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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

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Waste Heat Recovery based Captive Power Plant of VMPL in West Bengal
Version-01
10th August 2006

A.2. Description of the project activity:

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Vikash Metal & Power Limited (VMPL) is proposing to install a waste gas based Captive Power Plant (CPP) for generation of electricity by recovering the sensible heat in waste gases from sponge iron exhaust. The purpose of the proposed project activity is to generate electricity using waste heat contained in the waste flue gases released from the Direct Reduced Iron (DRI) during the Sponge Iron making Process.

VMPL is a 400 TPD sponge iron unit with 4 DRI Kilns of 100 TPD each. Each of the DRI Kiln emits around 24,000NM^3/hour of hot gas at a temperature of 950°C±50°C, containing heat energy to the tune of 7Mkcal/hour which, under normal circumstances would go as waste. The project proposes to use the waste heat by installing Waste Heat Recovery Boiler at the tail end of each DRI Kiln. Heat that is extracted from the hot gas is used to transform water to high temperature-high pressure steam. This steam is used to run conventional condensing type steam turbo-generator for the generation of electricity.

Of the 10 MW installed capacity of the CPP, about 9.399MW of power will be generated through 4 Waste Heat Recovery Boilers of capacity 10 TPH each, operating at 66kg/cm^2 and 485±5°C; and the rest through Atmospheric Fluidised Bed Combustion (AFBC) boiler. The total heat energy available from the waste gas of DRI kilns, on conversion to electrical energy produces about 9.399MW of electrical power. Harnessing this power by establishing a suitably designed CPP at the tail end of the DRI Kilns will enable VMPL to reduce green gas emission by generating power from waste gas / heat

The common practice in sponge iron units for meeting the energy requirements of its plants is to either produce the same in a coal-based power generation plant or import electricity from the state grid. In the absence of the project, the project proponents would have resorted to the above-mentioned ubiquitous practice. In view of the same, the proposed project will displace an equal amount of electricity imported from the state grid / generated by a coal based power plant.

The project will help in the following ways:

- To achieve energy efficiency by utilizing the available waste heat from the waste gases of sponge iron kiln, thus promoting cleaner and more efficient technologies;
- Meet the power requirement without any T & D losses;
- Conservation of energy and natural resources, to reduce direct and indirect consumption of scarce resources;
- Reduce the disparity between demand and supply of grid electricity and helps to become self reliant and less dependant on grid supply of electricity;
- Promotes the sustainable development

- Environmental improvements in sponge iron making process as well as reduction in Greenhouse Gases (GHG) emission;

The GHG emission reductions due to the project activity are equivalent to that quantity which would have been emitted from the combustion of a mixture of fossil fuels to produce the requisite electricity from the state grid. The total emission reductions for the entire crediting period of 21 years are expected to be approximately 11, 57,751 tCO2e. *It should be noted that even though a coal-based power plant is an equally plausible option, the eastern region grid has been assumed to be the base line as the results are more conservative.*

Project's Contribution to the Sustainable Development

Social well-being: The project is expected to create significant employment opportunities; directly, by way of manpower required to build / operate / maintain the unit and indirectly, by generating power and thus eliminating the need to draw power from an already deficit grid. Further, with growing technological advancement, the project activity will contribute to the capacity building in terms of technical knowledge and long-term skills. Such project, which involves energy efficiency, will certainly have long-term direct and indirect social benefits. The implementation of the project activity will bring about an increase in the business opportunities for contractors, suppliers, and erectors at different phases of its implementation. This will improve the local economic structure and hence social status of the involved people. The plant is located in a backward area and therefore the project activity will in a way help to improve the status of the local populace.

Economic well-being: With project activity's ability to reduce an equivalent demand of electricity on the grid, there is an advantage to the regional grid in combating power shortage and making power available for other important purpose.

Environmental well-being: In India, a major share of the country's electricity is generated from fossil fuel sources such as coal, diesel, furnace oil etc. The proposed waste heat recovery CDM project will displace or replace the equivalent quantity of electricity generated in the grid. Furthermore, the project will relieve the burden on the depleting resources of conventional fuel thereby making coal available for other utilizations. Since the project is able to avoid all the associated pollution occurring related to extraction, processing and transportation of natural resources, it promotes an overall environmental well being. In India, coal is the most abundantly available fossil fuel, which is mainly used for power generation. Power plants run for supply of power to regional grid, contribute about 16477.78 MW[1] of which more than 84% is accounted for by coal, gas and diesel based thermal power plants. The waste heat recovery CPP in VMPL has been able to displace/ replace electricity generated by grid-connected power plants in an equivalent amount. Being able to do away with grid power, VMPL has indirectly saved further depletion of natural resources in the form of coal, thus increasing its availability to other important processes in future. Thus the implementation of project activity is a demonstration of a clean technology.

Technological well-being: Waste Heat Recovery based captive power plant is a cleaner technology that uses the waste flue gases of sponge iron kilns which otherwise would have been emitted to the atmosphere leading to its pollution. The electricity generated by the plant is consumed for both auxiliary

[1] http://powermin.nic.in/generation/generation_state_wise.htm#estern

and captive purposes. Hence, the project activity has contributed to a better quality environment to the employees and the surrounding community.

A.3. Project participants:

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Name of Party involved (*) ((Host) indicates a host Party)	**Private and/or public entity(ies) project participants (*) (as applicable)**	**Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)**
Ministry of Environment and Forest, Government of India (Host Country)	Vikash Metal & Power Ltd (Private Entity, Project participant)	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

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India

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

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West Bengal

A.4.1.3. City/Town/Community etc:

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Village-Poradiha; Tehsil-Santuri, District-Puruliya

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

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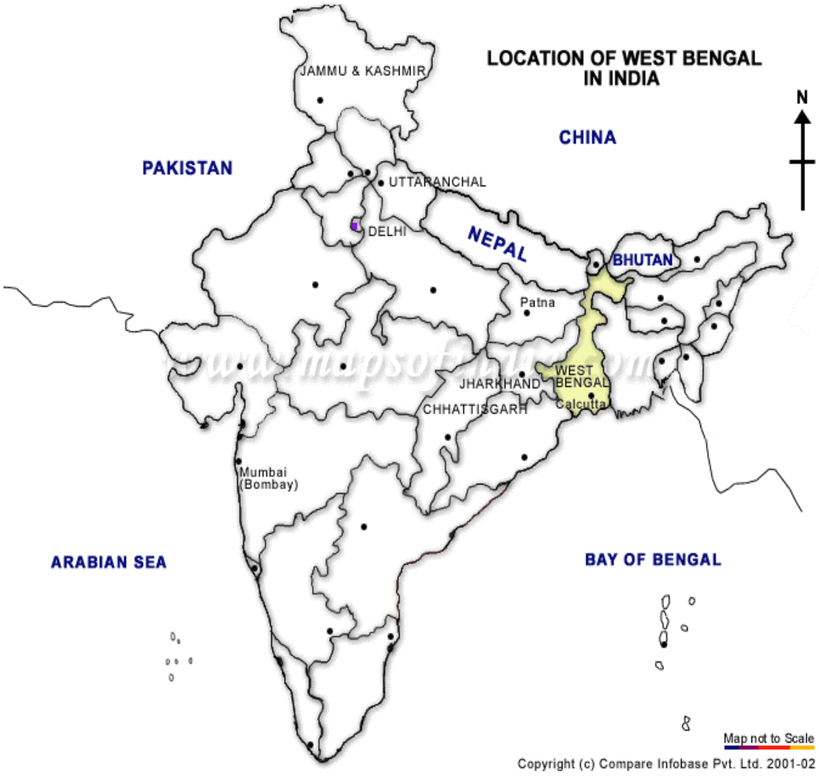
The proposed project will be located within the VMPL's sponge iron and mini steel plant at Village-Poradiha (a notified backward area), in the district of Puruliya, State -West Bengal, India (see maps below). The plant is located about 328 kms away from the state capital, Kolkata. The district is well connected by trains and buses from Calcutta, Durgapur, Asansol , Tata , Bokaro, Dhanbad & Ranchi. Puruliya is connected to the rest of the state through National Highway 6. The physical location of the project is $21^0$45' – $23^0$00' N latitude and $86^0$30'-$87^0$45'E Longitude


LOCATION OF WEST BENGAL
IN INDIA
N
JAMMU & KASHMIR
PAKISTAN
CHINA
UTTARANCHAL
DELHI
NEPAL
BHUTAN
Patna
WEST
BENGAL
JHARKHAND
CHHATTISGARH
Calcutta
Mumbai
(Bombay)
ARABIAN SEA
BAY OF BENGAL
Map not to Scale
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Maldah
Bangladesh
Jharkhand
Murshidabad
Birbhum
Barddhaman
Nadia
Puruliya
Bankura
North 24-
Parganas
Hugli
Calcutta
Haora
Medinipur
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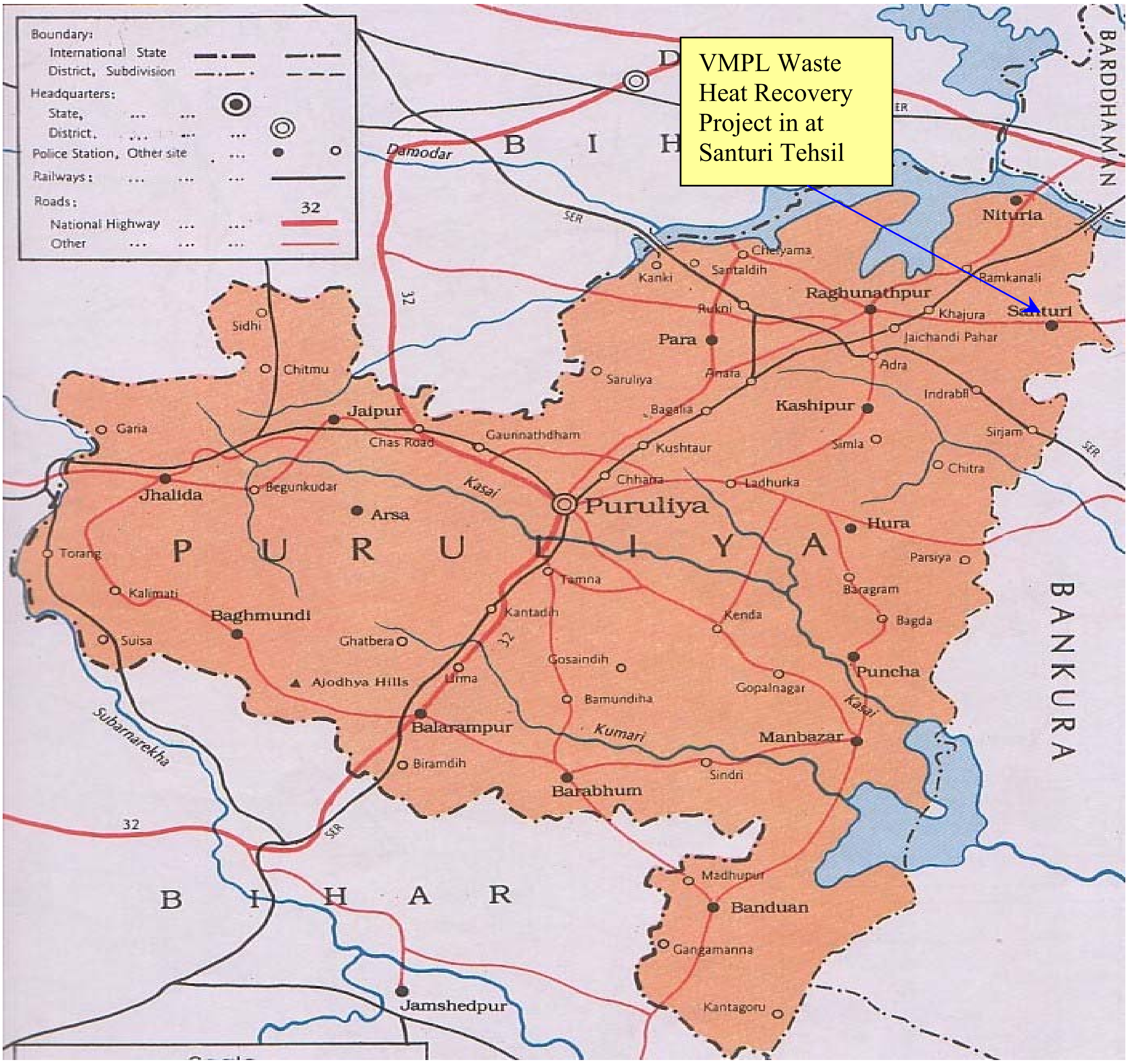
South 24-
Parganas
Orissa



