

T@W Good Practice Form

Setting

Title:

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

Country:

India

Location:

Ginigera, Koppal district, Karnataka state

Start date:

Construction Start Date: 4 August 2003

End date:

Commercial Operation: 11 February 2005.

Technology keyword(s):

choose from the list

Host:

Government of India, Kalayani Steels Limited

General description

Summary:

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 Nm³/h on a sustainable basis (56,000 Nm³/h at a maximum). The temperature of the waste gases will be 40°C, with average calorific value of 650 kCal/Nm³. 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 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.

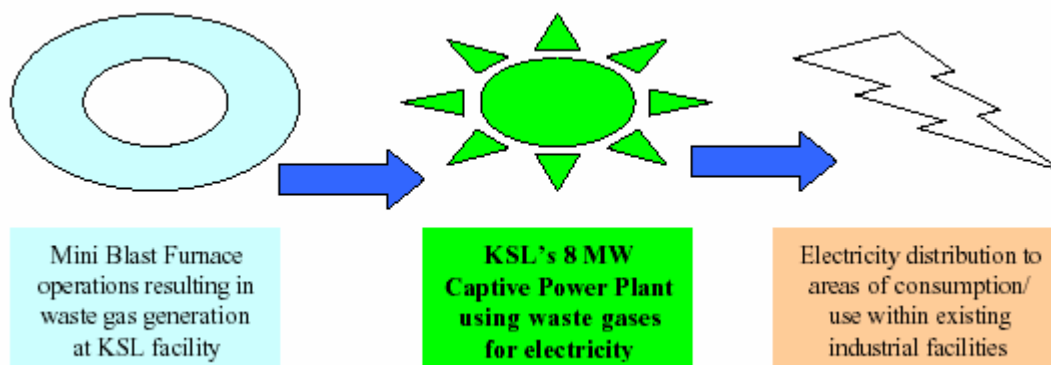
The project activity envisages development, designing, engineering, procurement, financing, construction, ownership, and operation and maintenance of the MBF gas collection and transportation facilities from the existing industrial facility of KSL and utilization of the same to generate electricity.

Aims:

The project activity aim is to make use of waste gas produced in iron manufacturing. The waste gas will produce electricity that will supply the iron plant.

Summary of Results:

The estimated emission reductions over the 10 year fixed crediting period would be 629,580 tCO₂.



Planning Time:	n.a
Planning issues:	n.a
Operation Time:	n.a
Feasibility Study:	n.a

Technical details

Technical details:

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font. The technology applied to the project activity has been tailor-made to recover enthalpy of MBF generated gases in a boiler1

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°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°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/Nm³), 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/NM³) is utilised for power generation.

Energy data

Energy data:	Text description
Energy saved/generated:	In common units, GJ/y (not mandatory)
Monitoring:	n.a

Environmental data

Environmental data:

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 plants². This would have resulted in higher GHG emissions than those emitted in the project activity.

Project GHG-emissions:	4,480 tonnes CO ₂ equivalent/year
GHG-emission reductions:	62,958 tonnes CO ₂ equivalent/year
"EAU, CER, ERU, AAU":	62,958 CERs/year

Methodology:

"Consolidated baseline methodology for waste gas and/or heat for power generation". Approved consolidated baseline methodology ACM0004.

Baseline

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 only¹. 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.

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	25.424 ²
(b) Import of electricity from the grid	2.815 ³
(c) New captive power generation on-site, using energy sources other than waste gas such as, coal	32.006 ⁴
(d) New captive power generation on-site, using energy sources other than was gas such as, diesel	18.007 ⁵

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

¹ The project activity does not involve sale of and/or supply of electricity to other consumers.

² 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.

³ The expenditure incurred by KSL for setting up infrastructure to connect to the KPTCL grid.

⁴ Estimated cost of setting up 8 MW coal based power plant.

⁵ Estimated cost of setting up 8 MW diesel based power plant.

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.

Monitoring:

The adopted monitoring methodology called “*Consolidated monitoring methodology for waste gas and/or heat for power generation*”⁶ has been used.

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.

Contribution to Sustainable Development:

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 data:

Economic data:

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.

Financing:

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.

⁶ Approved consolidated monitoring methodology ACM0004.

Capital cost: n.a

Operational Costs:

Grid cost per unit = Rs. 3.80 per kWh

Operating Expenses	01.01.2008 - 31.12.2011
Total Operating Expenses	3.07
Net Saving per unit	0.73
No of Months	48.00
Total Savings	35.04

Payback: n.a

Energy Production costs: n.a

Other savings: n.a

Additional Information

For additional information visit the UN website <http://cdm.unfccc.int/>

Photo Library

Pictures: Each one should have a caption. The provider must own the copyright (should be confirmed)

Contact information

Type of Organisation: Host company
 Organisation / Agency: Kalyani Steels Limited
 Main contact: Mr. Charuchandra Patankar
 Address: Mundwa, Pune, Maharashtra, 411 036 India
 Tel: +91-20-26823344
 Fax: +91-20-26871808
 E-mail: kalyani@kalyanisteels.com
 Web Site: www.kalyanisteels.com

Description of the Organisation for inclusion in the database of Technology and Service Providers: Kalyani Steels Ltd. was established in 1973, to fulfill the in-house requirements of forging quality steel of the Kalyani Group. It's corporate office is in Pune. Over the years, Kalyani Steels has been continuously upgrading its technology and infrastructure. At present the products for the KSL are manufactured at its Hospet plant which employs a new facility using less power intensive mini-blast furnace route.

Type of Organisation:

Organisation / Agency: Carbon Asset Services Sweden AB

Main contact Mr. Niels von Zweigbergk

Address: Drottninggt 92-94, 111 36 Stockholm, Sweden

Tel: +46 (0) 8 506 885 51

Fax: +46 (0)8 34 60 80

E-mail: niels.von.zweigbergk@tricorona.se

Web Site: www.tricorona.se

Description of the Organisation for inclusion in the database of Technology and Service Providers: Tricorona has been listed on the Stockholm Stock Exchange O-list since 1989. By the end of 2002 the number of shareholders were approx. 5 400. Operations are organised in two business divisions. Offering metallurgical and other industries services in the form of a large selection of raw materials, mainly secondary, as well as raw materials hedging and similar services are Tricoronas business concept.