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:

Power generation by utilizing Blast Furnace Gas at Mukand Limited, Ginigera, Karnataka

Version: 07

Date : 27/08/2011

A.2. Description of the project activity:

Mukand Limited belongs to the Bajaj Group of Companies-one of the most dynamic business groups in India. Its leadership in steel technology is built upon a long history of pioneering, sustained in-house research and development and continuous adoption of advanced technologies. Mukand Limited in association with Kalyani Steels Limited has entered into a Joint Venture in the name of Hospet Steels Limited for production of special and alloy steel through Mini Blast Furnace and Energy Optimising Furnace route. In order to expand the steel production capacity, a new Mini Blast Furnace (*i.e.* MBF-3) has been installed in their manufacturing facility at Ginigera in Koppal District of Karnataka. The Blast Furnace Gas (BFG), generated from the operation of MBF-3, is passed through a Gas Cleaning Plant (GCP) for dust removal. A part of the clean gas is consumed in the Hot Blast Stoves for supplying hot blast for MBF-3 operation. The surplus BFG does not have any consumption in the steel plant and would have been flared under normal operational conditions. The project activity, undertaken by Mukand Limited, entails utilization of the surplus BFG for power generation. The electricity thus generated will be consumed in-house for catering to the electrical energy requirement of the steel plant and will, therefore, replace the import of an equivalent quantum of electrical energy from the Southern Regional Grid[1]. The objectives of the project activity can therefore be summarized as:

- Recovery of the surplus BFG thereby preventing the wastage of useful energy
- Utilization of the surplus BFG for generation of steam and subsequently power
- Catering to the electrical energy requirement of the steel plant

The project activity power plant will also have the provision for Furnace Oil firing as back up fuel to supplement the heat content of the surplus BFG. With 350 days of annual operation of the power plant, there will be a net generation of around 94779 MWh of electrical energy which will replace an equivalent amount of electrical energy import from the Southern Regional Grid. However there will be a consumption of around 4123 tonnes of Furnace Oil per annum along with the surplus BFG

[1] Please refer to Section B.4 for details on selection of baseline scenario.

in the project activity power plant. Apart from Furnace Oil a small quantity of LPG shall be used for pilot flame in boiler. Considering both the aspect of replacement of power from Southern Regional Grid through generation of power in-house with surplus BFG as will as Furnace Oil consumption, the project activity will lead to an emission reduction of around 71,581 tCO_2 per annum. Therefore over the entire crediting period of ten years, the project activity is expected to result in emission reductions to the tune of around 7,15,810 tCO_2.

The project activity will also lead to sustainable development of the host country-India. The sustainability aspect of the project activity is elaborated below:

Table A-1: Project Activity's Contribution to Sustainable Development of the Host Country-India	
Social Well-being	The project activity will provide employment opportunities to rural people in the vicinity of the project activity site. It will also develop skilled manpower through training and will also hire skilled man power required for its implementation and operation. In its life cycle, the project activity will also provide business opportunities to the local people. Thus the project activity will help improve prosperity and social well-being.
Technological Well-being	The project activity aims at utilization of the surplus BFG generated from MBF-3 which otherwise would have been flared. Thus, the project activity conceptualizes a technology which will lead to effective utilization of waste energy for power generation. Successful implementation of the project activity will have lot of replication potential in similar sector. With more and more such project activities, the dependency on grid power would reduce significantly which in turn would lead to reduction in the power deficit scenario of the host country-India.
Economical Well-being	The project activity will lead to employment opportunities and business scopes for local people thereby improving the local economical structure. Furthermore power is considered to be an essential component for India's economic growth and India is currently going through a power crisis situation. The project activity will reduce the dependency of the project proponent on grid power thereby making grid power available for other important applications. This will lead to national economical development.
Environmental Well-being	The project activity entails generation of power with surplus BFG which otherwise would have been flared. This will replace generation of an equivalent power at the grid and its associated emissions (SO_x, NO_x and Suspended Particulate Matters). Furthermore this will lead to reduction in CO_2 emissions from grid power generation thereby mitigating global warming.

A.3. Project participants:

Name of the 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)
India (Host Party)	Mukand Limited (Private Entity)	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party (ies):

India

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

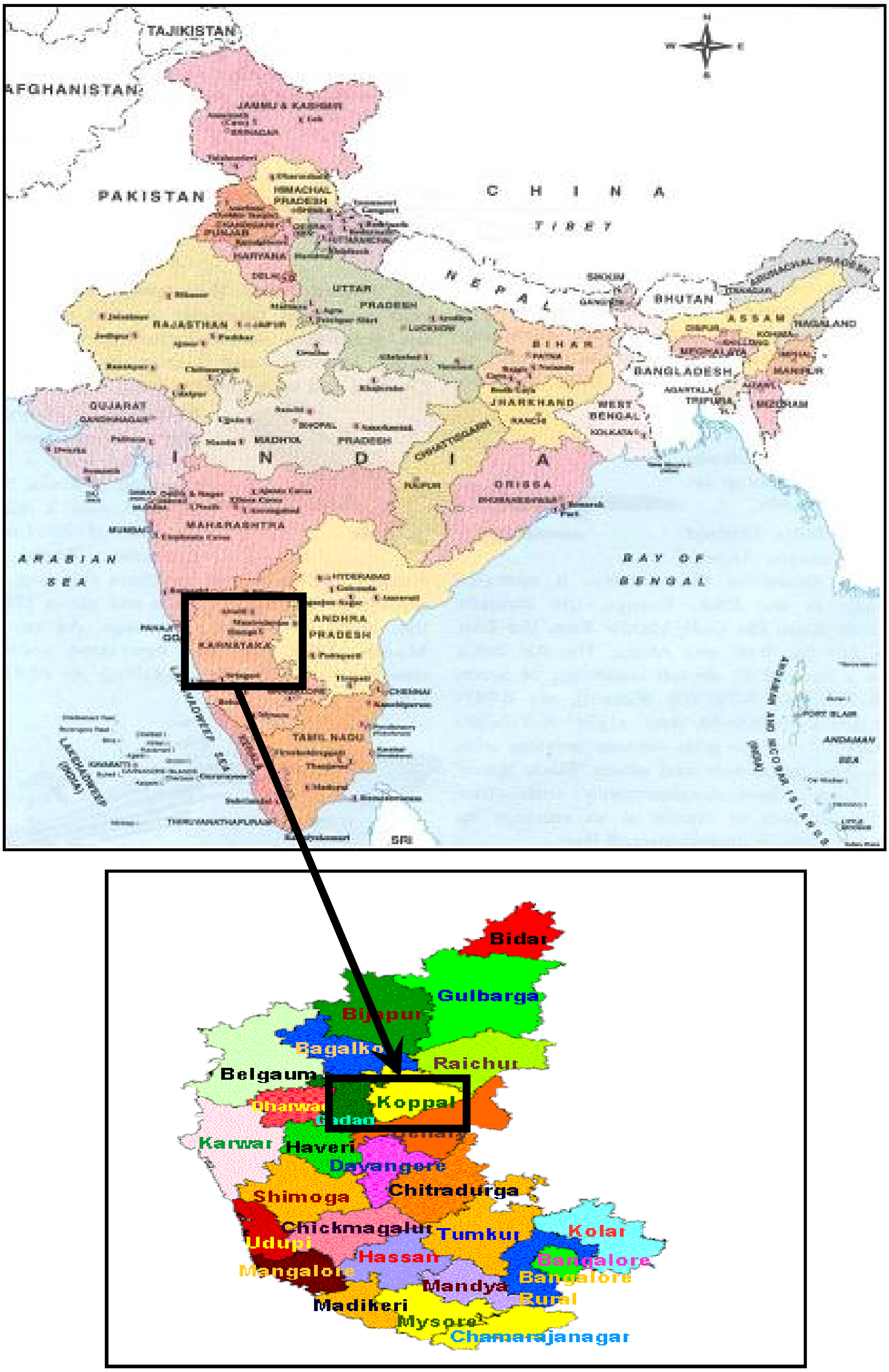
Karnataka

A.4.1.3. City/Town/Community etc:

Ginigera, District Koppal

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

The project activity will be implemented within the steel plant premise of Mukand Limited. The steel plant is located at Hospet, Koppal Road, Ginigera-538 228, Taluka and District: Koppal, Karnataka. The site is located at 15°20’11” N Latitude and 76°15’00” E Longitude. The plant is very well connected by road, rail and airways. The nearest railway station is at Ginigera at a distance of 1 km and the airport is located at Hubli, which is about 130 km away from the project site. National highways NH-13 and NH-63 are the connecting roadways to the plant.


TAJIKISTAN
AFGHANISTAN
PAKISTAN
C H I N A
T I B E T
N E P A L
BHUTAN
BANGLADESH
I N D I A
ARABIAN SEA
BAY OF BENGAL
JAMMU & KASHMIR
HIMACHAL PRADESH
PUNJAB
HARYANA
UTTAR PRADESH
RAJASTHAN
GUJARAT
MADHYA PRADESH
BIHAR
JHARKHAND
WEST BENGAL
ORISSA
MAHARASHTRA
ANDHRA PRADESH
KARNATAKA
TAMIL NADU
ASSAM
NAGALAND
Bidar
Gulbarga
Bijapur
Bagalkot
Raichur
Belgaum
Dharwad
Koppal
Gadag
Karwar
Haveri
Davangere
Shimoga
Chitradurga
Chickmagalur
Tumkur
Kolar
Udupi
Hassan
Bangalore
Mangalore
Mandya
Bangalore Rural
Madikeri
Mysore
Chamarajanagar

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

The project activity comes under the following Sectoral scopes:

- Sectoral Scope -(1) Energy industries (renewable / non-renewable) and
- Sectoral Scope -(4) Manufacturing industries

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

The project activity is based upon the concept of effective utilization of waste energy for generation of power. The surplus Blast Furnace Gas (BFG) of MBF-3 will be utilized for the purpose of generation electrical energy under the project activity. Under normal operational condition, Blast Furnace Gas (BFG) generated from MBF-3 will be first sent to the Gas Cleaning Plant (GCP) for dust removal. A part of the clean gas, emanating from the Gas Cleaning Plant (GCP), will be directed to the Hot Blast Stoves for supplying hot blast for MBF-3 operation. The surplus BFG has no utilization in the steel plant and would have been flared. In the process, the thermal energy content of the surplus BFG would have been lost. Power, equivalent to that generated in the project activity, would have been sourced from the Southern Regional Grid[2]. However the project activity will entail utilization of the surplus BFG in a boiler for generation of steam which will subsequently be fed into a Steam-Turbo Generator (STG) set for power generation. The boiler will also have a provision for firing of Furnace Oil (FO) as a back up fuel to supplement the energy content of the surplus BFG. The power thus generated will be consumed in-house in the steel plant and will therefore replace an equivalent power import from the Southern Regional Grid.

The power generation technology to be implemented will be based on Rankine Cycle. Surplus BFG will be fired in the boiler as the primary fuel. BFG, being a lean gas and subject to process fluctuations at the upstream end (*i.e.* MBF-3), Furnace Oil will also be fired as a secondary fuel to supplement the energy content of BFG. Demineralised water will be supplied from the existing De-Mineralised (DM) Water Plant. A new transfer line will be erected for this purpose. However, a new Reverse Osmosis (RO) plant will be constructed for the proposed power plant. De-Mineralized (DM) Water in the boiler drum will be converted into high pressure steam which will subsequently be expanded in the Steam Turbine. The turbine will be coupled with the Turbo-Generator and Alternator which can generate up to 15 MW of power. The power plant operation will be monitored

[2] Please refer to Section B.4 for details on selection of baseline scenario.

through a Programmable Logic Control (PLC) system. The technical specifications of the Boiler and the Steam-Turbo Generator (STG) set are provided below:

Table-A.2. Technical Specifications of Boiler

Parameter	Details
Number of Boilers	One
Type	BF Gas/FO fired water tube boiler, bottom supported, bi-drum, non-reheat, naturally circulated, outdoor type unit.
Life of Boiler	More than 15 years
Steam output from boiler at outlet of main steam stop valve	55 tph
Superheated steam pressure at outlet of M.S. stop valve	67 kg/cm^2
Superheated steam temperature at outlet of MS stop valve	485 ± 5°C
Feed Water temperature at Economiser inlet	145°C
Flue Gas temperature leaving air heater	140°C
Boiler Efficiency	86.1% (With 100% BF Gas firing) 87.9% (With 100% FO firing)

Table-A.3. Technical Specifications of Steam Turbine	
Parameter	**Details (100% load)**
Quantity	One
Installation	Indoor
Model of Steam Turbine	N15-6.275
Rated Power	15 MW
Rated Revolution	3000r/min
Hand of Rotation	CKW, seeing in the direction of steam flow
Rated Inlet Pressure	64 ata
Rated Inlet Temperature	480°C
Inlet steam flow (excluding ejector, GSC steam consumption)	60.9 tph
Exhaust pressure at rated condition	0.0098 ata
Layout manner	Double-tier
Stage number for Feed-Water Regenerative Heating	1 Deaerator + 1 LP Heater
Feed Water temperature at Deaerator outlet	145 °C
Guaranteed steam rate under rated condition	4.06 kg/kWh
Guaranteed Heat Rate under rated condition	11209 kJ/kWh
Vibration amplitude at rated speed	≤0.03mm (Double amplitudes)
Vibration amplitude at critical speed	≤0.15mm (Double amplitudes)
Elevation of operating floor	8m
Speed variation	±10%
Speed regulation	4.5%, adjustable
Insensitivity of speed governing	≤0.50%
Trip speed	3300-3360rpm
Expected lifespan of turbine	More than 15 years, subjected to proper operation and maintenance.