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

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The project activity is categorized under Sectoral Scope 01 "Energy Industries" (renewable / non-renewable sources). The project will be generating electricity by utilizing the waste gases from the sponge iron kiln. Thus, the approved methodology ACM0004 / Version02 – *"Consolidated baseline methodology for waste gas and/or heat and/or pressure for power generation"* is applicable to the project.

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

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The Waste Heat Recovery based Captive Power Plant equipped with modern equipments, utilizes the heat content of the waste flue gas from Direct Reduced Iron (DRI) kilns of sponge iron unit to generate electricity for captive consumption of VMPL.

VMPL is a 400 TPD sponge iron unit with 4 DRI Kilns of 100TPD each. Each DRI Kiln emits around 24,000 NM^3/hour of hot gas at a temperature of 950°C±50°C that contains heat energy to the tune of 7 Mkcal/hour which, if not suitably utilized, goes to waste.

Such energy waste could be abated by installing Waste Heat Recovery Boiler at the tail end of each DRI Kiln, which in fact works as a cooler for the high temperature gas. The heat extracted from the hot gases is utilized for transforming water to high temperature-high pressure steam, to run conventional condensing type steam turbo-generator for generation of electricity as a part of forward and backward integration process.

The gross heat energy that would be available from the hot gases at the boiler front has been estimated to be 28 Mkcal/hr. Thus, the total heat energy available from the waste gas of four DRI Kilns, on conversion to electrical energy generates approximately 9.399 MW of electrical power. The proposed plant shall be configured with four numbers of Waste Heat Recovery Boilers (WHRB) of capacity 10 TPH each, operating at 66 kg/cm^2 and 485±5°C, thus generating total power of 9.399MW.

The steam produced by the boilers will be routed to the 10MW single uncontrolled extraction condensing type steam turbine. The turbine is designed for main steam parameters of 64 ata 480°C to generate 10MW at generator terminal. The power plant power cycle is designed with one common de-aerator. The steam requirements for the de-aerator will be taken from the extraction of the turbine. The low-pressure extraction will meet with the de-aerator steam requirements.

The WHRB shall be sized and designed to extract maximum sensible heat energy contained in the waste gases emanating from the Direct Reduction Kiln. The major technical parameters of WHRB are given below:

1. The steam generator consists of radiant chamber, super heater, evaporator and economiser.
2. Pressure parts
   The complete system of boiler pressure parts, covering:
   - Steam drums
   - Water wall / radiant chamber
   - Evaporator
   - Super-heater
   - Economiser
   - Integral piping, interconnecting piping, valves, fittings, supports, etc. will be provided together with all the required headers.
   - The circulating system, essentially comprising of the drums, water walls etc, will be designed to provide an adequate circulation ratio. The sizing of the circulation system components will be adequate to ensure safe circulation ratios even under peak loading conditions.

The electricity requirements of the project activity and its associated systems are met by the project activity itself.

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

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The total emissions reductions throughout the first crediting period (7 years) from the project are expected to be as under:

Years	**Annual estimation of emission reductions in tonnes of CO2 e**
2007	55,131
2008	55,131
2009	55,131
2010	55,131
2011	55,131
2012	55,131
2013	55,131
Total estimated reductions for the first crediting period	**3,85,917**
Total number of crediting years	**21y-0m (7 x3)**
Annual average over the first crediting period of estimated reductions (tones of CO2 e)	**55,131**

A.4.5. Public funding of the project activity:

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No funding from the Annex I parties is available to the project activity.

SECTION B. Application of a baseline and monitoring methodology

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

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

Reference: *Approved Consolidated baseline methodology ACM0004 / Version02 – Sectoral Scope: 01, 3rd March 2006.*

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

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As stated in the "Consolidated baseline methodology for waste gas and/or heat for power generation"- **"*This methodology applies to project activities that generate electricity from waste heat or the combustion of waste gases in industrial facilities".*** The project activity under consideration recovers the heat content of waste gases emitted from the DRI kilns in WHRB and utilizes the same to produce steam which is further used to generate electricity.

Apart from the key applicability criteria, the project activity is required to meet the following conditions in order to apply the baseline methodology-

"***The methodology applies to electricity generation project activities:"***

1. ***"That displace electricity generation with fossil fuels in the electricity grid or displace captive electricity generation from fossil fuels,"-*** As per the Baseline Scenario analysis, conducted in Section B.4 of this PDD, the project activity displaces electricity generation with fossil fuels in the electricity grid (Eastern Regional Grid). Therefore the project activity meets this applicability criterion.

2. ***"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"-*** The project activity involves utilization of the heat content of waste gases of the sponge iron kiln. There is no fuel switch involved in the sponge iron kiln operation.

Furthermore, **"*The methodology covers both new and existing facilities*"-** Out of the four DRI kilns; first two kilns exist and other two kilns have started operating from 2006. VMPL is also installing a CPP at the tail end of DRI kilns which will enable to generate power from waste gas. Since the VMPL sponge iron plant is planning to expand its capacity the added capacity is treated as a new facility and it takes into consideration both new and existing facilities.

As stated above, the project activity under consideration meets all the applicability conditions of the baseline methodology. This justifies the appropriateness of the choice of the methodology in view of the project activity.

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

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As per ACM0004 Version02, the spatial extent of the project boundary comprises the waste heat (or gas sources), captive power generating equipment, any equipment used to provide auxiliary heat to the waste heat recovery process and the power plants connected physically to the electricity grid that the proposed project activity would affect.

This CDM project covers the activities carried out for production of electricity at VMPL facility from their waste heat based CPP. These include recovery and utilisation of waste flue gases of DRI kiln after complete combustion, generation of steam, feeding this steam to the common header of the CPP, generating power in turbo-generator set and finally the evacuation of power from the power plant. The produced electricity by CPP is used for in-house consumption. There is no auxiliary fuel used in the waste heat recovery steam generation system.

	Source	Gas	Included?	Justification/Explanation
Baseline	Grid Electricity Generation	$C0_2$	Yes	Main Emission Source
		CH_4	No	Excluded for Simplification. This is conservative.
		N_20	No	Excluded for Simplification. This is conservative.
Project Activity	Combustion of waste gas for electricity generation	$C0_2$	No	The hot gases would have been let to atmosphere in the absence of the project activity.
		CH_4	No	Excluded for simplification.
		N_20	No	Excluded for simplification.

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

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Identification of Alternative Baseline scenarios and selection of appropriate baseline scenario: As per the methodology, the project proponent should include all possible options that provide or produce electricity (for in-house consumption and/or other consumers) as baseline scenario alternatives. These alternatives are to be checked for legal and regulatory compliance requirements and also for their dependence on key resources such as fuels, materials or technology that are not available at the project site. Further, among those alternatives that do not face any prohibitive barriers, the most economically attractive alternative is to be considered as the baseline scenario.

The methodology has been applied to the project in following ways:

1. Identification of alternative baseline scenarios consistent with current laws and regulations
2. Additionality assessment
3. Determination of emission reductions from the project activity.

Identification of alternative baseline scenarios consistent with current laws and regulations

As highlighted in the baseline methodology the determination of the baseline scenario requires consideration of the following potential alternatives:

(a) The proposed project activity not undertaken as a CDM project activity
(b) Import of electricity from the grid
(c) Existing or new captive power generation on-site using other energy sources other than waste heat and/or gas, such as coal, diesel, natural gas, hydro, wind etc
d) A mix of options (b) and (c), in which case the mix of grid and captive power should be specified.
(e) Other uses of waste heat and waste gases
(f) The continuation of the current situation, whether this is captive or grid-based power supply.

Analysis of the alternative scenarios:

The analysis of each of the above scenarios is done bearing in mind the factors considered by the promoters while making the investment decision, namely:

(i) The iron and steel industry is a highly cyclical industry and all industry indicators seem to suggest that the peak has been reached;
(ii) The generation of power by the system is completely dependent on the use of sponge iron unit, which in turn is dependent on the landed price of scrap metal which is also fluctuating and
(iii) The power plant cannot be technically operated if the PLF is below 50%.

Option a: The proposed project activity not undertaken as a CDM project activity
The promoters have gone on record with their reluctance to set up the waste heat recovery based power unit, primarily on account of the high capital cost and the risks involved. In fact it was only when the CDM related revenue was highlighted to the investor group and concrete offers were produced to the investors that they agreed to invest the equity component required to fund the power plant. Otherwise, the investors were of the opinion that the project was very risky and preferred to set up the project by drawing the required power from the state electricity grid. It is being stated that the plant was operating from power drawn from the State Electricity Board and even after the expansion from its existing 200 TPD to 400 TPD; it had received sanction for the required power from the State Electricity Board.
In view of the above, it may be concluded that at the point when the decision to proceed with the project was taken, the CDM related revenue aspect was seriously considered during the expansion phase) and was a key factor responsible for the favorable decision (suitable documents will be provided to the DOE at the time of validation).
Thus the option to undertake this project as a non-CDM project was/is not a viable baseline scenario.

