margin	**1.110**

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Annex 4

MONITORING PLAN

This monitoring plan supplements the data monitoring details provided under various sub-sections of section D in this PDD, for various baseline and project activity parameters. The parameters identified below need annual monitoring and verification for estimating the actual annual emission reductions and also for checking the net calorific value of excess waste gases supplied to the power plant and the annual quantity of furnace oil to be used in the project activity during the crediting period.

Data variables, ID and reporting units	Source of data and Recording Frequency	How will the data be archived? (electronic/ paper)
Quantity of furnace oil (auxiliary fuel) used by project activity - Q_i - in "tonnes"	Power Plant records – continuously monitored data as per practice at the power plant. The quantity of furnace oil is measured on-line, and is reported daily in liters that is converted to tonnes	Electronic/ paper
Net calorific Value of furnace oil - NCV_i – in "TJ/tonne"	To be measured monthly from random samples and used for estimation of project emissions	Electronic/ paper
Total Electricity Generated - . EG_{GEN} – in "MWh/yr"	Power Plant records – continuously monitored data as per practice at the power plant from meters located at the power plant.	Electronic/ paper
Auxiliary Electricity - EG_{AUX} – in "MWh/yr"	Power Plant records – continuously monitored data as per practice at the power plant from meters located at the power plant.	Electronic/ paper
Net Calorific Value of excess waste gases supplied to the project activity from the BF operations of KSL – in kCal/NM^3	Power Plant records – daily estimates can be obtained from parameters monitored in the excess waste gases supplied to the power plant. There is provision for annual random sampling and analysis of the waste gases through an independent external agency.	Electronic/ paper

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