Table-A.4: Technical Specifications of Generator	
Parameter	**Details**
Mode of Generator	QF-15
Rated Power	15 MW
Rated Speed	3000r/min
Voltage at Generator Terminals	11 KV±10%
Rated Current	984.15 A
Frequency	50Hz ±5%
Power Factor	0.8 (lagging)
Poles	2
Phases	3
Excitation type	Brushless
Efficiency	97.4 %
Type of Generator Cooling	CACW
Connection of phases	Star
Insulation Class	Resin Rich
Temperature Rise	B Class

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

Years	Annual estimation of emission reductions in tonnes of CO_2e
Year 1	71,581
Year 2	71,581
Year 3	71,581
Year 4	71,581
Year 5	71,581
Year 6	71,581
Year 7	71,581
Year 8	71,581
Year 9	71,581
Year 10	71,581
Total estimated reductions (tonnes of CO_2 e)	**7,15,810**
Total number of crediting years	**10**
Annual average over the crediting period of estimated reductions ((tonnes of CO_2 e)	**71,581**

A.4.5. Public funding of the project activity:

No public funding from parties included in Annex-I 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:

Title: Consolidated baseline methodology for GHG emission reductions from waste energy recovery projects

Reference: Approved consolidated baseline methodology ACM0012/Version 03.2, Sectoral Scope 01 and 04, EB 51

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

As per the applicability conditions of the Approved Consolidated Baseline Methodology-ACM0012/Version 03.2, the same is applicable for the following type of project activities:

"Type-1: All the waste energy in identified WECM stream/s that will be utilized in the project activity is, or would be flared or released to atmosphere in the absence of the project activity at the existing or new facility. The waste energy is an energy source for:

- *Cogeneration; or*
- *Generation of electricity; or*
- *Direct use as process heat source; or*
- *For generation of heat in element process (e.g. steam, hot water, hot oil, hot air); or*
- *For generation of mechanical energy"*

The project activity under consideration entails utilization of the thermal energy content of the surplus BFG (*i.e.* the Waste Energy Carrying Medium-WECM), emanating from the newly commissioned MBF-3, for generation of electricity. In absence of the project activity, the surplus BFG would have been flared thereby wasting its energy content. Therefore the project activity falls under Type-1 category of the Approved Consolidated Methodology-ACM0012/Version 03.2.

Apart from the above applicability conditions, the project activity is also required to meet the following applicability conditions in order to apply the methodology:

"If the project activity is based on the use of waste pressure to generate electricity, electricity generated using waste pressure should be measurable"

The project activity does not involve use of waste pressure to generate electricity. Therefore this condition is not applicable for the project activity under consideration.

"Energy generated in the project activity may be used within the industrial facility or exported outside the industrial facility"

The net electricity generated from the project activity will be wholly used to meet the in-house power requirement of the integrated steel plant of Mukand Limited and Kalyani Steels Limited.

"The electricity generated in the project activity may be exported to the grid or used for captive purposes"

As stated above, the net electricity generated from the project activity will be wholly used to meet the in-house power requirement *i.e.* wholly consumed for captive purpose.

"Energy in the project activity can be generated by the owner of the industrial facility producing the waste energy or by a third party (e.g. ESCO) within the industrial facility."

Surplus BFG will be generated from the operation of MBF-3 within the steel plant premise of Mukand Limited. The same will be utilized for power generation by the integrated steel plant of Mukand Limited and Kalyani Steels Limited within the same industrial facility.

"Regulations do not constrain the industrial facility that generates waste energy from using the fossil fuels being used prior to the implementation of the project activity"

There is no national or state-level regulation(s) or any legal mandate that would have prevented Mukand Limited from using fossil fuel for electricity generation or procuring electricity directly from the grid.

"The methodology covers both new and existing facilities. For existing facilities, the methodology applies to existing capacity. If capacity expansion is planned, the added capacity must be treated as a new facility."

The project activity will been undertaken in the existing facility and the waste gas, used in the project activity, is emitted from the existing MBF-3.

"The emission reductions are claimed by the generator of energy using waste energy"

The project activity of power generation with the surplus BFG will be undertaken by Mukand Limited and the emission reduction credits will be claimed only by Mukand Limited *i.e.* generator of energy (electricity) using waste energy.

"In cases where the energy is exported to other facilities, an official agreement exists between the owners of the project energy generation plant (henceforth referred to as generator, unless specified otherwise) with the recipient plant(s) that the emission reductions would not be claimed by recipient plant(s) for using a zero-emission energy source."

Mukand Limited is implementing the project activity to utilize the thermal energy content of the surplus BFG generated from MBF-3 for generation of power. The emission reduction credits will solely be claimed by the project proponent *i.e.* Mukand Limited. Furthermore the entire power generated by the project activity will be consumed within the facility without any export of power. Therefore there will be no other consumer who can claim for any emission reduction credits for using zero-emission electrical energy sources.

"*For those facilities and recipients, included in the project boundary, which prior to implementation of the project activity (current situation) generated energy on-site (sources of energy in the baseline), the credits can be claimed for minimum of the following time periods:*

(a) The remaining lifetime of equipments currently being used; and

(b) Credit period"

Mukand Limited is not involved with power generation before the implementation of the project activity. The project activity will be implemented at existing MBF-3. Therefore this condition is not applicable for the project activity under consideration. However all the equipments to be installed under the project activity will have a minimum lifetime of 15 years or more and the project proponent will claim the emission reduction credits for a fixed crediting period of 10 years.

"Waste energy that is released under abnormal operation (for example, emergencies, shut down) of the plant shall not be accounted for."

The project proponent will not consider waste gas that will be released under abnormal operation (emergencies, shut down) of the plant for estimation of emission reductions.

Demonstration of use of waste energy in absence of CDM project activity

As per the requirement of the methodology, for Type-1 project activities:

"It shall be demonstrated that the waste energy utilized in the project activity was flared or released into the atmosphere (or wasted in case of project activity recovering waste pressure) in the absence of the project activity at the existing facility."

The surplus BFG of MBF-3, to be utilized in the project activity, does not have any other utilization in the steel plant. During the period of April 2008 – November 2008 the waste gas from MBF-3 was being utilized in an adjacent power plant of 9 MW capacity owned by Kalyani Steel Limited. This temporary measure was taken due to low/nil utilization of MBF-1 & MBF-2 due to the market scenario. However during the validation, DOE has confirmed that the waste gas available from MBF-1 & MBF-2 is sufficient to cater to the waste gas requirement of the 9 MW Power plant owned by KSL.

Therefore the project activity under consideration meets all the applicability conditions of the Approved Consolidated Methodology-ACM0012/Version 03.2. This justifies the appropriateness of the choice of the methodology in view of the above project activity.

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

As per the methodology, the geographical extent of the project boundary shall include:

"1. The industrial facility where waste energy is generated, including the part of the industrial facility where the waste gas was utilized for generation of captive electricity prior to implementation of the project activity;

2. The facility where process heat in the element process/steam/electricity/mechanical energy is generated (generator of process heat/steam/electricity/mechanical energy). Equipment providing auxiliary heat to the waste energy recovery process shall be included within the project boundary; and

3. The facility (ies) where the process heat in element process/steam/electricity/mechanical energy is used (the recipient plant(s)) and/or grid where electricity is exported, if applicable."

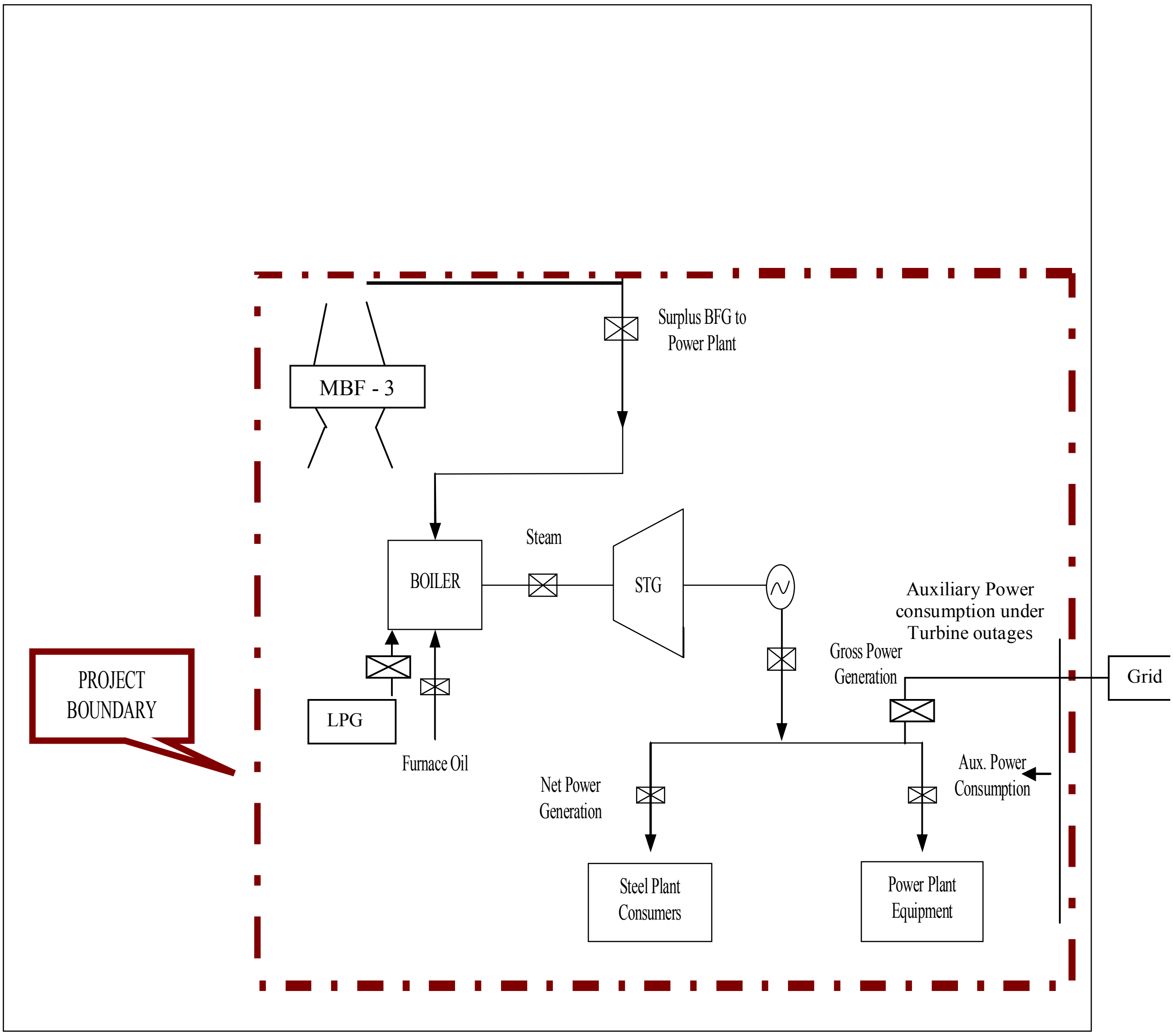
In accordance with methodology, the project boundary includes:

1. The source of waste gas *i.e.* MBF – 3 and the ducting systems for transportation of the surplus BFG from MBF-3 to the boiler of the proposed power plant;

2. The power plant equipments where the thermal energy content of the surplus BFG will be utilized for generation steam and subsequently power. This will also include the equipment required to cater to the auxiliary power demand of the power plant; and