Option b: Import of electricity from the grid
In the absence of the project activity, import of electricity from the state grid, would perhaps have been the most economically feasible option. The key advantage with the state grid electricity is the fact that the upfront capital investment (and thus the related project risk) is very low and this was a key factor under consideration by the project developers.
Furthermore, the plant meets all the legal and regulatory requirements needed to be able to purchase electricity. In addition, the project had received an offer from the state government for supply of the entire power required by the project.

Option c: Existing or new captive power generation on-site using other energy sources other than waste heat and/or gas, such as coal, diesel, natural gas, hydro, wind etc .

In analyzing this option it is necessary to consider fuels, materials and technology available at the project site.

Natural gas as a possible fuel can be ruled out on account of lack of infrastructure for its supply to the project activity. In other words, supply constraints rules out natural gas as an option.

Wind & hydro: Renewable energy sources like wind and hydro are unreliable sources of power and are thus not serious contenders. In addition wind / hydro are very capital intensive and the state of West Bengal does not have too many suitable wind / hydro sites. The basic criterion for developing wind power project depends on the density of wind in the particular site. The state of West Bengal has not developed too many wind power projects. The total electricity generated from the wind power projects in West Bengal is only 1.08 MU[2] with 1.1 MW[3] of installed capacity. It is evident from these statistics that the region is not too favourable for switching over to a wind-based source for generation of electricity.

Coal and diesel (including other liquid fossil fuel) are therefore left as alternatives for power generation. Even though the sponge iron plant will be installing diesel generators as back up units, on account of the high cost of operation, they will not be used continuously. The power generated would partially meet VMPL's own demand and the remaining power would be wheeled through the SEB grid. An equivalent amount of CO_2 emissions would be released at the CPP end. This alternative is in compliance with all applicable legal and regulatory requirements and can be a part of baseline option. But it should be noted that diesel based power generation is not an economically feasible option.

Of the potential options for captive units we are essentially limited to a small coal based electricity generation system as an alternative. Coal based boilers are installed in sponge iron plants to utilize the "char" (unburnt coal that exits the rotary kiln). The coal based generation plant, being cheaper in terms of up-front investment costs (estimates from manufacturers identified coal based boilers as 50% cheaper than waste heat recovery boilers), is generally a preferred option.

However the char must be mixed with coal in order to reduce the size of the boiler. The feasibility of generation from this set up depends on the access to coal over time and as coal is available in plenty in the eastern part of the country, this was an option that was under serious consideration by the project developers. Moreover in addition to the cost advantage, it did not suffer from the risks of under utilization that the WHR based power plant was faced with.
The coal-based power plant was thus a viable option that could also be considered to be the baseline scenario.

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[2] http://mnes.nic.in/wp12.htm

[3] http://www.indianwindpower.com/potential.html

<u>Option d: A mix of options (b) and (c), in which case the mix of grid and captive power should be specified.</u>

In view of the issues mentioned above, option (d) is a possible baseline scenario. However in order to be conservative, the baseline emission has been computed considering a 100% power draw down from the eastern regional grid.

<u>Option e :Other uses of waste heat and waste gases</u>

In examining option (e), i.e. other uses of waste heat and waste gas, there have been no attempts to utilize the gases for other purposes in the region. The majority of plants have traditionally released the gas into the atmosphere and the installation of waste heat recovery boilers has only been considered recently. There are not too many sponge iron plants in West Bengal which has a Waste Heat Recovery Based Power Plant. Therefore it is plausible to rule out this option in cases where the waste gases are generated in a sponge iron plant.

<u>Option f: The continuation of the current situation, whether this is captive or grid-based power supply.</u>

Grid based power is available to projects in the state and there are no limitations on obtaining a grid connection either by the type of industry or region. A plausible alternative baseline scenario is that of the electricity being generated by the operation of grid-connected power plants and by the addition of new generation sources.

Therefore, through the examination of the alternatives available to the project promoter it can be demonstrated that the possible options were limited to three:

- Import of electricity from the grid;
- Setting up a coal based power plant;
- The project activity that involves investment in sponge iron waste heat recovery;

Of the three options, the most plausible (and reliable) option would have been a combination of coal-based power together with additional power being drawn from the grid. However, in order to be conservative, the baseline has been considered to be 100% grid based power. The project activity therefore gives rise to emission reductions through the displacement of grid based power generation sources in the supply of electricity to the sponge iron plant and to other third parties, both of which would have been satisfied by the grid under the baseline scenario.

Key methodological Steps followed in determining the baseline scenario:

1. The methodology requires VMPL to establish base line scenario by considering all possible options that provide or produce electricity for in house consumption and /or sale to grid and/or other consumers. The methodology also identifies six possible alternative scenarios.

Each of the alternatives have been discussed above and illustrated that the import of power from grid as the baseline scenario.

2. The methodology requires us to demonstrate the additionality of project activity using the " latest version of Tool for demonstration and assessment of additionality".

The additionality of project activity using the "Tool *for demonstration and assessment of additionality version 02 of 28 November 2005''* in Section B.5.

3. The methodology applies to electricity generation project activities; that displaces electricity generation with fossil fuels in the electricity grid or displace captive electricity generation from fossil fuels, where no fuel switch is done in the process where the waste heat or pressure or the waste gas is produced after the implementation of project activity.

We have established that project activity generates electricity, which displaces grid power that is fossil fuel based and there is no fuel switch being done in the rotary kiln where the waste gases are produced in this project activity.

For determination of emission reductions please refer to B.6.

B.4.1 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)	For how long is archived data to be kept?	Comment
1. EG_y	*Net electricity generation available for captive purpose*	*Project Records/Log Book*	*MWh/yr*	*m*	*Continuously*	*100%*	*Paper / electronic*	*Credit period + 2 years*	*Meters at plant will automatically measure the data. The data will be recorded in project logbook.*
2. EG_a	*Auxiliary consumption of the power plant*	*Project Records/Log Book*	*MWh/yr*	*m*	*Continuously*	*100%*	*Paper / electronic*	*Credit period + 2 years*	*Meters at plant will automatically measure the data. The data will be recorded in project logbook.*

3.	EG_{total}	*Total electricity generated from the project activity*	*Project Records/Log Book*	*MWh/yr*	*m*	*Continuously*	*100%*	*Paper / electronic*	*Credit period + 2 years*	*Meters at plant will automatically measure the data. The data will be recorded in project logbook.*
4.	EF_y	CO_2 *Emission Factor of the grid*	*CEA*	*tCO2e/GWh*	*c*	*Annually*	*100%*	*Paper*	*Credit period + 2 years*	*Calculated as the weighted sum of OM and BM Emission Factor*
5.	$EF_{OM,y}$	CO_2 *OM Emission Factor of the grid*	*CEA*	*tCO2e/GWh*	*c*	*Annually*	*100%*	*Paper*	*Credit period + 2 years*	*Calculated as option 1 (simple OM) as per the referred methodology ACM 0002*
6.	$EF_{BM,y}$	CO_2 *BM Emission Factor of the grid*	*CEA*	*tCO2e/GWh*	*c*	*Annually*	*100%*	*Paper*	*Credit period + 2 years*	*Calculated as option 1 (Ex-ante) as per the referred methodology ACM 0002*

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

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As per the proposed baseline methodology, the project proponent is required to establish that the GHG reductions due to the project activity are additional to those that would have occurred in the absence of the present project activity as per *'Tool for the demonstration and assessment of additionality' agreed by the CDM Executive Board.*

Step 0: Preliminary screening based on the starting date of the project activity.

As the project will not be registered before the project date of commissioning (31st December 2006), the crediting period is expected to start after the project starts generating power. Since the project participants do not wish to have crediting period starting prior to the registration of their project activity the Step 0 is satisfied.

Step 1 – Identification of alternatives to the project activity consistent with current laws and regulations.

The demonstration of the baseline scenarios (in section B4) incorporated the steps contained within this section and therefore to summarize the conclusions of the baseline scenario, it has been shown that the alternatives might be limited to the project activity not undertaken as a CDM and in its stead, the supply of electricity coming from the grid.

Step 2 – Investment analysis

Step 3 -- Barrier analysis

That the project activity is additional can be established by carrying out a barrier analysis as envisaged in Step 3.

Sub-step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity

1. **Investment barrier(s)**

The key investment barriers are:

Availability of equity required for the project: The principal investment barrier is the availability of equity for the project. The investors had made it absolutely clear that the project was too risky and was not a preferred option. It was only based upon the consideration of the additional revenue from the sale of CERs being highlighted that one investor, Mr. Akash Patni, agreed to increase his contribution.

It should be highlighted that the investor (Mr. Patni) had initially agreed to invest the additional amount required for the power project in the form of Cumulative Convertible Preference Shares and it was only much later when project was being developed under the CDM that he agreed to bring in his additional investments in the form of equity.

In view of the above, it may be concluded that the additional revenue from the sale of CERs played a very important role in facilitating the mobilization of the required equity and debt for the project.

2. Technological barrier(s)

With a flow rate of the order of around 24,000 NM^3/hour of hot gas at a temperature of 950°C±50°C, the waste gas generated had a potential to generate net power of 10 MW. With the present heat energy available in the waste gases, the boiler capacity for the project was designed at 4X10 TPH each operating at 66kg/cm^2 pressure and 485±5°C temperature. As the major activity of the proponent is steel manufacturing, the management lacks the experience of operating the plant at higher configurations and this may turn out to be a difficult exercise for them.

Besides these risks and barriers regarding stand-alone operations, the project activity had to face operations risks related to the waste gas generation and its heat content, which affect the successful implementation of the project activity.

- If the heat content of the waste gas is not sufficient, the project activity will be directly affected and as a result, unable to generate power;
- Cumulative effect of sustained variable frequency operation due to fluctuations in waste gas supply (flow rate & temp) may have substantial bearing on safe and sustained operation of assets like the power plant equipments.
- Quality of products of a number of process industries like ingot manufacturing is heavily dependent on the quality of power supply. Poor quality of power supply not only results in reduced life of equipment but also in poor quality of products.
- Non-availability of waste gas at the required temperature can also result in a complete closure of the project activity. It has been further stated that resumption of production process takes a long time. Hence the power interruption even for a short spell destabilizes the manufacturing process, besides causing production loss and damage to the sophisticated equipments due to thermal shock.

Moreover if the waste gas temperatures are greater than 1000^{o}C, the corrosive nature of the waste gases increase manifolds and it would have a detrimental effect on the boiler tubes designed for waste gases between 950-1000^{o}C. The project activity thus required the installation of expensive controls to ensure the waste gas temperatures does not exceed 1000^{o}C, however in case of any failure of such controls the DRI kilns will have to be shut down immediately; else the boiler would be damaged

The suitable backup arrangements are required to be designed and created to take care of all fluctuations in power generation. Hence it is evident that the designing, installation and operation of a waste heat recovery based power plant with a sponge iron rotary kiln, based only on the flue gases, without any auxiliary fuel support, where the flue gas generation quality and quantity is not under control of the power plant operator and wherein the quantity & quality of the Waste Heat flue gas varies in accordance to a number of factors which influence the production of sponge iron in quantity as well as in quantity, is a great technology barrier.