3. The integrated steel plant where the electricity will be consumed.

The following figure provides a diagrammatic representation of the project boundary:



In accordance with the methodology, the following emission sources are considered for determination of baseline emissions, project emissions and emission reductions resulting from the project activity:

Table B-1: Overview on emission sources included in or excluded from the project boundary				
	Source	Gas	Included	Justification/ Explanation
Baseline	Electricity generation, grid or captive source	CO_2	Included	Main emission source.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Fossil fuel consumption in boiler for thermal energy	CO_2	Excluded	Not applicable since the project activity will not cater to the thermal energy requirement of the steel plant. *(Please refer to Section B.4 of this PDD)*.
		CH_4	Excluded	
		N_2O	Excluded	
	Fossil fuel consumption in cogeneration plant	CO_2	Excluded	Not applicable since the project activity does not entail installation of a cogeneration plant. *(Please refer to Section B.4 of this PDD)*.
		CH_4	Excluded	
		N_2O	Excluded	
	Baseline emissions from generation of steam used in the flaring process, if any	CO_2	Excluded	Not applicable since there is no steam requirement in the flaring process of surplus BFG. *(Please refer to Section B.4 of this PDD)*.
		CH_4	Excluded	
		N_2O	Excluded	
Project Activity	Supplemental fossil fuel consumption at the project plant	CO_2	Included	There will be provision for auxiliary/supplementary fuel firing within the project boundary. Furnace Oil will be fired as back up fuel to supplement the heat content of the surplus BFG and LPG shall be used for pilot flame in boiler. FO and LPG consumption will be monitored during the proposed crediting period and emissions reduction from the project activity will be determined considering the emissions from these fuels.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
	Supplemental electricity consumption	CO_2	Included	Under normal operational condition, the auxiliary power requirement of the power plant equipments will be catered from the project activity power plant. However under circumstances of turbine outages in the project activity power plant, the auxiliary power requirement of the power plant equipments will be catered from the grid and the same will only be accounted as supplemental electricity consumption in the project scenario.
		CH_4	Excluded	
		N_2O	Excluded	
	Electricity import to replace captive electricity, which was generated using waste gas in absence of project activity	CO_2	Excluded	Not applicable since there is no electricity generation by capturing partially the surplus BFG of MBF-3 before the implementation of the project activity.
		CH_4	Excluded	
		N_2O	Excluded	
	Project emissions from cleaning of gas	CO_2	Excluded	No additional cleaning of surplus BFG will be required in the project scenario than that in the baseline scenario. Therefore there will not be any additional energy consumption due to cleaning of surplus BFG in the project scenario. Hence there will not be any additional emissions.
		CH_4	Excluded	
		N_2O	Excluded	

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

The methodology requires the project proponent to identify all the realistic and credible alternatives available to Mukand Limited in absence of the project activity. Realistic and credible alternatives have been identified individually for:

- Waste energy use in the absence of the project activity
- Power generation in the absence of the project activity

Alternatives for steam/heat generation and mechanical energy generation in the absence of the project activity have not been considered since the project activity will not involve generation of steam/heat and mechanical energy.

In accordance with the guidance of the methodology, the project proponent has excluded alternatives that

- Do not comply with legal and regulatory requirements; or
- Depend on fuels (used for generation of power) that are not available at the project site

The following section will elaborate on selection of baseline scenario for the project activity under consideration:

Step-1: Define the most plausible baseline scenario for the generation of heat and electricity using the following baseline options and combinations[3]

As per the methodology, ACM0012/Version 03.2,

"The baseline candidates should be considered for following facilities:

- *For the industrial facility where the waste energy is generated; and*
- *For the facility where the energy is produced; and*
- *For the facility where the energy is consumed"*

The project proponent has identified and evaluated all the realistic and credible alternatives for utilisation of the thermal energy content of the surplus BFG and generation of power. The analysis of all the alternatives has been presented below:

[3] The project activity does not entail generation of steam/heat or mechanical energy. Therefore realistic and credible alternatives for generation of heat energy in absence of the project activity have not been considered.

Table-B.2: Potential Alternatives for Waste Energy Utilization and Power Generation			
Option	Description	Credibility	Conclusion
Waste Energy Utilization			
W1	WECM[4] is directly vented to atmosphere without incineration or waste heat is released to the atmosphere or waste pressure energy is not utilized	As per the legal requirement, the surplus BFG is required to be combusted completely before the same can be discharged into the atmosphere. Therefore direct venting of the surplus BFG to the atmosphere without incineration is not a feasible option for the project proponent in absence of the project activity.	Cannot be a part of the baseline
W2	WECM is released to the atmosphere (for example after incineration) or waste heat is released to the atmosphere or waste pressure energy is not utilized	In absence of the project activity, the project proponent will flare (*i.e.* releasing after complete combustion) the surplus BFG into the atmosphere. In such a situation, the entire thermal energy content of the surplus BFG would have been lost to the atmosphere. This alternative is in compliance with all the legal and regulatory requirements and can be a part of the baseline. Therefore this alternative is considered further for determination of baseline scenario for the project activity under consideration.	May be a part of the baseline
W3	Waste energy is sold as an energy source	This alternative cannot be considered as a realistic and credible alternative for the project proponent in absence of the project activity. There is no potential purchaser for the surplus BFG in the near vicinity. Furthermore, BFG being a poisonous gas because of its high CO concentration, transportation of the same over a long distance poses high risk. Moreover BFG is a colourless, odourless and low-pressure gas and hence identification of leakage in the gas transportation line will be extremely difficult. Therefore transportation of surplus BFG over a long distance is not technically feasible.	Cannot be a part of the baseline
W4	Waste energy is used for meeting energy demand	The surplus BFG from MBF-3 cannot be used in the reheating furnace of the integrated steel plant. The existing reheating furnace uses furnace oil and the costs for conversion for usage of BFG would entail significant design changes owing to (i) the differences in calorific value of the furnace oil and BFG (ii) Space constraints in the existing integrated steel plant and (iii) ducting challenges given the existing site layout. However, the surplus BFG from MBF-3 could have been utilized entirely	May be a part of the baseline

[4] Waste Energy Carrying Medium.

Table-B.2: Potential Alternatives for Waste Energy Utilization and Power Generation			
Option	Description	Credibility	Conclusion
		to meet the electrical energy requirement of the integrated steel plant. This alternative (*i.e.* power generation with the surplus BFG of MBF-3) is in compliance with all the legal and regulatory requirements and can be a part of the baseline. Therefore this alternative is considered further for determination of baseline scenario for the project activity under consideration.	
W5	A portion of the waste gas produced at the facility is captured and used for captive electricity generation, while the rest of the waste gas produced at the facility is vented/flared	As explained above, the surplus BFG from MBF-3 could have been utilized entirely to meet the electrical energy requirement of the integrated steel plant. Therefore partial utilization of surplus BFG for generation of captive electricity can not be considered as a realistic and credible alternative for the project activity under consideration.	Cannot be a part of the baseline
W6	All the waste gas produced at the industrial facility is captured and used for export electricity generation	The project activity aims at utilization of the thermal energy content of the surplus BFG for power generation which will entirely be consumed in-house in the steel plant. There will not be any balance electricity left for export in the project scenario. Electricity export to the grid fetches lesser money than the savings accrued as a result of supply of electricity for captive consumption. Export of electricity therefore does not make economic sense and therefore this alternative can not be considered as a realistic and credible alternative for the project activity under consideration.	Cannot be a part of the baseline
Power Generation			
P1	Proposed project activity not undertaken as a CDM project activity	The project proponent could have utilized the thermal energy content of the surplus BFG for generation of power. The same could have been conceptualized without the revenue from CDM. This alternative is in compliance with all the legal and regulatory requirements and can be a part of the baseline. Therefore this alternative is considered further for determination of baseline scenario for the project activity under consideration.	May be a part of the baseline
P2	On site or off-site existing/new fossil fuel fired cogeneration plant	The project activity entails power generation with surplus BFG. The project proponent does not have any requirement for steam. Therefore installation of a fossil fuel fired cogeneration plant in absence of	Cannot be a part of the baseline

Table-B.2: Potential Alternatives for Waste Energy Utilization and Power Generation			
Option	Description	Credibility	Conclusion
		the project activity is not a realistic and credible alternative for the project proponent.	
P3	On site or off-site existing/new renewable energy based cogeneration plant	The project activity entails power generation with surplus BFG. The project proponent does not have any requirement for steam. Therefore installation of a renewable energy based cogeneration plant in absence of the project activity is not a realistic and credible alternative for the project proponent.	Cannot be a part of the baseline
P4	On site or off-site existing/ new fossil fuel based existing captive or identified plant	In absence of the project activity, the project proponent could have installed a fossil fuel fired captive power plant for generation of electrical energy equivalent to that generated in the project activity. This alternative is in compliance with all the legal and regulatory requirements and can be a part of the baseline. Therefore this alternative is considered further for determination of baseline scenario for the project activity under consideration.	May be a part of the baseline
P5	On site or off-site existing/new renewable energy or other waste energy based existing captive or identified plant	The power generated in the project activity will be consumed entirely in the steel plant. Steel plant operation is power intensive and therefore reliable and consistent power supply is of key importance from the perspective smooth operation of the steel plant machineries. Any inconsistency or disruption in power supply would hamper the steel plant operation and adversely affect the life of power driven machineries of the steel plant. Renewable energy based power sources (like hydro, wind, solar power) cannot ensure reliable and consistent power supply because of their seasonal nature. Supply of consistent quality and sufficient quantity of biomass is of concern. The steel plant is energy intensive and requires stable supply of power which could not be assured in the given circumstances in the region and therefore biomass plant is not considered. Furthermore other waste energy (like municipal solid waste) based power generation practice has not been implemented widely in the host country-India. Therefore this alternative cannot be considered as a realistic and credible alternative for the project proponent in absence of the project activity.	Cannot be a part of the baseline
P6	Sourced Grid-connected power plants	In absence of the project activity, the project proponent could have opted for flaring of the surplus BFG without generating any power. Under	May be a part of the baseline

Table-B.2: Potential Alternatives for Waste Energy Utilization and Power Generation			
Option	Description	Credibility	Conclusion
		such a situation, electrical energy, equivalent to that generated in the project activity, would have been sourced from power plants connected to the grid where the project activity power plant is connected *i.e.* Southern Regional Grid. This alternative is in compliance with all the legal and regulatory requirements and can be a part of the baseline. Therefore this alternative is considered further for determination of baseline scenario for the project activity under consideration.	
P7	Captive electricity generation using waste energy (if project activity is captive generation using waste energy, this scenario represents captive generation with lower efficiency than the project activity)	Installation of a power plant with lower efficiency is not financially justifiable as a lower efficiency power plant would generate less electricity as compared to a higher efficiency plant. As detailed in section B.5, the project activity is not economically attractive and therefore a project activity with a lower efficiency will not be economically attractive as well.	Cannot be a part of the baseline
P8	Cogeneration using waste energy (if project activity is cogeneration with waste energy, this scenario represents cogeneration with lower efficiency than the project activity)	The project activity is not a cogeneration activity as the project proponent has no requirement for steam. Therefore this alternative is not a realistic and credible alternative for the project proponent.	Cannot be a part of the baseline
P9	Existing power generating equipment (used previous to implementation of project activity for captive electricity generation from a captured portion of waste gas) is either decommissioned to build new more efficient and larger capacity plant or modified or expanded (by installing new equipment), and resulting in higher efficiency, to produce and only export electricity generated from waste gas. The electricity	The project activity entails utilization of surplus BFG from newly commissioned MBF-3 for power generation. Before the commissioning of the project activity, the surplus BFG from MBF-3 is flared without utilizing any portion of it for power generation. There is no existing equipment which will be modified or expanded under the project activity. Therefore this alternative is not a realistic and credible alternative for the project proponent.	Cannot be a part of the baseline

Table-B.2: Potential Alternatives for Waste Energy Utilization and Power Generation			
Option	Description	Credibility	Conclusion
	generated by existing equipment for captive consumption is now imported from the grid		
P10	Existing power generating equipment (used previous to implementation of project activity for captive electricity generation from a captured portion of waste gas) is either decommissioned to build a new more efficient and larger capacity plant or modified or expanded (by installing new equipment), and resulting in higher efficiency, to produce electricity from waste gas (already utilized portion plus the portion flared/vented) for own consumption and for export	The project activity entails utilization of surplus BFG from newly commissioned MBF-3 for power generation. Before the commissioning of the project activity, the surplus BFG from MBF-3 is flared without utilizing any portion of it for power generation. There is no existing equipment which will be modified or expanded under the project activity. Therefore this alternative is not a realistic and credible alternative for the project proponent.	Cannot be a part of the baseline
P11	Existing power generating equipment is maintained and additional electricity generated by grid connected power plants.	There is no existing power generating equipment available with the project proponent *i.e.* Mukand Limited. Therefore this alternative is not a realistic and credible alternative for the project proponent.	Cannot be a part of the baseline

From the above evaluation, it can be concluded that in absence of the project activity, the project proponent could have opted for the following three alternatives:

Table-B.3: Potential Alternatives available to Mukand Limited in absence of the project activity

Alternative	Baseline Alternatives		Description of Alternative
	Waste Energy	Power	
1	W2	P4	With this alternative in place, the surplus BFG of MBF-3 would have been flared and the thermal energy content of the surplus BFG would have been wasted. Power, equivalent to that generated in the project activity, would have been generated in a fossil fuel fired captive power plant. As stated above, this alternative is in compliance with all the legal and regulatory requirements and can be a part of the baseline. Therefore this alternative is considered further for determination of baseline scenario for the project activity under consideration.
2	W2	P6	With this alternative in place, the surplus BFG of MBF-3 would have been flared and the thermal energy content of the surplus BFG would have been wasted. Power, equivalent to that generated in the project activity, would have been sourced from power plants connected to the Southern Regional Grid. As stated above, this alternative is in compliance with all the legal and regulatory requirements and can be a part of the baseline. Therefore this alternative is considered further for determination of baseline scenario for the project activity under consideration.
3	W4	P1	With this alternative in place, the surplus BFG of MBF-3 would have been utilized entirely for generation of power to meet the electrical energy requirement of the integrated steel plant. This could have been conceptualized without the revenue from CDM. As stated above, this alternative is in compliance with all the legal and regulatory requirements and can be a part of the baseline. Therefore this alternative is considered further for determination of baseline scenario for the project activity under consideration.

Step-2: Identify the fuel for the baseline choice of energy source taking into account the national and/or sectoral policies as applicable

Amongst the three alternatives identified above, Alternative-1 entails generation of power in a fossil fuel fired captive power plant. With this alternative in place, the project proponent would have set up a fossil fuel fired captive power plant to cater to their in-house electrical energy requirement. As per the guidance of the methodology, the project proponent is required to identify the suitable fossil fuel option for the project proponent and demonstrate the abundant availability of the fossil fuel.

The different fossil fuel options which are practiced widely in the host country-India for the purpose of power generation are-coal, diesel and natural gas. However there is no coal reserve in Karnataka[5] where the project activity plant is located. This can also be demonstrated that there are only two coal based power plants in the entire Karnataka state[6]. With such a background, the project proponent would require to source coal from long distant collieries to set up a coal based captive power plant to meet their in-house electrical energy requirement. This would always be exposed to the risk of non-availability of coal for power generation and a corresponding higher landed cost of coal. Furthermore the other options like, diesel and natural gas based electricity generation are also not feasible options for the project proponent. This is because diesel based electricity generation is highly expensive and is primarily used for emergency purposes whereas natural gas is not available in Karnataka[7] where the project activity plant is situated. Therefore only coal based captive power plant is considered as Alternative-1 to meet the in-house electrical energy requirement of the project proponent in absence of the project activity.

Alternative-2 entails generation of power at power plants connected to the Southern Regional Grid where the project activity power plant is connected. Grid power consists of power generated with different fuels like fossil fuels (*e.g.* coal, diesel, natural gas *etc.*), renewable resources (*e.g.* hydro, wind, biomass *etc.*), nuclear power *etc* .The availability of the fuels at the respective power plants connected to the grid will always be ensured by the respective power producers for their own sustenance.

Alternative-3 entails generation of power with surplus BFG of MBF-3. The availability of surplus BFG is linked to the operation of MBF-3. Since MBF-3 is being operated by the project proponent, therefore availability of surplus BFG will be ensured. However the quantity of surplus BFG may fluctuate depending on the operation of MBF-3.

<u>Step-3: Step 2 and/or step 3 of the latest approved version of the "Tool for the demonstration and assessment of additionality" shall be used to identify the most plausible baseline scenarios by eliminating non-feasible options</u>

From Step-1 and Step-2 above, it is clearly demonstrated that the project proponent, in absence of the project activity, could have opted Alternative-1, Alternative-2 or Alternative-3 to meet their in-

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[5] Source: http://www.economywatch.com/business-and-economy/coal-industry.html, www.icfi.com/Markets/Energy/doc_files/**indian-coal**-sector.pdf and http://www.mapsofindia.com/maps/india/coalreserves.htm

[6] http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

[7] http://petroleum.nic.in/ng.htm

house electrical energy requirement. Therefore, in accordance with the guidance of the methodology-ACM0012/ Version03.2, the project proponent has conducted an investment comparison analysis amongst all the three alternatives following the guidance of Step-3 of the "Tool for the demonstration and assessment of additionality". The levelized cost of electricity of these alternatives has been selected as the financial indicator for the investment comparison analysis. The basic assumptions used for computation of the levelized cost of electricity and the results of the investment comparison analysis are tabulated below:

Table-B.4: Analysis of Levelized Cost Comparison

Parameters	Unit	Alternative-1	Alternative-2	Alternative-3	Special Remarks
Annual net electricity generation/import	MWh/ annum	94779	94779	94779	However due to the initial de-stabilization problems, net electricity generation in the 1st year of operation for Alternative-3 is assumed to be 70 % of 94779 MWh that is 66346 MWh.
Power Rate for imported power from Southern Regional Grid	INR/kWh	3.91 (in the first year)	3.91 (in the first year)	3.91 (in the first year)	An appropriate annual escalation of 2.49 % in power rate has been considered
Total Project Cost	INR Lacs	6000	-	5556	
Consumption of primary fuel	-	Coal-87642 tonnes/annum	-	Surplus BFG-489 Million Nm^3/annum	The consumption of primary fuel for Alternative-3 in the first year is considered to be 70% of the consumption in the other years. This is rational as the power

Table-B.4: Analysis of Levelized Cost Comparison					
Parameters	Unit	Alternative-1	Alternative-2	Alternative-3	Special Remarks
					generation in the first year is also assumed to be 70% of the power generation in the other years for this alternatives.
Price of primary fuel	-	Coal-INR 1506/ton in the first year with an appropriate annual escalation of 5.87%	-	Surplus BFG-No cost has been considered since this is waste gas	
Consumption of supplementary fuel (*i.e.* Furnace Oil)	-	2 ml/kWh	-	4123 tonnes/annum	The consumption of supplementary fuel (*i.e.* furnace oil) for Alternative-3 in the first year is considered to be 70% of the consumption in the other years. This is rational as the power generation in the first year is also assumed to be 70% of the power generation in the other years.
Price of supplementary fuel (*i.e.* Furnace Oil)	INR/kg	23.95	-	23.95	An appropriate annual escalation of 14.28 % in furnace oil price has been considered

Table-B.4: Analysis of Levelized Cost Comparison					
Parameters	Unit	Alternative-1	Alternative-2	Alternative-3	Special Remarks
Water Cost	INR/kWh	0.05	-	0.05	i) The consumption of water for Alternative-3 in the first year is considered to be 70% of the consumption in the other years. This is rational as the power generation in the first year is also assumed to be 70% of the power generation in the other years. ii) An appropriate annual escalation of 5.01 % in water cost has been considered
Consumables, Stores & Spares	%	1% of Total Project Cost	-	1% of Total Project Cost	i) The cost for consumables, stores and spares for Alternative-3 in the first year is considered to be 70% of the consumption in the other years. This is rational as the power generation in the first year is also assumed to be 70% of the power generation in the other years.

Table-B.4: Analysis of Levelized Cost Comparison					
Parameters	Unit	Alternative-1	Alternative-2	Alternative-3	Special Remarks
					ii) An appropriate annual escalation of 5.01 % in cost of consumables, stores and spares has been considered
Repair & Maintenance	%	2.5% of Total Project Cost	-	2.5% of Total Project Cost	i) The cost of repair and maintenance for Alternative-3 in the first year is considered to be 70% of the consumption in the other years. This is rational as the power generation in the first year is also assumed to be 70% of the power generation in the other years. ii) An appropriate annual escalation of 2.63 % in cost of repair and maintenance has been considered
Administrative Expenses	INR Lacs/ annum	20.8	-	20.8	i) The administrative expenses for Alternative-3 in the first year is considered to be 70% of the

Table-B.4: Analysis of Levelized Cost Comparison					
Parameters	Unit	Alternative-1	Alternative-2	Alternative-3	Special Remarks
					consumption in the other years. This is rational as the power generation in the first year is also assumed to be 70% of the power generation in the other years. ii) An appropriate annual escalation of 5.01 % in administrative expenses has been considered
O&M Cost	INR Lacs/ annum	Aggregated cost of water, consumables, stores and spares, repair and maintenance and administrative expenses	-	Aggregated cost of water, consumables, stores and spares, repair and maintenance and administrative expenses	
Insurance	INR Lacs/ annum	Approx. INR 52.3 Lacs in the first year and Approx. INR 56.2 Lacs for the other years	-	Approx. INR 52.3 Lacs in the first year and Approx. INR 56.2 Lacs for the other years	
Depreciation	%	Plant & Machineries-5.28% and Building-3.34%	-	Plant & Machineries-5.28% and Building-3.34%	Depreciation has been calculated as per Straight Line Method
Income Tax	%	33.99% (including		33.99% (including	As per Income Tax Act

Table-B.4: Analysis of Levelized Cost Comparison					
Parameters	Unit	Alternative-1	Alternative-2	Alternative-3	Special Remarks
		surcharge)		surcharge)	
Period of assessment for Levelized Cost Computation	Years	15	15	15	
Levelized Cost of Electricity	**INR/kWh**	**4.36**	**4.32**	**4.47**	

From the above comparison, it is clearly established that Alternative-2 has the lowest levelized cost of electricity amongst all the three alternatives and hence it is the most financially viable alternative available to the project proponent.

This is further to be noted that a sensitivity analysis has been conducted with the following parameters in both the cases of Alternative – 1 (Generation of Power in a coal based captive power plant) and Alternative – 3 (Project activity with BFG based power generation without CDM). The parameters are –

1. Project cost
2. Total variable cost
3. Electricity Generation

The results of the sensitivity analysis have been summarized as follows:

Table- Levelized Cost Comparison for Baseline Alternatives			
Parameter	**Alternative-1 (Coal)**	**Alternative-2 (Grid)**	**Alternative-3 (Project)**
Levelized Cost (INR/kWh)	4.36	4.32	4.47

Table - Sensitivity Analysis for Levelized Cost comparison of Baseline Alternatives					
Parameters	**Variation**	**Levelised Cost (INR/KWh)**			**Comment/Justification**
		Alternative - 1	**Alternative - 2**	**Alternative - 3**	
Project Cost	+10%	4.51	4.32	4.62	Under this scenario the Levelized cost of electricity for both Alternative–1 & Alternative–3 are higher than the Levelized cost of electricity for Alternative – 2.
	-10%	4.20	4.32	4.32	Under this scenario the Levelized cost of electricity for Alternative – 1 is lower than the same for Alternative – 2. However it is most unlikely that there would be a reduction in the project cost for Alternative–1 *i.e.* coal based captive power generation with equivalent power output as compared to the project activity under consideration. It is to mention that the capital cost for the coal based power plant has been taken from the data published by the 'Expert Committee on Fuels for Power Generation' for Central Electricity Authority (CEA) of Govt. of India, made available in 2004 (Available at http://www.cea.nic.in/thermal/Special_reports/Report%20of%20the%20expert%20committee%20on%20fuels%20for%20power%20generation.pdf). This data was applicable for the year 2004. However as conservative estimate, PP has not considered any escalation on the capital cost (project cost) for the coal based captive power plant at the time of the investment decision in 2007 although the escalation is evident as the cost of plant & machineries, buildings and other associated components which form a part of the project cost has increased significantly as evident from the records available at the 'Office of Economic

Table - Sensitivity Analysis for Levelized Cost comparison of Baseline Alternatives					
Parameters	Variation	Levelised Cost (INR/KWh)			Comment/Justification
		Alternative - 1	Alternative - 2	Alternative - 3	
					Advisor, Government of India (available at: http://eaindustry.nic.in)'. As per the published data available at the time of the investment decision, the price of non-electrical machineries, electrical industrial machineries and all commodities have been subjected to an annual price escalation of 4.57%, 2.63% and 5.01% respectively. Consideration of the above escalation on the project cost would have lead to a higher capital cost for the coal based captive power plant at the time of decision making and thus would result into even a higher levelized cost of generation for Alternative – 1. Therefore the scenario for Alternative – 1 where the project cost decreases by 10% is not realistic and most unlikely to occur. Under this scenario the Levelized cost of electricity for Alternative – 3 is equal to that of Alternative – 2. However it is unlikely that there is a reduction in the project cost from that of the estimated project cost considered at the time of approval of the project activity. Furthermore, the details of the actual project cost incurred and planned to be incurred has also been provided to the DOE which shows that there is an increase in project cost than the estimated project cost considered at the time of approval of the project activity. Therefore the scenario for Alternative – 3 where the project cost decreases by 10% is not realistic and most unlikely to occur.