Moreover the plant is located in the notified backward region of Poradiha where there is a shortage of skilled professionals and workers to run the CPP. The PLF (plant load factor) also is dependant on the proper operations of equipment, which in turn depends on skilled personnel. This would pose as a significant barrier for their proposed project activity.

The technical and operational barriers mentioned above make the investment in the proposed project activity a very risky proposition, not only from the project activity's point of view but also from the larger steel manufacturing operations point of view as any mishap could adversely affect the steel manufacturing operations, leading to significant financial losses.

3. **Other barrier(s):** Due to lack of awareness about available technologies, products, financial support; limited dissemination of information on operation know-how; limited managerial resources; organizational capacity

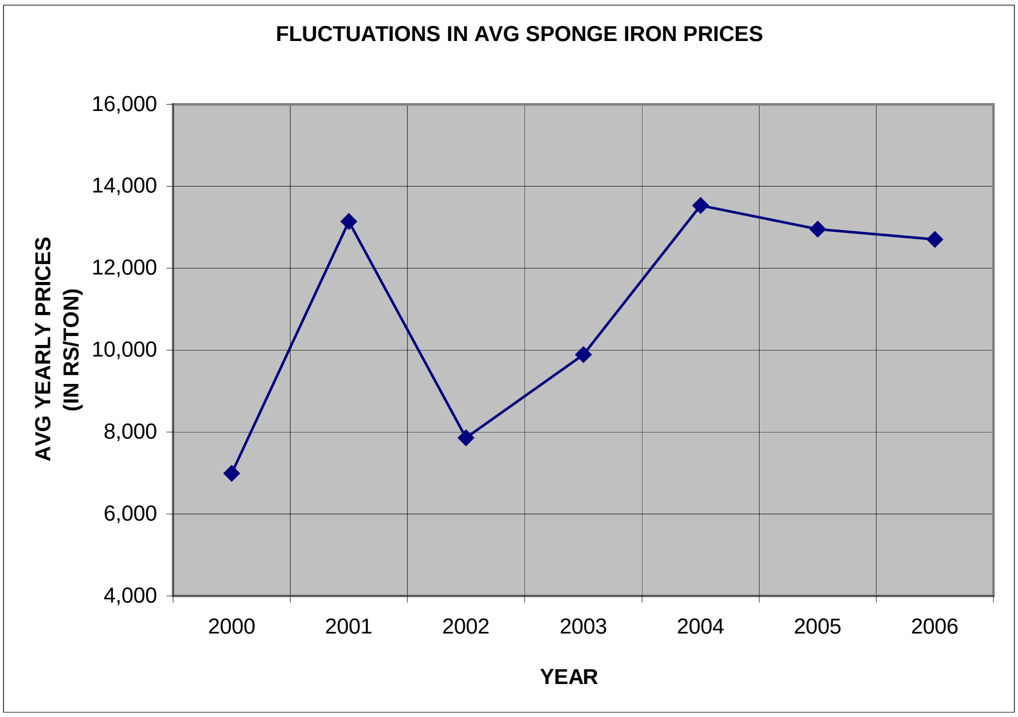
The sponge-iron manufacturing sector belongs to steel industry sector with limited knowledge and exposure of complications associated with production of power. VMPL personnel lacked the necessary technical background to develop and implement a waste heat recovery based power plant with technological innovation. They had to strengthen their internal capacity by inviting external expertise to implement the project activity. The VMPL personnel at various levels lacked relevant managerial background for project activity implementation, operation and maintenance. They were provided with training to ensure smooth operation. They had no background strength in the power sector economics and power generation sector.

The domestic sponge iron and Ferro alloy industry in India is witnessing a downward trend in prices of sponge iron. This can directly lead to a drop in allocation of working capital requirements (i.e. budget) of none core activities like that of the CPP. VMPL is committed to the cause of green power produced by the waste heat recovery project and although it will continue to support the successful implementation and operation of the project, it may be constrained for funding further development/training for the CPP operations in the event of squeeze in working capital as forecasted.

The market scenario of the sponge iron in the country is volatile; the prices for the final product too have been fluctuating[4] as shown in the graph given below. The fluctuation in the price of the final product is significant as the project was conceptualized at a point in time when the steel prices had peaked and were showing a downward trend. The promoters, being aware of this, were very keen to limit their total project exposure.

The proposed project activity (waste heat based power plant) is totally dependent on the upstream sponge iron plant and also to a large extent on the prices of scrap (as below a level, it would make economic sense to shift partially / completely from sponge iron to scrap). Furthermore, the market conditions being volatile, there is the possibility of the project promoters having to discontinue the project activity and shift to alternative power sources. This may lead to either downscaling or shutting down the upstream sponge iron plant altogether and thus terminating the project activity (the project activity will cease to generate power at below ~ 35% PLF). Therefore there is a significant capital risk associated with the project.

[4] http://www.indiainfoline.com/sect/stee/db71.html



In spite of all these barriers and large financial risks, VMPL has decided to implement the waste heat recovery based power plant, in order to reduce GHG emissions thereby generating power from an environment friendly source.

Sub-step 3 b. Show that the identified barriers would not prevent a wide spread implementation of at least one of the alternatives (except the proposed project activity already considered in step 3a):

VMPL's project activity is a WHR based power project utilizing waste heat from sponge iron rotary kiln VMPL would not have faced any regulatory or investment barrier in case it would opt for Alternative b i.e., Import of electricity from the grid (existing sponge iron units of VMPL had imported the power from the grid to meet their requirements). This alternative option was evaluated with respect to the above-mentioned barriers. So far as investment barrier is concerned, there is no high initial cost or high operational and maintenance cost required for this option. Further for import of power from grid, VMPL would not have to face any technological barriers as in the case of generation of waste heat based power. Therefore, it is most likely that in absence of the project activity VMPL would opt for the business-as-usual scenario, i.e. releasing the waste heat into the atmosphere and importing equivalent electricity from regional grid to cater to the need.

Step 4 – Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity:

In the sponge iron sector of West Bengal with similar socio-economic environment, geographic conditions and technological circumstances, VMPL is one of the exceptions which is in the construction phase of the waste heat recovery based captive power plant in order to reduce GHG emissions and avail the revenues from sale of carbon emission reductions.

There are a total of 67 sponge iron plants already in operation in the state surrounding the proposed project activity. Of the 67 sponge iron plants, only four plants (including VMPL) have Waste Heat Recovery plants and the same also applies to availing carbon credits. They are namely Jai Balaji Sponge Ltd, Sri Ramrupia Balaji, Electrosteel Castings Ltd, Vikash Metal & Power Ltd. This indicates a very low penetration of technology. The project activity occurs in 6% of the similar industries and therefore is not a common practice.

It may be concluded that the there are significant barriers (technical / investment / market related etc.) that has resulted in the low penetration level of the technology in the area and the proposed project activity is NOT a common practice.

Sub-step 4b. Discuss any similar options that are occurring:

From the above analysis the proposed project activity is not common practice amongst plants facing similar techno-economic circumstances.

Step 5 – Impact of CDM registration

The main benefits of CDM registration relate to the financial and investment impacts of the CDM revenue stream as highlighted in step 2. Furthermore, the inherent risks in undertaking the project are reduced through the increased return associated with registering the project under CDM, thereby specifically offering the plant greater leeway in its first two years of operation when the promoter is gaining experience of operating the plant efficiently and assisting the project in achieving financial closure. In addition, the registration of the project under the CDM would enhance VMPL's profile as a company that is concerned about the environment that it operates under.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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According to the methodology ACM 0004,

Project emissions *are applicable only if auxiliary fuels are fired for generation startup, in emergencies, or to provide additional heat gain before entering the Waste Heat Recovery Boiler***.** However, auxiliary fuel firing would not be required for start up and there is no provision for auxiliary fuel firing for additional heat gain of waste gases in the project activity.

The project proponent has identified all the possible sources, which could have directly or indirectly added to GHG emissions in the project activity:

- GHG emission due to heat energy extraction in the WHRB is zero, as there is no change in chemical composition of waste gases at the inlet and outlet of the boiler.
- No major on-site emissions for meeting the auxiliary consumption, since the plant runs on the power that is generated by the project activity.

Baseline Emissions are given as:

$BE_{electicity,y} = EG_y * EF_{electricity,y}$
Where,
EG_y *= Net quantity of electricity supplied to the manufacturing facility by the project during the year y in MWh, and*
$EF_{electricity,y}$ = CO_2 *baseline emission factor for the electricity displaced due to the project activity during the year y* (tCO_2/MWh)
As per the methodology, if the project displaces the electricity generation by fossil fuel combustion for captive purpose then the baseline scenario is as follows:

<u>Selected Option 2.</u> Since baseline scenario is grid power imports (As illustrated in B.4)
Emission Factor of the Grid (EFy)
Baseline emission factor of eastern region (EF*y*) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors according to the following three steps.
STEP 1. Calculate the Operating Margin emission factor

As per ACM0002, the simple OM method can only be used where low-cost must run resources constitutes less then 50% of total grid generation of average of the five most recent years. As illustrated in Annex 3, Since the average of low cost must run resources in the five most recent years constitutes less then 50% of the total grid, the simple OM method is selected.
The simple OM emission factor ($EF_{OM, simple,y}$) is calculated as the generation-weighted average emissions per electricity unit (tCO_2/MU) of all generating sources serving the system, not including low-operating cost and must-run power plants.

$$EF_{OM,y} = \frac{\Sigma F_{i,j,y} * COEF_{i,j\,y}}{\Sigma\ GEN_{j,y}}$$

where *Fi ,j, y* is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*,
j refers to the power sources delivering electricity to the grid, not including low-operating cost and must run power plants, and including imports to the grid,
COEFi,j y is the CO2 emission coefficient of fuel *i* (tCO2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y*, and
GENj,y is the electricity (MWh) delivered to the grid by source

The fuel consumption in individual plants as required by the above formula is not readily and correctly available. However, Central Electricity Authority publishes the Station Heat Rate (SHR), which is a measure of plant efficiency in Kcal/KWh. In order to calculate the emission factor by the simple OM method, the formula in the numerator is expressed as:

$$\Sigma F_{i,j,y} * COEF_{i,j\,y} = \Sigma \frac{GEN_{j,y}.\ SHR_i}{NCV_i} X\ NCV_i\ X\ EF_{CO2i}\ X\ Oxid_i$$

Or $\Sigma\ GEN_{j,y}.\ (SHR_i\ X\ EF_{CO2i}\ X\ 44/12\ X\ Oxid_i)$

Where,
SHRi is the station heat rate with fuel i
EF_{CO2i} is the emission factor per unit of energy of fuel j and
Oxidi is the oxidation factor for fuel i

The values of SHRi are available from CEA report on Performance Review of Thermal Power Stations 2004-05 Section 13 and Ministry of Power websites.
Values of EF_{CO2i}, Oxidi are available from Revised 1996 IPCC guidelines for Greenhouse Gas Inventories Workbook and Reference Manual for various fuels used in Indian power plants.