Table - Sensitivity Analysis for Levelized Cost comparison of Baseline Alternatives					
Parameters	**Variation**	**Levelised Cost (INR/KWh)**			**Comment/Justification**
		Alternative - 1	**Alternative - 2**	**Alternative - 3**	
Total Variable Cost	+10%	4.38	4.32	4.49	Under this scenario the Levelized cost of electricity for both Alternative–1 & Alternative–3 are higher than the Levelized cost of electricity for Alternative–2.
	-10%	4.33	4.32	4.45	Under this scenario the Levelized cost of electricity for both Alternative–1 & Alternative–3 are higher than the Levelized cost of electricity for Alternative–2.

Table - Sensitivity Analysis for Levelized Cost comparison of Baseline Alternatives					
Parameters	**Variation**	**Levelised Cost (INR/KWh)**			**Comment/Justification**
		Alternative - 1	**Alternative - 2**	**Alternative - 3**	
Annual Electricity Generation	+10%	4.21	4.32	4.19	Under this scenario the Levelized cost of electricity for Alternative – 1 is lower than the same for Alternative – 2. However the additional electricity in Alternative-1 would be generated only if there is a demand for it within the plant of Mukand Limited. Therefore this is not practical to compare the levelized cost of electricity for Alternative-1 with that of Alternative-2 with a difference in electrical energy output. Under this scenario the Levelized cost of electricity for Alternative – 3 is lower than the same for Alternative – 2. However it is unlikely that the annual electricity generation will increase further by 10% as the same is subject to the availability of surplus BFG from MBF-3. The annual net electricity generated from the project activity is determined with the average volume of surplus BFG available from MBF-3 which is within 4.5% of the maximum volume of surplus BFG available from MBF-3, as per the specification of MBF-3 (evidence of which has already been submitted to the DOE). Though considering the maximum wind volume of 66,000 Nm^3/h (2 X 33,000 Nm^3/h) available in the above computation, would land up in a scenario where the total amount of 55 TPH steam would be generated with BFG and the same is the maximum possible steam generation from the Boiler as per the Manufacturer's specification (already submitted to the DOE). However the availability of BFG is subjected to high level of fluctuations and therefore consideration of a 100% availability of wind blow from the Blowers and thereby 100% availability of consequent BFG generation would be highly unrealistic and impractical to consider. Therefore it

Table - Sensitivity Analysis for Levelized Cost comparison of Baseline Alternatives					
		Levelised Cost (INR/KWh)			
Parameters	Variation	Alternative - 1	Alternative - 2	Alternative - 3	Comment/Justification
					is very unlikely to consider that there would be an increase in annual electricity generation by 10% for the Alternative-3 Moreover PP has submitted the BFG generation data for a period of 9 months (February 2010 to October 2010) and as per the BFG generation records available for the above mentioned 9 months, the maximum value of BFG generation is 62,754 Nm^3/hr. Considering the same as the BFG value input (to demonstrate the extreme scenario) the levelized cost of electricity for Alternative-3 would be much higher (INR 5.81/kWh) than that of Alternative – 2.
	-10%	4.53	4.32	4.81	Under this scenario the Levelized cost of electricity for both Alternative–1 & Alternative–3 are higher than the Levelized cost of electricity for Alternative – 2.

Therefore, as per the guidance of the methodology, Alternative-2 is considered as the baseline scenario for the project activity under consideration.

This is further substantiated by the fact, that this is a status-quo of the steel plant before the implementation of the project activity. With this alternative in place, the surplus BFG of MBF-3 would have been flared and the thermal energy content of the surplus BFG would have been wasted. Power, equivalent to that generated in the project activity, would have been sourced from power plants connected to the Southern Regional Grid.

Step-4: If more than one credible and plausible alternative scenario remain, the alternative with the lowest baseline emissions shall be considered as the most likely baseline scenario

As per Step-3, Alternative-2 has been identified as the baseline scenario for the project activity under consideration. Therefore this step is not applicable any further.

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):

As per the decision 17/cp.7 para 43, a CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in absence of the registered CDM project activity. The methodology requires the project proponent to determine its additionality based on the "Tool for the demonstration and assessment of additionality (Version 05.2)", agreed by the CDM Executive Board. A step by step approach has been used in order to demonstrate additionality for the project activity under consideration.

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

In Sub-step 1a (Define alternatives to the project activity) and Sub-step 1b (Consistency with mandatory laws and regulations), Mukand Limited is required to identify the realistic and credible alternative(s) that will provide output or services comparable with the project activity. These alternatives are required to be in compliance with all applicable legal and regulatory requirements.

The identification of alternatives for waste gas (*i.e.* surplus BFG) utilisation and power generation as well as their compliance with the current laws and regulations has been dealt in details in Section B.4 of the Project Design Document. Both the alternatives (*i.e.* "Alternative-1: Generation of power

in a fossil fuel based captive power plant" and "Alternative-2: Import of power from the grid") as well as the project option (*i.e.* Recovery and utilisation of the thermal energy content of the surplus BFG of MBF-3 for power generation) are in line with the current laws and regulations those are enforced in the host country-India. Therefore Mukand Limited could have implemented either Alternative-1, Alternative-2 or the project activity. However implementation of the project activity without CDM revenue is not a feasible alternative for the project proponent. The same has been illustrated below through 'Step 2: Investment Analysis'.

Step-2. Investment analysis

As per the investment analysis, the project proponent is required to determine whether the project activity is economically or financially less attractive than other alternative (*i.e.* Alternative-1 and Alternative-2) without the revenue from the sale of Certified Emission Reductions (CERs). To conduct the investment analysis, Mukand Limited is required to use the following sub-steps:

Sub-step 2a. Determine appropriate analysis method

The project activity will generate electricity for in-house consumption and has financial implications other than those related to CDM. Therefore 'Option-I: Simple cost analysis' would not be an appropriate analysis method.

Amongst the other two options *i.e.* 'Option-II: Investment comparison analysis' and 'Option-III: Benchmark analysis' Mukand Limited has adopted the benchmark analysis wherein the project activity's post tax project Internal Rate of Return (IRR) was assessed with reference to the Weighted Average Cost of Capital (WACC) selected as the benchmark. The justification for selection of Weighted Average Cost of Capital (WACC) as the appropriate benchmark is provided below:

As per the guidance provided under Paragraph-12 of 'Selection and Validation of Appropriate Benchmarks' in the 'Guidelines on the assessment of investment analysis/ Version 03.1' in EB 51/Annex- 58,

"In cases where a benchmark approach is used the applied benchmark shall be appropriate to the type of IRR calculated. Local commercial lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR. Required/expected returns on equity are appropriate benchmarks for equity IRR. Benchmarks supplied by relevant national authorities are also appropriate if the DOE can validate that they are applicable to the project activity and the type of IRR calculation presented".

The financial viability of the project activity has been assessed by the project proponent based on the project activity's Internal Rate of Return (IRR) as the financial indicator. Therefore, in

accordance with the above mentioned guidelines, the project proponent has selected the Weighted Average Cost of Capital (WACC) as the benchmarks for the project IRR.

As per the guidance provided under Paragraph-13 of 'Selection and Validation of Appropriate Benchmarks' in the 'Guidelines on the assessment of investment analysis/ Version 03.1' in EB 51/Annex- 58,

"In the cases of projects which could be developed by an entity other than the project participant the benchmark should be based on publicly available data sources which can be clearly validated by the DOE. Such data sources may include local lending and borrowing rates, equity indices, or benchmarks determined by relevant national authorities. The DOE.s validation of such benchmarks shall also include its opinion of the suitability of the benchmark applied in the context of the underlying project activity"

There is no potential purchaser for the surplus BFG in the near vicinity. Furthermore, BFG being a poisonous gas because of its high CO concentration, transportation of the same over a long distance poses high risk. Moreover BFG is a colourless, odourless and low-pressure gas and hence identification of leakage in the gas transportation line will be extremely difficult. Therefore transportation of surplus BFG over a long distance is not technically feasible. Thus there is no possibility that the project activity under consideration could have been developed by an entity other than the project participant outside the premise of Mukand Limited. Therefore this condition is not applicable for the project activity under consideration.

As per the guidance provided under Paragraph-14 of 'Selection and Validation of Appropriate Benchmarks' in the 'Guidelines on the assessment of investment analysis/ Version 03.1' in EB 51/Annex- 58,

"Internal company benchmarks/expected returns (including those used as the expected return on equity in the calculation of a weighted average cost of capital - WACC), should only be applied in cases where there is only one possible project developer and should be demonstrated to have been used for similar projects with similar risks, developed by the same company or, if the company is brand new, would have been used for similar projects in the same sector in the country/region. This shall require as a minimum clear evidence of the resolution by the company's Board and/or shareholders and will require the validating DOE to undertake a thorough assessment of the financial statements of the project developer - including the proposed WACC - to assess the past financial behaviour of the entity during at least the last 3 years in relation to similar projects"

The Return on equity used in the computation of WACC has been arrived following the widespread and well accepted methodology of Capital Asset Pricing Model (CAPM) using S&P CNX Nifty index since 01/01/2001 to 31/03/2007[8] (considered for a period of 6.25 years) and the Beta Factor of 14 similar companies in the same industrial sector (existing companies engaged in the similar activity). The average Regression Beta value used for the computation is 1.16. The risk-free-return has been considered as 7.12% based on the average 10 year yield from the Govt. Securities[9] as available from the Annual Report of RBI (Year 2005 – 06).

All these data are publicly available (evidence submitted to DOE) and therefore they are not the internal data/assumptions for Mukand Limited. Therefore this condition is also not applicable for the project activity under consideration.

As per the guidance provided under Paragraph-15 of 'Selection and Validation of Appropriate Benchmarks' in the 'Guidelines on the assessment of investment analysis/ Version 03.1' in EB 51/Annex- 58,
"*Risk premiums applied in the determination of required returns on equity shall reflect the risk profile of the project activity being assessed, established according to national/international accounting principles. It is not considered reasonable to apply the rate general stock market returns as a risk premium for project activities that face a different risk profile than an investment in such indices".*
Project proponent has followed the CAPM to determine the return on equity. As per the CAPM the required return on equity investment is the return of a risk-free security plus beta times the difference between the market return and the risk-free return. The weighted average yield of Government Securities has been taken to represent the risk free return. Therefore this guidance has already been taken in to consideration by the Project proponent while determining the return on equity

Sub-step 2b. Option III. Apply benchmark analysis
The project activity has a high initial capital cost with no capital investment for the baseline alternative *i.e.* "Alternative-2: Import of power from the grid". Mukand Limited conducted an investment analysis of the project activity with the Internal Rate of Return as the financial indicator.

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[8] Data available from National Stock Exchange website: www.nse-india.com
[9] http://rbidocs.rbi.org.in/rdocs/AnnualReport/PDFs/72286.pdf

'Internal Rate of Return' is one of the known financial indicators used by banks, financial institutions and project developers for making investment decisions.

Sub-step 2c. Calculation and comparison of financial indicators

Mukand Limited has calculated the project activity's Internal Rate of Return (IRR) and compared it with the Weighted Average Cost of Capital (WACC). The Internal Rate of Return (IRR) for the project activity is calculated based on the following aspects:

- IRR is calculated over a period of 15 years *i.e.* the lifetime of the project activity under consideration
- Annual net electricity generation from the project activity power plant - 94779 MWh (However due to the initial de-stabilization problems, net electricity generation in the 1st year of operation is assumed to be 70 % of 94779 MWh that is 66346 MWh.)
- Power Rate for imported power from Southern Regional Grid-INR 3.91/kWh in the first year with an appropriate annual escalation of 2.49 % based on the escalation rates applicable to 'Electricity for Industry' as per the WPI as published by the Office of Economic Advisor, Government of India.
- Total project cost-INR 5556 Lacs
- Annual consumption of supplementary fuel *i.e.* Furnace Oil- 4123 tonnes/annum (However due to the initial de-stabilization problems, furnace oil consumption in the 1st year of operation is assumed to be 70% of 4123 tonnes that is 2886 tonnes)
- Price of supplementary fuel *i.e.* Furnace Oil-INR 23.95/kg with an appropriate annual escalation of 14.28 % based on the escalation rates applicable to 'Furnace Oil' as per the WPI as published by the Office of Economic Advisor, Government of India.
- Variable Cost (like water cost, consumables, stores and spares, repair and maintenance) has been calculated as per standard assumptions and CERC guidelines-For details of these assumptions, please refer to Table-B.4
- Variable Cost (like administrative expenses) has been considered as estimated by the Project proponent for the project activity under consideration-For details of this assumptions, please refer to Table-B.4
- Insurance cost has been considered based on the quotations received-For details of this assumptions, please refer to Table-B.4
- Depreciation has been calculated based on Straight Line Method
- Taxes has been calculated as per the provisions of Income-Tax Act at a rate of 33.99% including surcharge

Based on the above assumption, the financial Internal Rate of Return (IRR) of the project activity without CDM revenues is found to 17.78% which is much lower than the Weighted Average Cost of Capital (WACC) of 20.38%.

All financial data used to arrive at the Internal Rate of Return (IRR) of the project activity without CDM revenues and the Weighted Average Cost of Capital (WACC) has been provided to the DOE in the process of Validation.

Sub step 2d: Sensitivity Analysis

The IRR of the project activity is found to be sensitive to the following parameters:

- Project Cost
- Annual Net Electricity Generation
- Power Tariff
- Furnace Oil Cost
- Variable Cost

The sensitivity analysis is conducted for scenarios with variations in each one of the above mentioned factors considering the most favorable and unfavorable parameters simultaneously in order to assess the implications on the project activity under such circumstances. The results of the sensitivity analysis are presented below:

Table-B.5: Sensitivity Analysis

Sl. No.	Parameters	Variation	Project Activity IRR (%)	Comment
1.	Project Cost	+10%	15.35%	In this case, the project activity IRR is below the benchmark *i.e.* 20.38% (WACC).
		-10%	20.64%	In this case, the project activity IRR slightly crosses the benchmark *i.e.* 20.38% (WACC). However it is unlikely that there is a reduction in the project cost from that of the estimated project cost considered at the time of approval of the project activity. Furthermore, the details of the actual project cost incurred and planned to be incurred has also been provided to the DOE which shows that there is an increase in project cost than the estimated project cost considered at the time of approval of the project activity.

Table-B.5: Sensitivity Analysis				
Sl. No.	**Parameters**	**Variation**	**Project Activity IRR (%)**	**Comment**
2.	Annual Net Electricity Generation	+10%	23.07%	In this case, the project activity IRR is higher than the benchmark *i.e.* 20.38% (WACC). However, in case the BFG generation is assumed to be 66,000 Nm^3/hr (i.e. 2 x 33000 Nm^3/hr) which is the maximum as per the specifications, the IRR for the project activity comes out to be 24.88% which is higher than the Benchmark *i.e.* 20.38% (WACC). However PP has submitted the BFG generation data for a period of 9 months (February 2010 to October 2010) and as per the BFG generation records available for the above mentioned 9 months, the maximum value of BFG generation is 62,754 Nm^3/hr. Considering the same as the BFG value input (to demonstrate the extreme scenario) the IRR of the Project comes out to be negative. Thus based on the actual BFG generation data it can be very well concluded that, consideration of a scenario with 100% availability of BFG throughout the entire year is most unrealistic and impractical to occur. As the electricity generation is linked with BFG availability, therefore it is very unlikely to consider that there would be an increase in annual electricity generation by 10%.
		-10%	9.09%	In this case, the project activity IRR is much below the benchmark *i.e.* 20.38% (WACC).
3.	Power Tariff (in the first year of operation)	+10%	23.53%	In this case, the project activity IRR is above the benchmark *i.e.* 20.38% (WACC). However it is unlikely that the power tariff will increase further in the first year of operation of the project activity. This is because the power tariff at which the project proponent has purchased power from the grid has not changed over the last four years. The same has been demonstrated to the DOE through plant bill analysis. Furthermore this is to be noted that the IRR computation already considers an

Table-B.5: Sensitivity Analysis				
Sl. No.	**Parameters**	**Variation**	**Project Activity IRR (%)**	**Comment**
				annual escalation on power tariff which is conservative.
		-10%	7.32%	In this case, the project activity IRR is much below the benchmark *i.e.* 20.38% (WACC).
4.	Furnace Oil Cost (in the first year of operation)	+10%	13.24%	In this case, the project activity IRR is below the benchmark *i.e.* 20.38% (WACC).
		-10%	20.82%	In this case, the project activity IRR is slightly above the benchmark *i.e.* 20.38% (WACC). It is unlikely that the price of furnace oil will reduce in the first year of operation of the project activity. This is because furnace oil is a natural resource which is being consumed internationally. Being a depleting natural resource with international demand, the price of the same is always expected to increase. The trend analysis of furnace oil pricing will also demonstrate the same as evident from the records available at the 'Office of Economic Advisor, Government of India (available at: http://eaindustry.nic.in)'.
5.	Variable Cost (in the first year of operation)	+10%	17.15%	In both cases, the project activity IRR is below the benchmark *i.e.* 20.38% (WACC).
		-10%	18.39%	

The results of the sensitivity analysis conducted confirm that the financial Internal Rate of Return (IRR) of the project activity without CDM revenues is much lower than the Weighted Average Cost of Capital (WACC), under circumstances which could bring about variations in the critical factors used for the IRR computations in Step 2c.

Hence, the conclusion that the 'the project activity is financially non viable' is robust to reasonable variations in the critical assumption and the CDM revenue the project activity would obtain through sale of the emission reductions is very crucial to sustain the operations of the project activity.

Step-4: Common Practice Scenario Analysis

The project proponent is further required to conduct the common practice analysis as a credibility check to complement the investment analysis (Step 2). The project proponent is required to identify and discuss the existing common practice through the following sub-steps:

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

As per the guidance provided under Sub-step 4a of the "Tool for the demonstration and assessment of additionality/Version 05.2", the project proponent is required to

'Provide an analysis of any other activities that are operational and that are similar to the proposed project activity. Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc.'

However, while determining the similar project activities, the tool also specifies that *'Other CDM project activities (registered project activities and project activities which have been published on the UNFCCC website for global stakeholder consultation as part of the validation process) are not to be included in this analysis'*

The project activity under consideration envisages utilization of the thermal energy content of the surplus BFG emanating from Mini Blast Furnace, MBF-3. As per the 'Association of Indian Mini Blast Furnaces', there are 28 plants in India where mini blast furnaces are under operation apart from the MBF-3 under consideration. Out of these 28 plants with MBF in India, only 16 plants are equipped with BFG based power generation facilities. Out of these 16 BFG based power plants, 7 power plants have considered CDM revenue and hence, as per the above guidance, they may be excluded from further analysis (evidence of the same has been submitted to the DOE).

Out of the remaining 9 power plants, 7 power plants have significantly lower power generation capacities (*i.e.* Capacity < 50% of project activity power plant) and hence not comparable with the project activity power plant in terms of their scale of operation. Therefore, as per the above guidance, these power plants may also be excluded from further consideration. Hence there are only 2 power plants, namely- Jayaswal Neco Industries Limited and IDCOL Kalinga Works Limited

which have been implemented with the similar technology and are having similar power generation capacities. However both these power plants (and also the 7 power plants excluded above) have been commissioned before electricity reforms in India in the year 2002-2003.

This is to be noted here that prior to 2002-2003, Indian power sector was predominantly controlled by the state with monopolistic State Electricity Boards (SEBs) managing the Transmission & Distribution (T&D) operations in their respective states. The inadequacies in the T&D systems in India was resulted from lack of investments by the State Electricity Boards (SEBs), poor infrastructure, high technical and commercial losses, and poor financial health of state utilities. This had resulted into lower availability of grid power and hence extreme difficulties in accessing easy power for the manufacturing industries like steel for which power is the key and essential most commodities to sustain plant operation. This is to mention that among the 9 power plants stated above, Electro steel Castings & Tata Metaliks Limited are located in the State of West Bengal, Jayaswal Neco Industries Limited is located in the State of Madhya Pradesh, Kirloskar Ferrous Industries Limited & Kudremukh Iron Ore Company Limited are located in the State of Karnataka, IDCOL Kalinga Works Limited is located in Orissa, Lanco Industries Limited is located in Andhra Pradesh, Usha Martin Limited is located in Bihar and Aparant Iron & Steel Limited is located in the State of Goa. All of the above mentioned Power plants had either been conceptualized or been commissioned during early or mid 1990's (Kindly refer to the excel sheet submitted for detail information). As per the Annual Report (2001 – 02) on the Working of State Electricity Boards & Electricity Departments Planning Commission (Power & Energy Division), Government of India (Refer to Page no 86, Annexure 3.39, 'Power Supply Position in India'), there was an acute power deficit (under normal scenario as well as peak demand scenario) in all the States mentioned above (where the 9 power plant are located) during the period of 1991-92 to 2001-02. Link publicly available at: http://planningcommission.nic.in/reports/genrep/seb/ar_seb02.pdf.

Therefore, under this circumstance *i.e.* prior to 2002-2003, setting up a captive power plant by the power intensive manufacturing industries like steel was more of an essential requirement to meet the in-house power demand and ensure an uninterrupted power supply in order to sustain their plant operation.

However in 2002-2003, there was a significant reform in the Indian Power Sector with the introduction of Electricity Act 2003 and improved transmission capacity by Power Grid Corporation of India (PGCIL). Power Grid Corporation of India (PGCIL) is the Central Transmission Utility responsible for inter-regional/states electricity transmission and planning and development of the

infrastructure. It owns and operates 80% of India's inter-state transmission networks and, more importantly, accounts for 95% of the transformation capacity[10]. PGCIL is also responsible for developing a national grid, to enable transfer of power from power-surplus regions to power-deficit regions; to enable optimal development and utilization of coal and hydro resources that are located far from the consumption centres; and to improve the economy, reliability and quality of power supply. The national grid has been developed in phases. In the first phase, which was completed in 2002, PGCIL created an interregional power transmission capacity of 5,050 MW. Therefore prior to 2002-2003, opportunity like transfer of power from power-surplus regions to power-deficit regions was not in place and uninterrupted power supply was not ensured to the consumers like the power intensive manufacturing industries like steel. Furthermore the introduction of Electricity Act of 2003 with favourable Government regulations and policies supporting 'Open Access' for any generation company or transmission licensee resulted into higher availability of grid power and hence, more reliable power supply.

Therefore, under this circumstance *i.e.* prior to 2002-2003, setting up a captive power plant by the power intensive manufacturing industries like steel was more of an essential requirement to meet the in-house power demand and ensure an uninterrupted power supply in order to sustain their plant operation. Therefore at this point of time, the investment climate scenario for setting up a captive power generation facility was entirely different as compared to the project activity under consideration, as during this time, there was no concept of a national grid to enable transfer of power from power-surplus regions to power-deficit regions. This had resulted into a complete dependence on the State Electricity Boards (SEB) operated grid which were highly power deficient. This justifies the essentiality of both of the 2 manufacturing units (as well as the 7 manufacturing units excluded earlier), as indicated above, to set up their captive power plant with BFG to ensure reliable and uninterrupted power supply in order to sustain their plant operation.

However the decision for the project activity under consideration was taken by the Management of Mukand Limited on 22 May 2007 which is much later in comparison to the above mentioned project activities and in a completely different investment climate (in terms of investment in to captive power projects). This is because PGCIL has almost tripled its interregional power

[10] Source: Global Transmission Report 2008 – Link publicly available at http://www.globaltransmission.info/archive.php?id=395

transmission capacity upto 14100 MW[11] by 2007 which ensures transfer of power from power-surplus regions to power-deficit regions. Furthermore the introduction of favorable Government regulations and policies through the Electricity Act 2003 allows an 'Open Access' for any generation company or transmission licensee and therefore Mukand Limited could have easily accessed the grid power from different public/private sources. This has improved grid availability and interregional power transmission and hence the reliability of grid power. Therefore Mukand Limited does not have the same level of essentiality to set up the BFG based power generation facility under consideration as compared to those 2 manufacturing units (as well as the 7 manufacturing units excluded earlier), as indicated above. And hence, the decision making environment for Mukand Limited was not at all comparable with the other project developers considering the essentiality of similar project implementation.