STEP 2. Calculate the Build Margin emission factor
The project developer has adopted option 1 (Ex-ante), which requires to calculate the Build Margin emission factor *EFBM,y ex-ante* based on the most recent information available on plants already built for sample group *m* at the time of PDD submission

STEP 3. Baseline Emission Factor
This is in conformance with the guidelines in the section "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM 0002).

Net quantity of electricity supplied to the manufacturing facility by the project (EG_y)
Net units of electricity substituted in the grid (EGy) = (EG_{total} - EG_a)
where
EG_{total}: Total electricity generated
EG_a: Auxiliary Consumption
The details of the baseline calculations have been provided in Annex 3.

Leakage Effects:
No leakage is considered as per the methodology.

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

(Copy this table for each data and parameter)-

Data / Parameter:	**$EF_{OM\ Y}$**
Data unit:	tco_2e/GWh
Description:	**$C0_2$ Operating Margin Emission Factor of the grid**
Source of data used:	Central Electricity Authority Reports.
Value applied:	To calculate the power contributed from waste heat recovery generation system of the CPP.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as option 1 (simple OM) as per the referred methodology ACM 0002. As per ACM0002, the simple OM method can only be used where low-cost must run resources constitutes less then 50% of total grid generation of average of the five most recent years. From the detailed calculations provided in Annex 3, it is inferred that since low cost must run resources in the five most recent years constitutes less then 50% of the total grid, the simple OM method is selected.
Any comment:	Calculated as indicated in the relevant OM baseline methodology. This involves the use of official data released by the power generating company. Quality

	control of this data is beyond the control of the project operators. However, the data, if considered unreasonable, may be supplanted by more accurate data according to methods verified by the DOE

Data / Parameter:	$\mathbf{EF_{BM,Y}}$
Data unit:	tco_2e/GWh
Description:	**CO_2 BM Emission Factor of the grid**
Source of data used:	Central Electricity Authority Reports.
Value applied:	To calculate the power contributed from waste heat recovery generation system of the CPP
Justification of the choice of data or description of measurement methods and procedures actually applied :	Project developer has adopted option 1 (Ex-ante), which requires to calculate the Build Margin emission factor *EFBM,y ex-ante* based on the most recent information available on plants already built for sample group *m* at the time of PDD submission.The sample group m that consists of (b) the power plants capacity additions in the electricity system that comprise 20% of the system generation and that have built most recently is adopted.
Any comment:	This involves the use of official data released by the power generating company. Quality control of this data is beyond the control of the project operators. However, the data, if considered unreasonable, may be supplanted by more accurate data according to methods verified by the DOE

Data / Parameter:	$\mathbf{EF_{Y}}$
Data unit:	tco_2e/GWh
Description:	**Baseline Emission Factor**
Source of data used:	Central Electricity Authority Reports.
Value applied:	To calculate the power contributed from waste heat recovery generation system of the CPP.
Justification of the choice of data or description of measurement methods and procedures actually applied :	The baseline emission factor $EF_{,y}$ is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,\ y}$) and the Build Margin emission factor (EF_{BM},y). The project activity would generate electricity by utilizing the heat content of the waste gas of the sponge iron kiln and displace an equivalent amount of electricity from the grid. The emission reduction resulting from the project activity would depend on the emission factor of the grid mix..
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

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According to the methodology ACM 0004, ***project emissions** are applicable only if auxiliary fuels are fired for generation startup, in emergencies, or to provide additional heat gain before entering the Waste Heat Recovery Boiler.* However, auxiliary fuel firing would not be required for start up and there is no provision for auxiliary fuel firing for additional heat gain of waste gases in the project activity. Thus project emissions are estimated to be zero.

Baseline Emissions are given as:

$BE_{electicity,y} = EG_y * EF_{electricity,y}$
Where,
EG_y = Net quantity of electricity supplied to the manufacturing facility by the project during the year y in MWh, and
$EF_{electricity,y}$ = CO_2 baseline emission factor for the electricity displaced due to the project activity during the year y (tCO_2/MWh)
As per the methodology, if the project displaces the electricity generation by fossil fuel combustion for captive purpose then the baseline scenario is as follows:

The baseline emission factor $EF_{,y}$ is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM, y}$) and the Build Margin emission factor ($EF_{BM,y}$) , where equal weights to them.

$EF_{grid,,y} = 0.5(EF_{OM, y} + EF_{BM, y})$

The project activity is designed to generate gross electricity of 73.086 million units per annum with a PLF of 90% and 360 days of operation. After 10% auxiliary consumption and taking into account production loss due to maintenance of klin, the net electricity available for captive purpose is 59.461 MU per annum.

The baseline emissions are estimated to be 55,131t CO_2 e per year.

Leakage Effects:
No leakage is considered as per the methodology**.**
The emissions reductions from the project activity is given as : BE_y - PE_y -L_y
= 55,131 t CO_2 e per annum.

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

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Year	Estimation of project activity emissions	Estimation of baseline emissions (t CO_2 e)	Estimation of leakage	Estimation of overall emissions reductions
2007	0	55,131	0	55,131
2008	0	55,131	0	55,131
2009	0	55,131	0	55,131
2010	0	55,131	0	55,131
2011	0	55,131	0	55,131
2012	0	55,131	0	55,131
2013	0	55,131	0	55,131

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

B.7.1 Data and parameters monitored:	
(Copy this table for each data and parameter)	
Data / Parameter:	**EG_y**
Data unit:	MWh/day
Description:	**Net Electricity Generation from Project Activity**.
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data holds a significant purpose for determining the baseline emissions and the emissions reductions accruing due to the project activity. This is calculated as the difference between the gross waste heat power generated for a year from the auxiliary power consumption during that year.
Description of measurement methods and procedures to be applied:	This will be measured from the data recorded in the logbooks on a continuous basis. The data will be archived either electronically or in papers and will be available upto two years after the crediting period. The project activity has employed state-of-the-art monitoring and control equipments that will measure, record, report and control the net electricity generated from the project activity. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy. The parameters essential to evaluate the net electricity generation from the WHRBs are: total steam generated from both WHR and AFBC boiler, total steam consumed by TG, Total steam vented in the CPP, flow of WHR steam from common header, effective WHR steam, average temperature and pressure of WHR steam and AFBC steam before common header, average pressure of WHR steam before common header, enthalpy of WHR steam and AFBC steam.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. This data would be used for calculating power contributed from waste heat recovery steam generation system of the CPP.
Any comment:	Meters at plant will automatically measure the data. The data will be recorded in project logbooks.

Data / Parameter:	**E_a**
Data unit:	MWh/day
Description:	**Auxiliary consumption of the power plant**
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data holds a significant purpose for determining the baseline emissions and the emissions reductions accruing due to the project activity.
Description of measurement methods	This will be measured from the data recorded in the logbooks on a continuous basis. The data will be archived either electronically or in papers and will be

and procedures to be applied:	available upto two years after the crediting period. The project activity has employed state-of-the-art monitoring and control equipments that will measure, record, report and control the power used for auxiliary consumption. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. This data would be used for calculating power contributed from waste heat recovery steam generation system of the CPP.
Any comment:	Meters at plant will automatically measure the data. The data will be recorded in project logbooks.

Data / Parameter:	EG_{total}
Data unit:	MWh/day
Description:	**Total Electricity generated by the CPP**
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data holds a significant purpose for determining the baseline emissions and the emissions reductions accruing due to the project activity.
Description of measurement methods and procedures to be applied:	This will be measured from the data recorded in the log books on a continuous basis. The data will be archived either electronically or in papers and will be available upto two years after the crediting period. The project activity has employed state-of-the-art monitoring and control equipments that will measure, record, report and control the power used for measuring the total electricity generated. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. This data would be used for calculating power contributed from waste heat recovery steam generation system of the CPP.
Any comment:	The data will be monitored from flow meters at plant and DCS. Manager in-charge would be responsible for calibration of the meters

Data / Parameter:	S_{gen}
Data unit:	Tonnes/ day
Description:	**Total Steam Generated from both WHR and AFBC boiler**
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data will be used for calculating the effective Waste heat recovery steam flow per day.

Description of measurement methods and procedures to be applied:	This will be measured from the data recorded in the logbooks on a daily basis. The data will be archived either electronically or in papers and will be available upto two years after the crediting period. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. It is a critical parameter that would used to calculate the net / effective WHR steam.
Any comment:	The data will be monitored from flow meters at plant and DCS. Manager in-charge would be responsible for calibration of the meters

Data / Parameter:	S_{cons}
Data unit:	Tonnes/day
Description:	**Total steam consumed by TG**
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data will be used for calculating the effective Waste heat recovery steam flow per day.
Description of measurement methods and procedures to be applied:	This will be measured from the data recorded in the logbooks on a daily basis. The data will be archived either electronically or in papers and will be available upto two years after the crediting period. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. It is a critical parameter that would used to calculate the net / effective WHR steam.
Any comment:	The data will be monitored from flow meters at plant and DCS. Manager in-charge would be responsible for calibration of the meters.

Data / Parameter:	S_{vent}
Data unit:	Tonnes
Description:	**Total steam vented/dumped in the CPP**
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data will be used for calculating the effective Waste heat recovery steam flow per day.
Description of measurement methods and procedures to be	This will be measured from the data recorded in the log books on a daily basis. The data will be archived either electronically or in papers and will be available upto two years after the crediting period. The monitoring and controls is part of

applied:	the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. It is a critical parameter that would used to calculate the net / effective WHR steam.
Any comment:	The data will be calculated on a daily basis.

Data / Parameter:	**S_{WHR}**
Data unit:	Tonnes/day
Description:	**Flow of WHR steam from common header**
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data will be used for calculating the effective Waste heat recovery steam flow per day.
Description of measurement methods and procedures to be applied:	This will be measured from the data recorded in the log books on a daily basis. The data will be archived either electronically or in papers and will be available upto two years after the crediting period. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. It is a critical parameter that would used to calculate the net / effective WHR steam.
Any comment:	The data will be monitored from flow meters at plant and DCS. Manager in-charge would be responsible for calibration of the meters

Data / Parameter:	***S 1***
Data unit:	Tonnes/day
Description:	**Effective WHR Steam**
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data will be used for calculating the effective Waste heat recovery steam flow per day.
Description of measurement methods and procedures to be applied:	This will be calculated (S_{WHR}- S_{vent}) and would be recorded on a daily basis. The data will be archived either electronically or in papers and will be available upto two years after the crediting period. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. It is a critical parameter that would used to calculate the net / effective WHR

	steam.
Any comment:	The data will be calculated on a daily basis.