Moreover, both the 2 manufacturing units (as well as the 7 manufacturing units excluded earlier) have conceptualized their power plants prior to 1997 *i.e.* prior to the introduction of Kyoto Protocol-Clean Development Mechanism. Therefore consideration of CDM revenue from these BFG based power generation facilities was again not applicable.

The above discussion clearly demonstrates that BFG based power generation having an equivalent capacity and implemented in the similar investment climate as that of the project activity power plant is not practiced at all in the host country-India without the consideration of CDM revenue. Therefore the project activity implementation without CDM revenue consideration is not a common practice in the host country-India.

<u>Sub-step 4b. Discuss any similar options that are occurring:</u>

As demonstrated under Sub-step 4a, no activity *i.e.* BFG based power plant similar to the project activity power plant (in terms of scale of operation and implemented with the similar background) could be identified in the host country-India in the post-Kyoto period which have not considered CDM revenue.

From the above discussion, it can be established that the project activity is not a feasible option for the project proponent considering all the financial risks associated with its implementation. The

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[11] Source: Global Transmission Report 2008 – Link publicly available at http://www.globaltransmission.info/archive.php?id=395

Management of Mukand Limited has been apprised about all these direct financial risks which even have the potential to make the project proposal completely unviable. Furthermore the failure of the project activity could ultimately lead to a production downtime in the consumer end and subsequently into loss of revenue. However the Management of Mukand Limited could realize the potential of the CDM revenue that can be made available once the project activity is commissioned and registered with UNFCCC. With immense confidence on Kyoto Protocol-Clean Development Mechanism, the Management of Mukand Limited has finally decided to implement the project activity as a climate change initiative.

The start date for the project activity is 1st June 2007 *i.e.* the date on which an advance payment was made to the boiler supplier 'ISGEC John Thompson' for supply of boiler and auxiliaries. Since the start date of the project activity is before the date of validation, therefore a detailed timeline showing project implementation schedule has been presented below:

Chronology of Events for 'Power generation by utilizing Blast Furnace Gas at Mukand Limited, Ginigera, Karnataka		
Milestone	**Date**	**Supportive Document**
Project Approval from the Board of Mukand Limited with the consideration of CDM revenue	22nd May 2007	1. 'Excerpts of the Agenda Note of the Meeting of the Board of Directors of the Company held on 22nd May 2007' and 2. 'Excerpts of the Minutes of the Meeting of the Board of Directors held on 22nd May 2007'
Advance Payment to M/s. ISGEC John Thompson for supply of Boiler and auxiliaries-Project Start Date	1st June 2007	Contract Copy
Appointment of CDM Consultant	4th October 2007	Engagement Letter signed between M/s. Mukand Limited and the CDM Consultant
Submission of Project Idea Note (PIN) to M/s. Mukand Limited	28th December 2007	Mail communication from CDM Consultant to M/s. Mukand Limited
Purchase Order issued to M/s. ISGEC John Thompson for supply of Boiler and auxiliaries	29th January 2008	Purchase Order issued by M/s. Mukand Limited to M/s. ISGEC John Thompson
Commissioning of MBF-3	29th March 2008	Commissioning Certificate
Receipt of Environmental Clearance from State Level	28th April 2008	Environmental Clearance issued to M/s. Mukand Limited by State Level Environment Impact Assessment Authority, Karnataka

Chronology of Events for 'Power generation by utilizing Blast Furnace Gas at Mukand Limited, Ginigera, Karnataka		
Milestone	**Date**	**Supportive Document**
Submission of PDD & PCN to Ministry of Environment & Forests, Government of India for Host Country Approval	28th May 2008	Forwarding Letter to Ministry of Environment & Forests, Government of India from M/s. Mukand Limited
Appointment of Validator	6th June 2008	Contractual Agreement between the Validator and M/s. Mukand Limited
Purchase Order issued to M/s. Qingdao Jieneng Power Station Engineering P Ltd., China for supply of Steam-Turbo Generator Set and its auxiliaries	10th July 2008	Purchase order
Publication of PDD for Global Stakeholder Consultation	10th July 2008 to 8th August 2008	http://cdm.unfccc.int/Projects/Validation/DB/7CR7317YZ4BZ6S1INPMZMU3JONA8DC/view.html
Presentation at Ministry of Environment & Forests, Government of India	21st July 2008	Host Country Approval Letter issued to M/s. Mukand Limited by Ministry of Environment & Forests, Government of India
Receipt of Host Country Approval Letter from Ministry of Environment & Forests, Government of India	3rd September 2008	Host Country Approval Letter issued to M/s. Mukand Limited by Ministry of Environment & Forests, Government of India
Receipts of Consents under the Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 from State Pollution Control Board	11th September 2008	Consent issued to M/s. Mukand Limited by Karnataka State Pollution Control Board
Proposed commissioning of the power plant	May 2009	Project Planning document
Proposed commercial production	July 2009	Project Planning document

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

As per the selection of the baseline scenario conducted in Section B.4 of this PDD, 'Alternative-2: Import of power from the grid' is found to be the baseline scenario. Therefore following the guidance of the methodology, the baseline emissions will be computed by quantifying the emissions related to flaring of surplus BFG (if any) and the emissions related to generation of power (equivalent to the net power generated in the project activity) at the Southern Regional Grid connected power plants. Project emissions are applicable only if auxiliary fuels are fired for

supplementing the heat content of the surplus BFG and in case of electrical energy consumption for surplus BFG cleaning prior to its utilization for power generation or for other supplementary electricity consumption. [12]The methodology does not require the project proponent to consider any leakage emissions. Therefore the emission reduction resulting from the project activity will be computed as a difference between the baseline emissions and the project emissions.

Computation of Baseline Emissions

As per the baseline scenario (*i.e.* Alternative-2), power, equivalent to the net power generated in the project activity, would have been generated in the power plants connected to Southern Regional Grid. Therefore following the guidance of the methodology, the baseline emission will be computed as:

$$BE_y = BE_{En,y} + BE_{flst,y}$$

Where:

BE_y = Baseline emissions during the year y (in tonnes of CO_2)

$BE_{En,y}$ = Baseline emissions from energy generated by project activity during the year y (in tonnes of CO_2)

$BE_{flst,y}$ = Baseline emissions from steam generation, if any, using fossil fuel, that would have been used for flaring the surplus BFG in absence of the project activity (in tonnes of CO_2).

'y' is any year within the proposed crediting period of the project activity.

However, as stated above in Section B.3 of the PDD, there would not be any steam requirement in order to flare the surplus BFG generated from MBF-3 in absence of the project activity *i.e.,*

$$BE_{flst,y} = 0$$

Therefore the baseline emissions resulting from the project activity can be considered as:

$$BE_y = BE_{En,y}$$

In accordance with the guidance provided in the methodology *(please refer to 'Baseline emissions for Scenario 1')*, the baseline emissions from electrical energy generated by the project activity will be computed as:

$$BE_{En,y} = BE_{Elec,y} = f_{cap} \times f_{wcm} \times \sum_j \sum_i \left(EG_{i,j,y} \times EF_{Elec,i,j,y} \right)$$

Where:

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[12] Auxiliary fuels fired within the boiler are incorporated in the computation of $f_{wcm.}$ This is applicable for the fuels which are fired outside the boiler

$BE_{En,y}$ = Baseline emissions from energy generated by project activity during the year y (in tonnes of CO_2)

$BE_{Elec,y}$ = Baseline emissions due to displacement of electricity during the year y (in tonnes of CO_2)

$EG_{i,j,y}$ = Quantity of electricity supplied to the recipient *j* by generator, that in the absence of the project activity would have been sourced from the i^{th} source (*i.e.* the Southern Regional Grid) during the year y (in MWh)

$EF_{elec,i,j,y}$ = CO_2 emission factor for the electricity source *i* (*i.e.* the Southern Regional Grid), displaced due to the project activity during the year y (in tCO_2/MWh)

f_{wcm} = Fraction of total electricity generated by the project activity using waste energy (*i.e.* surplus BFG), calculated as given below

f_{cap} = Energy that would have been produced in project year y using waste energy (*i.e.* surplus BFG) generated in base year expressed as a fraction of total energy produced using waste source in year y, determined as given below.

'y' is any year within the proposed crediting period of the project activity.

<u>Determination of f_{cap}</u>

In accordance with the guidance of the methodology *(please refer to Method-2[13] of "Capping of baseline emissions")*, the baseline emissions will be capped at the maximum quantity of waste gas *i.e.* surplus BFG that would have been generated before the implementation of the project activity. With this consideration, f_{cap} will be determined as given below:

$$f_{cap} = \frac{Q_{WCM,BL}}{Q_{WCM,y}}$$

Where:

$Q_{WCM,BL}$ = Quantity of waste energy *i.e.* Surplus BFG generated prior to the start of the project activity, calculated as given below (Nm^3)

$Q_{WCM,y}$ = Quantity of WECM *i.e.* surplus BFG used for energy generation during year y (Nm^3)

'y' is any year within the proposed crediting period of the project activity.

The quantity of waste energy *i.e.* Surplus BFG that would have been generated prior to the start of the project activity *i.e.* $Q_{WCM,BL}$ will be calculated as:

$$Q_{WCM,BL} = Q_{BL,product} \times q_{wcm,product}$$

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[13] Since the project activity will be implemented at MBF-3 where three year production data are not available, therefore Method-1 is not selected for determination of f_{cap}.

Where,

$Q_{WCM,BL}$ = Quantity of waste energy *i.e.* Surplus BFG generated prior to the start of the project activity (Nm^3)

$Q_{BL,product}$ = Production associated with the relevant waste energy *i.e.* surplus BFG generation as it occurs in the baseline scenario (ton), determined as given below

$q_{wcm,product}$ = Amount of waste energy *i.e.* surplus BFG per unit of product generated by the process (that generates waste energy *i.e.* surplus BFG) in the industrial facility (Nm^3/ton)

In accordance with the guidance of the methodology, $Q_{BL,product}$ shall be determined from manufacturer's data for normal operating conditions in case of a new facility. Since the project activity also envisages the utilization of surplus BFG from the newly commissioned MBF-3, therefore $Q_{BL,product}$ for the project activity will be considered from the manufacturer's specifications.

<u>Determination of *fwcm*</u>

For the project activity under consideration, direct measurement of electricity generated with WECM *i.e.* surplus BFG is not possible as Furnace Oil will also be consumed alongwith surplus BFG in the boiler. Therefore f_{WCM} will be determined following the guidance of the methodology *(please refer to Situation 1 of "Calculation of the energy generated (electricity and/or steam) in units supplied by WECM and other fuels")* as given below:

$$f_{WCM} = \frac{\dfrac{\sum_{h=1}^{8760} Q_{WCM,h} \times (Cp_{wcm} \times (t_{wcm,h} - t_{ref}) + NCV_{WCM,y})}{H_r}}{EG_{tot,y}}$$

Where:

f_{WCM} = Fraction of total electricity generated by the project activity using waste energy (*i.e.* surplus BFG)

$Q_{WCM,h}$ = Quantity of WECM *i.e.* surplus BFG recovered in hour h (Nm^3/h)

Cp_{wcm} = Specific heat of WECM *i.e.* surplus BFG ($TJ/Nm^3/^0C$)

$t_{wcm,h}$ = Temperature of WECM *i.e.* surplus BFG in hour h (^0C)

t_{ref} = Reference temperature *i.e.* ambient temperature (^0C)

$NCV_{WCM,y}$ = Net Calorific Value of WECM *i.e.* surplus BFG in year y (TJ/Nm^3)

H_r = Average heat rate of the power plant where electricity is produced (1/efficiency), calculated as given below

$EG_{tot,y}$ = Total annual energy produced at the power plant (TJ/year)

'y' is any year within the proposed crediting period of the project activity.