Data / Parameter:	***T1***
Data unit:	^{0}C
Description:	**Avg. Temp of WHR steam before common header**
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data will be used for calculating the Total Enthalpy from Effective WHR steam.
Description of measurement methods and procedures to be applied:	This will be measured from the data which is recorded continuously in the log books. The data will be archived either electronically or in papers and will be available upto two years after the crediting period. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. This data would be used for calculation of WHR steam parameters.
Any comment:	The data will be monitored from flow meters at plant and DCS. Manager in-charge would be responsible for calibration of the meters .

Data / Parameter:	**P1**
Data unit:	^{0}C
Description:	**Avg. pressure of WHR steam before common header**
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data will be used for calculating the Total Enthalpy from Effective WHR steam.
Description of measurement methods and procedures to be applied:	This will be measured from the data which is recorded continuously in the log books. The data will be archived either electronically or in papers and will be available upto two years after the crediting period. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. This data would be used for calculation of WHR steam parameters
Any comment:	The data will be monitored from flow meters at plant and DCS. Manager in-charge would be responsible for calibration of the meters.

Data / Parameter:	**h1**
Data unit:	Kcal/kg

Description:	**Enthalphy**
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data will be used for calculating the Total Enthalpy from Effective WHR steam.
Description of measurement methods and procedures to be applied:	This will be calculated from steam tables/mollier diagram The data will be archived either electronically or in papers and will be available upto two years after the crediting period. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. This data would be used for calculation of WHR steam parameters
Any comment:	The data will be monitored from flow meters at plant and DCS. Manager in-charge would be responsible for calibration of the meters.

Data / Parameter:	**H1**
Data unit:	Kcal
Description:	**Enthalphy of WHR steam**
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data will be used for calculating the Total Enthalpy from Effective WHR steam.
Description of measurement methods and procedures to be applied:	This will be calculated as S1 x h1. The data will be recorded on daily basis and archived either electronically or in papers and will be available upto two years after the crediting period. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. This data would be used for calculation of WHR steam parameters
Any comment:	The data would be calculated on daily basis.

Data / Parameter:	**T2**
Data unit:	^{0}C
Description:	**Avg. Temp of AFBC steam before common header**
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected	The data will be used for calculating the Total Enthalpy from Effective AFBC steam.

emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	This will be measured from the data which is recorded continuously in the log books. The data would be archived either electronically or in papers and will be available upto two years after the crediting period. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. This data would be used for calculation of FBC steam parameters.
Any comment:	The data will be monitored from flow meters at plant and DCS. Manager in-charge would be responsible for calibration of the meters

Data / Parameter:	**P2**
Data unit:	Kg/cm^2
Description:	**Avg. Pressure of AFBC steam before common header**
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data will be used for calculating the Total Enthalpy from Effective AFBC steam.
Description of measurement methods and procedures to be applied:	This will be measured from the data which is recorded continuously in the log books. The data would be archived either electronically or in papers and will be available upto two years after the crediting period. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. This data would be used for calculation of FBC steam parameters
Any comment:	The data will be monitored from flow meters at plant and DCS. Manager in-charge would be responsible for calibration of the meters

Data / Parameter:	**h2**
Data unit:	Kcal/kg
Description:	**Enthalphy**
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data will be used for calculating the Total Enthalpy from Effective WHR steam.
Description of measurement methods	This will be calculated from steam tables/mollier diagram The data will be archived either electronically or in papers and will be available upto two years

and procedures to be applied:	after the crediting period. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. This data would be used for calculation of FBC steam parameters
Any comment:	The data will be monitored from flow meters at plant and DCS. Manager in-charge would be responsible for calibration of the meters.

Data / Parameter:	***S 2***
Data unit:	Tonnes/day
Description:	**Flow of Steam from common header**
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data will be used for calculating the Total Enthalpy from Effective WHR steam.
Description of measurement methods and procedures to be applied:	This will be calculated and would be recorded on a daily basis. The data will be archived either electronically or in papers and will be available upto two years after the crediting period. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. This data would be used for calculation of FBC steam parameters
Any comment:	The data will be monitored from flow meters at plant and DCS. Manager in-charge would be responsible for calibration of the meters

Data / Parameter:	**H2**
Data unit:	Kcal
Description:	**Enthalphy of AFBC steam**
Source of data to be used:	Project records and log books maintained by the plant authorities.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	The data will be used for calculating the Total Enthalpy from Effective AFBC steam.
Description of measurement methods and procedures to be applied:	This will be calculated as S1 x h1. The data will be recorded on daily basis and archived either electronically or in papers and will be available upto two years after the crediting period. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments are calibrated and marked at regular interval to ensure accuracy.

QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. This data would be used for calculation of FBC steam parameters
Any comment:	The data would be calculated on daily basis.

B.7.2 Description of the monitoring plan:

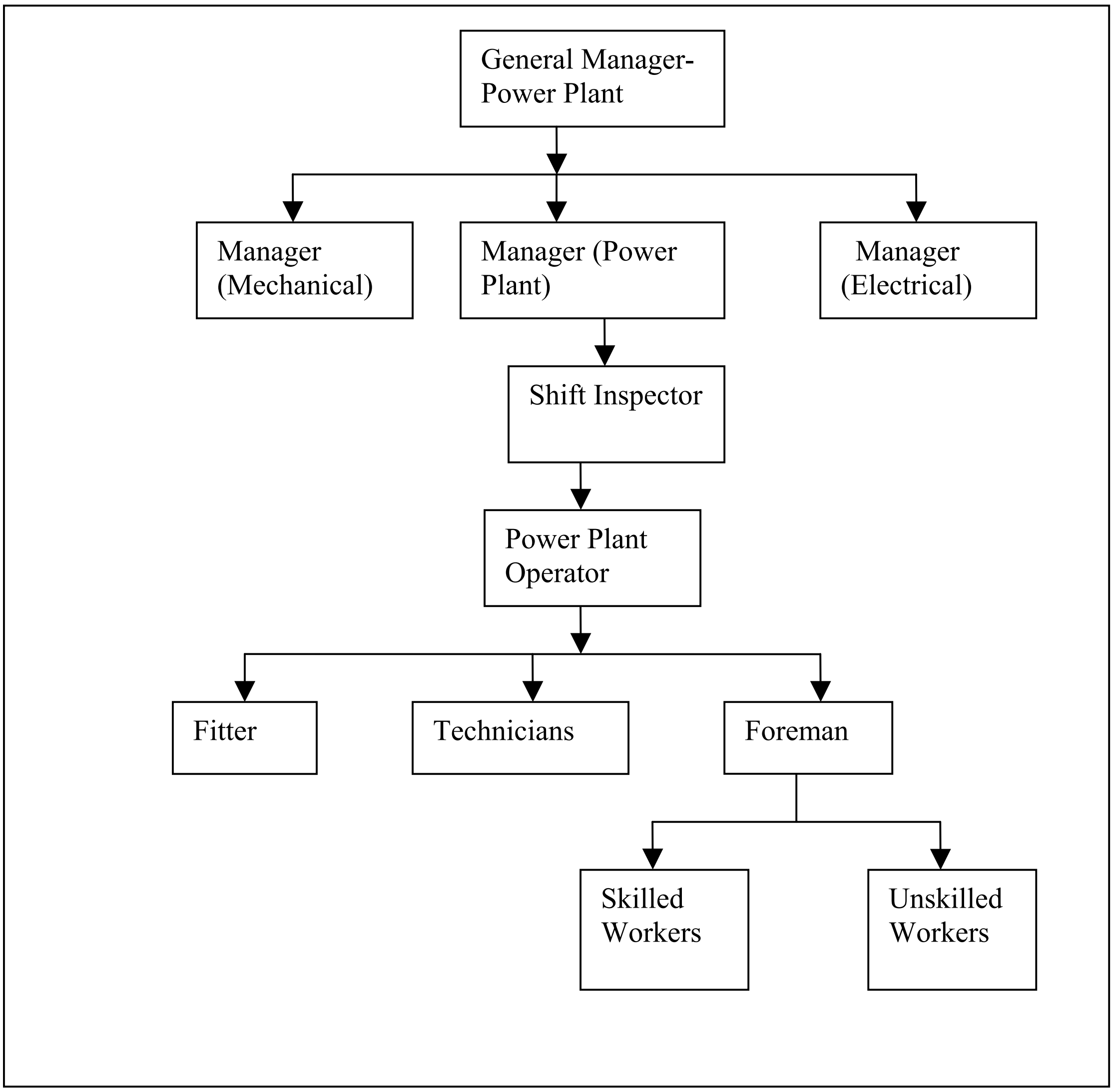
>>
The monitoring of the project activity will be according to the "Consolidated monitoring methodology for waste gas and/or heat and/or pressure for power generation." -ACM0004 /version 02, Sectoral scope: 01, 03 March 2006.

The justification of the choice of the monitoring methodology and how it is applicable to the project activity is as given below:

1. Project activity generates 9.399MW electricity from waste heat, without adding any GHG emission.
2. The 9.399 MW electricity produced by project activity displaces import of electricity from the grid to the plant where the project activity is implemented.
3. The 9.399 MW electricity produced by project activity, displaces electricity generated from fossil fuels based power plants in the electricity grid.
4. There will be no fuel switch after completion of project activity.

The monitoring methodology will essentially aim at measuring and recording through devices, which will enable verification of the emission reductions achieved by the project activity that qualifies as Certified Emission Reductions (CERs). The generation of power, auxiliary consumption, steam generation, steam characteristics [temperature and pressure], flue gas quantity and quality are the essential parameters to be monitored. The methods of monitoring adopted should also qualify as economical, transparent, accurate and reliable. The amount of electrical energy generated and thereby substituted in the grid is directly controlled by the project proponent and will be under the preview of monitoring plan. A detailed monitoring plan is given in Annex 4.

The management of the plant will designate one person to be responsible for the collation of data required to conduct the monitoring plan who will report to the General Manager (GM). The management of the plant will put in place monthly reporting of electricity generation. This data will be part of the management information systems for the power plant. The emission reductions will be calculated monthly, reported back to the management of plant and incorporated into existing management information systems. The organization chart is presented below:



B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

>>
Name of person/ entity determining the baseline: Vikash Metal and Power Ltd.
Detailed contact information of the above is given in Annex 1

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>

01/08/2005

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

>>
30y– 0m

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

C.2.1. Renewable crediting period

Three crediting periods 3 x 7 =21 years

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

>>
01/01/2007

C.2.1.2. Length of the first crediting period:

>>
7y-0m

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
Not applicable

C.2.2.2. Length:

>>
Not applicable

SECTION D. Environmental impacts

>>

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

>>

The Project activity is to produce 9.399 MW power based on waste heat recovery. There are no additional GHG emissions other than the existing GHG emissions in the absence of project activity.

Environmental Impact Analysis:
The waste heat recovery based captive power project would cause an impact on environment in three distinct phases:
During Construction Phase
During Operational Phase and
Maintenance Phase

The impacts envisaged during construction of project activity were:
Impact on Soil Quality
Impact on Air Quality
Impact on Noise Levels

The environmental impact during the construction phase is regarded as temporary or short term and hence does not affect the environment significantly. The impacts that are evident during the operational and maintenance phases are discussed below. All possible environmental aspects for the various project activities have been identified and discussed for their impacts on the baseline environment that prevailed before the project was executed.

The project does not have any adverse impact on environment. The project requires an "approval for installation" from the Pollution Control Board and in each subsequent year, "consent to operate" will also be required from the Pollution Control Board. VMPL has already obtained NOC for Establishment from the West Bengal Pollution Control Board. These approvals will be part of the monitoring programme and will be produced at the time of validation and verification. The unit will only start operating only after obtaining "Consent to Operate" from the West Bengal State Electricity Board along with complete installation of pollution control devices and commissioning of the CPP using waste heat and AFBC boilers.

Sources of Pollution:
The major sources of pollution from the power plant are as follows:

i) Pollutants in the gases emitting from the stack.
ii) Acidic effluents from chemical water treatment plant.

Pollution Control Measures
The various measures proposed to mitigate the impact of the above pollution sources are described below:

Stack Emissions

The exit gases from the kiln, after recovery of the sensible heat in WHRB, will be passed through an ESP to control the dust emissions in to the ambient atmosphere. Provisions for a stack of adequate height and multi-field ESP for dust extraction in the exit gases before entry into the stack will ensure that particulate levels are within the acceptable limits. The exact height of the stack will be determined during the detail engineering stage. Stack emissions would be restricted to less than 100 mg / Nm^3.

Plant Effluents

In the chemical water treatment plant, acidic and alkaline effluents are produced during the generation of cation/anion and mixed bed exchangers. The effluents from the chemical water treatment plant will be led to a properly sized impervious, neutralization pit. Normally these effluents are self neutralizing but provision will be made for dosing lime into the neutralizing pit to ensure the sufficiently high pH value before these effluents are disposed.

The sanitary sewage from ablution blocks etc. will be segregated from industrial waste and routed to the sewage treatment plant through sewage network. The treated effluents will be used for the development of a green belt. The aim of pollution control measures will be to ensure zero discharge such that no effluent is discharged outside the plant boundary.

As mentioned the plant will install an electrostatic precipitator and this will limit particle emissions to less than 100mg/Nm^3. Particle emissions will therefore meet the regulations governing air pollution (Air Prevention and Control of Pollution Act, 1981) and assurances and guarantees have been sought from the manufacturer as to on-going performance of the ESP.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

As per the host party regulations, the Environment Impact Assessment is not required for the project activity. The project activity is not polluting and the impacts associated with the project activity are insignificant. However the project proponent will monitor the environmental impacts and will abate the insignificant impacts.

SECTION E. Stakeholders' comments

>>

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

>> VMPL identifies the following as stakeholders to keep the transparency in the operational activity of the project promoter and thereby meeting local/ environmental regulations. The stakeholders identified are:

1. Ministry of Environment and Forest
2. State pollution control board
3. Local Village Panchayat
4. Project consultants
5. Equipment suppliers

E.2. Summary of the comments received:

>>

Name of the Stakeholder	Summary
Ministry of Environment and Forest	Provides Host country endorsement for the CDM project. VMPL had already been invited by MOEF for the Host Country Approval presentation, DNA on 27th July 2006.
West Bengal Pollution Control Board (WBPCB)	WBPCB, a regulatory body to monitor environmental impacts and environmental management of industries. Accords clearances for setting up of industries in the state after ensuring adherence to the statutory regulations. Also gives consent to start the operation of the project if satisfied with the environmental management and pollution control measures. The project has acquired the necessary clearances from WBPCB.
Local Village Panchayat	Accords permission for setting up of the project under the jurisdiction of the village. The village Panchayat /local elected body of representatives administering the local area is a true representative of the local population in a democracy like India. Hence the public comments received from the village Panchayat / elected body of representatives administering the local area give a proper reflection of the opinions of the local people. The village representative in the Village of Poradiha was also approached.
Project Consultants (Consultancy)	Project consultants were involved in the project activity to take care of various pre-contract and post-contract project activities like preparation of Detailed Project Report (DPR), preparation of basic and detailed engineering documents, preparation of tender documents, selection of vendors / suppliers, and supervision of project implementation.
Equipment Suppliers	Supplied the equipments as per the specifications finalized for the project and are responsible for successful erection & commissioning of the same at the site.

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

>> No comments have been available. The project proponents are awaiting positive feedback for the Waste Heat Recovery Project.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Vikash Metal and Power Limited
Street/P.O.Box:	Chittaranjan Ranjan Avenue
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State/Region:	West Bengal
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FAX:	+91 33 22112154
E-Mail:	**info@vikashmetalpower.com** , **vikashmetal@vsnl.net**
URL:	www.vikashmetalpower.com
Represented by:	
Title:	Director
Salutation:	Mr.
Last Name:	Patni
Middle Name:	
First Name:	Akash
Department:	
Mobile:	91 9831191212
Direct FAX:	
Direct tel:	
Personal E-Mail:	akash@impex-infotech.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding involved in the project activity.

Annex 3

BASELINE INFORMATION

The project activity would generate electricity by utilizing the heat content of the waste gas of the sponge iron kiln and displace an equivalent amount of electricity from the grid. The emission reduction resulting from the project activity would depend on the emission factor of the grid mix. Therefore it is required to select the appropriate grid where an equivalent amount of electricity would be displaced by the electricity generated from the project activity.

Choice of the Grid

Indian power grid system (or the National Grid) is divided into five regional grids namely Northern, North Eastern, Eastern, and Southern and Western Region Grids. The Eastern Regional Grid consists of Bihar, Jharkhand, Orissa, West Bengal and Sikkim sector grids. These states under the regional grid have their own power generating stations as well as centrally shared power-generating stations. While the power generated by own generating stations is fully owned and consumed through the respective state's grid systems, the power generated by central generating stations is shared by more than one state depending on their allocated share. Eastern Region Electricity grid facilitates the share of power generated by the central generating stations.

Eastern regional grid has a total generating capacity of 16477.78 MW[5] as on 03.04.2006, of which private and Central stations has a generating capacity of 8425.14 MW and the balance is being generated by power stations at state level. Thus more than 50% of the generation capacity is coming from the central and private generating stations. As all the states forming part of the Eastern grid are dependent on power allocation from Central generating stations, Eastern region regional grid is considered as the appropriate grid system for the project activity.

As per the methodology, if the project displaces the electricity generation by fossil fuel for the captive purpose then the baseline scenario is **Option b. If baseline scenario is grid power import.**

Emission Factor of the Grid (EFy)

Baseline emission factor of eastern region (EF*y*) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors according to the following three steps.

STEP 1. Calculate the Operating Margin emission factor
STEP 2. Calculate the Build Margin emission factor
STEP 3. Baseline Emission Factor

The baseline emission factor (EF*y*) of the chosen grid is calculated as combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors following the guidelines in

[5] http://powermin.nic.in/generation/generation_state_wise.htm#estern

the section "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM 0002).

Step 1: Calculation of Operating Margin Emission Factor for the region based on Simple OM

As per ACM0002, the simple OM method can only be used where low-cost must run resources constitutes less then 50% of total grid generation of average of the five most recent years.

Fuel	GWh				
	2005	2004	2003	2002	2001
Hydro	8266.6	7297	4479	7828	5809
Thermal	76649.06	68558	59972	55748	53436
Total	84915.66	75855	64451	63576	59245
% of Low Cost must run projects	9.735	9.61	6.94	12.3	9.80
Average of five most recent years of low cost/must run projects constitutes less than 50%					9.684415

Since the average of low cost must run resources in the five most recent years constitutes less then 50% of the total grid, the simple OM method is selected.

The simple OM emission factor ($EF_{OM, simple,y}$) is calculated as the generation-weighted average emissions per electricity unit (tCO_2/MU) of all generating sources serving the system, not including low-operating cost and must-run power plants.

$$EF_{OM, y} = \frac{\Sigma\, F_{i,j,y} * COEF_{i,j\,y}}{\Sigma\, GEN_{j,y}}$$

where *Fi ,j, y* is the amount of fuel *i* (in a mass or volume unit) consumed by relevant power sources *j* in year(s) *y*,
j refers to the power sources delivering electricity to the grid, not including low-operating cost and must run power plants, and including imports to the grid,
COEFi,j y is the CO2 emission coefficient of fuel *i* (tCO2 / mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources *j* and the percent oxidation of the fuel in year(s) *y*, and
GENj,y is the electricity (MWh) delivered to the grid by source *j*.

The fuel consumption in individual plants as required by the above formula is not readily and correctly available. However, Central Electricity Authority publishes the Station Heat Rate (SHR), which is a measure of plant efficiency in Kcal/KWh. In order to calculate the emission factor by the simple OM method, the formula in the numerator is expressed as:

$$\Sigma\, F_{i,j,y} * COEF_{i,j\,y} = \Sigma\, \frac{GEN_{j,y}.\ SHR_i}{NCV_i} \text{ X } NCV_i \text{ X } EF_{CO2i} \text{ X } Oxid_i$$

Or Σ GENj,y. (SHRi X EF_{CO2i} X 44/12 X Oxidi)

Where,
SHRi is the station heat rate with fuel i
EF_{CO2i} is the emission factor per unit of energy of fuel j and
Oxidi is the oxidation factor for fuel i

The values of SHRi are available from CEA report on Performance Review of Thermal Power Stations 2004-05 Section 13 and Ministry of Power websites. Values of EF_{CO2i}, Oxidi are available from Revised 1996 IPCC guidelines for Greenhouse Gas Inventories Workbook and Reference Manual for various fuels used in Indian power plants.

The power generation mix of eastern region comprises of coal based thermal power generation, diesel based thermal power generation and hydropower generation. The actual generation data of entire eastern region was analysed for the years 2003, 2004 and 2005 to arrive at the contribution of the fossil based power plants in the grid.

Source of generation	MU		
	2005	2004	2003
Hydro power generation	8266.6	7297	4479
Coal power generation	76607.74	68552	59965
Diesel power generation	41.32	6	7
Total power generation in the grid	84915.66	75855	64451
% of Hydro power generation	9.74	9.62	6.95
% of thermal power generation	90.26	90.38	93.05
Average % of Hydro in the grid	8.77 % average of three years		

VMPL has therefore adopted the 'Simple OM' method, and the simple OM emission factor is calculated using "A 3-year average statistics"

Fuel	2005	Heat Rate	Carbon Emission Factor (tC/TJ)	Carbondioxide Emission Factor (tCO2e/GWh)	Carbondioxide Emissions (tCO2e)
	GWH	Kcal/KWh			
Hydro	8266.6	0	0	0	0
Coal	76607.74	2429.04	26.2	977	74845762
Diesel	41.32	2062	20.2	639	26403.48
Total	84915.66				74872165

Fuel	2004	Heat Rate	Carbon Emission Factor (tC/TJ)	Carbondioxide Emission Factor (tCO2e/GWh)	Carbondioxide Emissions (tCO2e)
	GWH	Kcal/KWh			
Hydro	7297	0	0	0	0
Coal	68552	2429.04	26.2	977	66975304

Diesel	6	2062	20.2	639	3834
Total	75855				66979138

Fuel	2003 GWH	Heat Rate Kcal/KWh	Carbon Emission Factor (tC/TJ)	Carbondioxide Emission Factor (tCO_2e/GWh)	Carbondioxide Emissions (tCO_2e)
Hydro	4479	0	0	0	0
Coal	59965	2717	26.2	977	58585805
Diesel	7	2062	20.2	639	4473
Total	64451				58590278

Factor	2005	2004	2003
∑ Fi,,j,y x COEF i,,j (tons/year)	74872165	66979138	58590278
∑ GEN i,,j (MU)	76649.06	68558	59972
∑ EF OM,y (tCO_2/yr)	976.8	976.9	976.94
Average ∑ EF OM,y (tCO_2/yr)	976.9		

Step 2: Calculation of Build Margin Emission Factor for the region (ex-ante):

The project developer has adopted option 1 (Ex-ante), which requires to calculate the Build Margin emission factor *EFBM,y ex-ante* based on the most recent information available on plants already built for sample group *m* at the time of PDD submission. The data used to determine the simple BM emission factor (*EFBM,y*)

$$EF_{BM,y} = \frac{\Sigma\, F_{i,m,y} * COEF_{i,m}}{\Sigma\, GEN_{m,y}}$$

where

Fi,m,y, *COEFi,m* are analogous to the variables described for the simple OM method above for plants *m*.

A	20% of state grid (MU)	16983.13
B	Plants meeting 20% (MU)	17005.81
C	Last Five Plants Total (MU)	8936.8

For the VMPL project, the sample group m that consists of (b) the power plants capacity additions in the electricity system that comprise 20% of the system generation and that have built most recently is adopted. Below is a list of power plants that comprises 20% of the system generation and which are built most recently.

Power Stations	Installed capacity MW	Fuel	Generation GWh 2005	Emissions tCO2 2005	Year of Commission
Talcher STPS	500	Coal-3E	3317	3618963	2003
Talcher STPS	500	Coal-3E	3317	3618963	2003
Chandil	2 x 4	Hydro	0	0	2002
Bakreswar	210	Coal 1D	1590	1734745	2001
Upper Indravati	150	Hydro	2851.3	0	2001
Upper Indravati	150	Hydro		0	2000
Upper Indravati	150	Hydro		0	1999
Upper Indravati	150	Hydro		0	1999
Bakreswar	210	Coal 1D	991	1081216	2000
Teesta	7.5 x 3	Hydro	107.87	0	1999
Teesta	7.5 x 3	Hydro		0	1998
Teesta	7.5 x 3	Hydro		0	1997
Bakreswar	210	Coal 1D	1597	1742383	1999
Mejia	210	Coal 3E	1583	1727108	1999
Rangit	3 x 20	Hydro	369.64	0	1999
Tenguhat	210	Coal 1D	0	0	1998
Mejia	210	Coal 3E	1282	1398707	1998
E.G. canal	5	Hydro		0	1997
Budge Budge	500	Coal 1D	3784.46	4128978	1997

∑ Fi,,j,y x COEF i,,j (tons/year)	14922084
∑ GEN i,,j (MU)	17005.81
∑ EF BM,y (tCO2/yr)	877.47

Step 3 Baseline Emission Factor ($EF_{,y}$)

The baseline emission factor $EF_{,y}$ is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,\ y}$) and the Build Margin emission factor (*EFBM,y*) , where the weights W_{OM} and W_{BM}, by default, are 50% and $EF_{OM,,y}$ and EF*BM,y* are calculated as described in steps 1 and 2 above and are expressed in tCO_2/MU.

$EF_{grid,,y} = 0.5(EF_{OM,\ y} + EF_{BM,\ y})$

∑ EF BM,y	877.47 tCO2e/ GWh
∑ EF OM,y	976.91 tCO2e/ GWh
∑ EFy (Avg of OM &BM)	**927.19 tCO2e/Gwh**

Annex 4

MONITORING INFORMATION

VMPL's 9.399 MW Captive Power Plant consists of four 10 TPH Waste Heat Recovery Boilers that utilizes waste heat from sponge iron kilns as energy source, a 15 TPH Fluidized Bed Combustion (FBC) Boiler that uses coal rejects (coal char and coal fines) from sponge iron process as fuel, a common steam header and a 10MW turbo generator (TG) set as shown in figure below. WHRB is installed by VMPL to improve the energy efficiency of the production process and AFBC is installed to avoid the pollution problems associated with disposal of coal rejects as required by pollution control norms.

The Steam parameters of pressure and temperature from both WHR and FBC boilers are the same i.e. 66 kg/cm^2 and 485± 5ºC. The working parameters of various equipments and location of Steam Flow meters, pressure and temperature gauges are as indicated in the figure. As working steam parameters of pressure and temperature are identical for both the boilers, the only dependent variable for calculation of waste heat power would be the steam flow from respective boilers. However, to maintain transparency in calculating WHR power following monitoring methodology is used.

1. Vent Steam/steam dumping: To maintain the design pressure (66kg/cm2) in the common header, some quantity of steam generated from both WHR and AFBC is vented (or dumped) out intermittently. Vent position is after the location of flow meters in the steam mains pipes from boilers (see figure). Since the quantity of vent steam from respective boilers is not measured in the site, to arrive at a conservative estimate for project purpose it is assumed to be entirely coming from WHR boiler alone (most conservative estimate). The total vent steam is calculated as the difference of total steam generated (from both WHR and FBC) and the total steam consumed in the TG sets. The total vent steam quantity in tonnes per day is subtracted from WHR steam to get the value of Effective WHR steam.

   i.e, S_{vent} = (Total steam generated in both WHR and FBC) – (Total Steam Consumed in TG)

2. Calculation of Waste Heat Power: The waste heat power generated is calculated thermodynamically on the basis of Total Enthalpy (steam enthalpy per unit x steam flow) of Effective WHR steam as a percentage of Total Enthalpy of Steam fed to the common header from both WHR and FBC.

The calculation is shown as follows:
Total Enthalpy of Steam from WHRB in kCal (H1)
= (Enthalpy of steam at boiler outlet in kCal/kg) x (Effective WHR steam flow in tonnes per day)
= h1 x S1

The enthalpy of steam is calculated based on average temperature and pressure readings for the day and Effective WHR steam flow per day.

Similarly Total Enthalpy of Steam from FBC in kCal (H2)
= Enthalpy of steam at boiler outlet in kCal/kg x steam flow in tonnes per day
= h2 x S2

The enthalpy of steam is calculated based on average temperature and pressure readings for the day and steam flow from the FBC outlet steam flow meter.

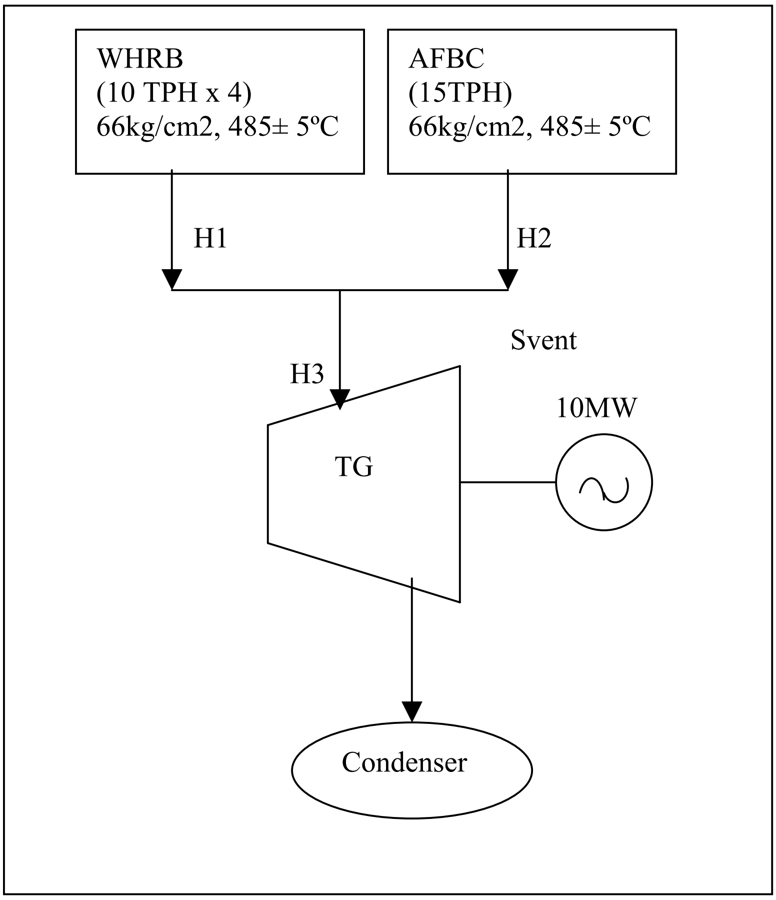
If EG_{CPP} is the Total Power generated by the CPP per day (in MWh) then Power Generated by Waste heat Recovery Boiler (EG_{GEN}) would be calculated as

EG_{GEN} (MWh) = EG_{CPP} x (H1)/ (H1 + H2) …………1

Again, if Auxiliary Consumption for the CPP per day is $EG_{AUX\ CPP}$ (in MWh), then WHRB Auxiliary Consumption (EG_{AUX}) will also calculated in the same ratio as

EG_{AUX} (MWh) = $EG_{AUX\ CPP}$ x (H1)/ (H1 + H2) ……….2

Therefore Net Generation from Waste heat Recovery i.e., Project activity (1 – 2)
EGy (MWh) = (EG_{GEN} - EG_{AUX}) ……………3



The following are the parameters to evaluate the net electricity generation from the WHRB of the captive power plant, along with the sources of emissions mentioned in section D needed to be monitored:

- Total steam generated from both WHR and AFBC boiler

- Total steam consumed by TG
- Total steam vented in the CPP
- Flow of WHR steam from common header
- Effective WHR steam
- Average temperature and pressure of WHR steam and AFBC steam before common header
- Average pressure of WHR steam before common header
- Enthalpy of WHR steam and AFBC steam

- - - - -