The average heat rate of the power plant will be calculated as:

$$H_r = \frac{\sum_{h=1}^{8760} \sum_{i=1}^{I} Q_{i,h} \times (Cp_i \times (t_{i,h} - t_{ref}) + NCV_i)}{EG_{tot,y}}$$

Where:

H_r = Average heat rate of the power plant where electricity is produced (1/efficiency)

$Q_{i,h}$ = Amount of individual fuel (WECM *i.e.* surplus BFG and other fuel) i consumed at the energy generation unit *i.e.* the power plant during hour h (Nm^3/h and ton/h)

Cp_i = Specific heat of WECM *i.e.* surplus BFG ($TJ/Nm^3/^0C$)

$t_{i,h}$ = Temperature of individual fuel (WECM *i.e.* surplus BFG and other fuel) i consumed at the energy generation unit *i.e.* the power plant during hour h (^0C)

t_{ref} = Reference temperature *i.e.* ambient temperature (^0C)

NCV_i = Net Calorific Value (annual average) of individual fuel (WECM *i.e.* surplus BFG and other fuel) i consumed at the energy generation unit *i.e.* the power plant (TJ/Nm^3 and TJ/ton)

$EG_{tot,y}$ = Total annual energy produced at the power plant (TJ/year)

'y' is any year within the proposed crediting period of the project activity.

However, as per the methodology, in case the index 'i' represents fuel, the energy content corresponding to the sensible heat of fuel 'i' is to be considered as zero. Since both the surplus BFG and Furnace Oil will be used as fuel in the boiler of the project activity power plant, therefore the sensible heat of both the surplus BFG and Furnace Oil are to be considered as zero. Therefore, f_{WCM} and H_r will be calculated as:

$$f_{WCM} = \frac{\frac{\sum_{h=1}^{8760} Q_{WCM,h} \times NCV_{WCM,y}}{H_r}}{EG_{tot,y}}$$

and

$$H_r = \frac{\sum_{h=1}^{8760} \sum_{i=1}^{I} Q_{i,h} \times NCV_i}{EG_{tot,y}}$$

<u>Determination of $EF_{elec,i,j,y}$</u>

As per the methodology, in case of displacement of electricity from the grid, the CO_2 emission factor for the electricity source i (*i.e.* $EF_{elec,i,j,y} = EF_{elec,gr,j,y}$) shall be determined following the guidance provided in the 'Tool to calculate the emission factor for an electricity system/ Version 02'. In accordance with this guidance, the Central Electricity Authority (CEA) of Government of

India has calculated the CO_2 emission factor for the Southern Regional Grid and the same is made available in the 'Baseline Carbon Dioxide Emission Database/Version 03[14]'. The emission factor of Southern Regional Grid, as published by CEA, will be followed for the computation of baseline emissions resulting from the project activity and the same will remain fixed for the entire crediting period. The step-wise approach followed for computation of the CO_2 emission factor of the Southern Regional Grid is presented below:

Southern Regional Grid consists of independent state level electricity systems including public sector undertakings that exchange significant power within the region depending on the demand. The overall power flows are managed by the Southern Regional Load Despatch Centre (SRLDC). According to the 'Tool to calculate the emission factor for an electricity system/ Version 02', the CO_2 emission factor for the Southern Regional Grid is calculated by the Central Electricity Authority (CEA) of Government of India as a Combined Margin (CM), comprising the Operating Margin (OM) emission factor and the Build Margin (BM) emission factor. The following procedure is adopted for estimating the CO_2 emission factor for the Southern Regional Grid:

Step-1: Calculation of the Operating Margin

Step-2: Calculation of the Build Margin

Step-3: Calculation of the CO_2 emission factor for the Southern Regional Grid (Combined Margin)

Step-1: Calculation of the Operating Margin

The 'Tool to calculate the emission factor for an electricity system/ Version 02' recommends the use of dispatch data analysis as the first methodological choice. However, in India availability of accurate data on grid system dispatch order for each power plant in the system and the amount of power dispatched from all plants in the system during each hour is practically not possible. Also, still the merit order dispatch system has not become applicable and is not likely to be so during the crediting period. In view of this, it is proposed to apply other choices as suggested in the 'Tool to calculate the emission factor for an electricity system/ Version 02'. Since the average power supplied by low cost - must run power plants to the Southern Regional Grid during the five most recent years before the implementation of the project activity is 22.28% which is clearly below 50%, it is decided to apply the simple OM method following the guidelines of the tool. The same can be validated with published records of the Central Electricity Authority of Government of India (available at:
http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm)

[14] Source: http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

and is presented below:

Share of Must-Run (Hydro/Nuclear) (% of Net Generation)						
Grid	2002-2003	2003 - 2004	2004 - 2005	2005 - 2006	2006 – 2007	Average
South	18.3%	16.2%	21.6%	27.0%	28.3%	22.28%

Determination Simple OM

In the Simple OM method, the emission factor is calculated as generation weighted average emissions per electricity unit (tCO_2/MWh) of all generating sources serving the system, not including low-operating cost and must-run power plants. The data vintage option selected is the *ex-ante* approach, where a 3 year weighted average OM is calculated. The most recent three years data for the Southern Regional Grid, available at the time of submission of the CDM PDD to the DOE (*i.e.* data for 2004-2005, 2005-2006 and 2006-2007), has been considered for the computation of Simple OM. The same has been calculated as per the following guideline of the tool:

Option A - Calculation based on average efficiency and electricity generation of each plant

$$EF_{grid,OMsimple,y} = \frac{\sum_{m} EG_{m,y} \cdot EF_{EL,m,y}}{\sum_{m} EG_{m,y}}$$

Where:

$EF_{grid,OMsimple,y}$ = Simple operating margin CO2 emission factor in year y (tCO2/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$EF_{EL,m,y}$ = CO2 emission factor of power unit m in year y (tCO2/MWh)

m = All power units serving the grid in year y except low-cost / must-run power units

y = The relevant year as per the data vintage chosen in step 3 of the Tool

Determination of $EF_{EL,m,y}$

The emission factor of each power unit m should be determined as follows:

Option A1:

$$EF_{EL,m,y} = \frac{\sum_i FC_{i,m,y} \cdot NCV_{i,y} \cdot EF_{CO2,i,y}}{EG_{m,y}}$$

Where:

$EF_{EL,m,y}$ = CO2 emission factor of power unit m in year y (tCO2/MWh)

$FC_{i,m,y}$ = Amount of fossil fuel type i consumed by power unit m in year y (Mass or volume unit)

$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type i in year y (GJ/mass or volume unit)

$EF_{CO2,i,y}$ = CO2 emission factor of fossil fuel type i in year y (tCO2/GJ)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

m = All power units serving the grid in year y except low-cost/must-run power units

i = All fossil fuel types combusted in power unit m in year y

y = The relevant year as per the data vintage chosen in Step 3 of the Tool

In accordance with this guidance, the Central Electricity Authority (CEA) of Government of India has calculated the Simple OM for the Southern Regional Grid and the same is made available in the 'Baseline Carbon Dioxide Emission Database/Version 03[15]'. The same is presented as below:

Determination of Simple OM					
Parameter	Unit	2004-2005	2005-2006	2006-2007	Source/ Remarks
Southern Grid - Simple OM excl imports	tCO_2/MWh	1.00	1.01	1.00	CEA Database - Version 3.0
Southern Grid - Net Generation in OM	GWh	105568.5	100978.4	109116.4	CEA Database - Version 3.0
Southern Grid - Absolute emissions in OM	tCO2	105603623.8	101760966.3	109251805.6	Calculated
Net electricity import from ER	GWh	286.2	99.81	1551.69	CEA Database - Version 3.0
ER simple OM excl imports	tCO_2/MWh	1.20	1.16	1.13	CEA Database - Version 3.0
Absolute emissions from imports	tCO_2	344511.3972	115624.9299	1751354.347	Calculated
Absolute emissions incl imports	tCO_2	105948135.2	101876591.2	111003160.0	Calculated
Net generation incl imports	GWh	105854.67	101078.19	110668.07	Calculated
Southern Grid - Simple OM incl imports	tCO_2/MWh	1.000882947	1.007898888	1.003027906	Calculated
Weighted Generation Operating Margin	tCO_2/MWh	1.0039			Calculated

Hence, $EF_{grid,OM,y}$ = 1.0039 tCO_2/MWh

Step-2: Calculation of the Build Margin

The 'Tool to calculate the emission factor for an electricity system/ Version 02' provides two options for determination of build margin emission factor- *ex-ante* and *ex-post* determination of the

[15] Source: http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

Build Margin (BM). Option 1 is selected wherein the build margin emission factor is calculated *ex-ante* based on most recent information available on plants already built for sample group m in Southern Region at the time of submission of the CDM- PDD to the DOE for validation. The sample group m shall be the one having higher power generation between

(a) five power plants that have been built most recently and

(b) the capacity additions in the electricity system that comprises 20% of the system generation built most recently.

It is found that the option (b) has higher generation compared to option (a). Hence option (b) is selected. As per this guideline the Build Margin has been calculated for the most recent year (*i.e.* 2006-2007) at the time of submission of the CDM- PDD to the DOE for validation in accordance with the following formula:

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

Where:

$EF_{grid.BM,y}$ = Build Margin CO_2 emission factor in year y (tCO_2/MWh)

$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit m in year y (MWh)

$EF_{EL,m,y}$ = CO_2 emission factor of power unit m in year y (tCO_2/MWh)

m = Power units included in the build margin

i = All fossil fuel types combusted in power plant/ unit m in year y.

y = Most recent historical year for which power generation data is available at the time of submission of the CDM- PDD to the DOE for validation (*ex-ante* option)

In accordance with this guidance, the Central Electricity Authority (CEA) of Government of India has calculated the Build Margin for the Southern Regional Grid and the same is made available in the 'Baseline Carbon Dioxide Emission Database/Version 03[16]'. The same is presented as below:

Determination of Build Margin Emission Factor ($EF_{BM,y}$)			
Parameter	Unit	2006-2007	Source/ Remarks

[16] Source: http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

Build Margin Emission Factor - $EF_{grid,BM, y}$	tCO_2 / MWh	0.7054	'Baseline Carbon Dioxide Emission Database/Version 03' published by Central Electricity Authority (CEA), Government of India

Step-3: Calculation of the baseline emission factor (Combined Margin)

In accordance with the guidelines of the 'Tool to calculate the emission factor for an electricity system/ Version 02' , the baseline emission factor in year y is calculated as the average of the OM and BM emission factors, *i.e.* OM and BM are each weighted with 50%. As noted above, the resulting Combined Margin is calculated *ex-ante* as below and would remain fixed for the entire crediting period for the project activity under consideration.

$$EF_{elec, i, j, y} = EF_{elec,gr,j,y} = (w_{OM} \text{ x } EF_{grid,OM, y} + w_{BM} \text{ x } EF_{grid,BM, y})$$

Where:

$EF_{elec, i, j, y}$ = CO_2 emission factor for the electricity source *i* (*i.e.* the Southern Regional Grid), displaced due to the project activity during the year y (in tCO_2/MWh)

$EF_{grid,OM, y}$ = Operating Margin Emission Factor (in tCO_2/MWh)

$EF_{grid,BM, y}$ = Build Margin Emission Factor (in tCO_2/MWh)

w_{OM} = Weighing of Operating Margin Emission Factor (50%)

w_{BM} = Weighing of Build Margin Emission Factor (50%)

In accordance with this guidance, the Combined Margin Emission Factor for the Southern Regional Grid is calculated as below:

Determination of Combined Margin Emission Factor ($EF_{elec,i,j, y}$)			
Parameter	Unit	2006-2007	Source/ Remarks
CO_2 emission factor for the electricity source *i* (*i.e.* the Southern Regional Grid), displaced due to the project activity during the year y- $EF_{elec,gr,j,y}$	tCO_2 / MWh	0.8546	Calculated

Computation of Project Emissions

As per the guidance of the methodology, project emissions will include:

- Emissions from consumption of auxiliary fuel to supplement the heat content of the waste gas *i.e.* surplus BFG and
- Emissions from consumption of electrical energy for cleaning of waste gas *i.e.* surplus BFG prior to its utilization for generation of electrical energy or other supplementary electricity consumption

Therefore following the methodological guidance, the project emissions will be computed as:

$$PE_y = PE_{AF,y} + PE_{EL,y}$$

Where:

PE_y = Project emissions during the year y (in tonnes of CO_2)

$PE_{AF,y}$ = Project activity emissions from on-site consumption of fossil fuels by the power plant, in case they are used as supplementary fuels, due to non-availability of waste energy *i.e.* surplus BFG to the project activity or due to any other reason (in tonnes of CO_2)

$PE_{EL,y}$ = Project activity emissions from on-site consumption of electricity for gas cleaning equipment or other supplementary electricity consumption (in tonnes of CO_2)

'y' is any year within the proposed crediting period of the project activity.

Determination of Project Emissions due to auxiliary fossil fuel consumption

The project emissions from on-site fossil fuel consumption will be computed following the guidance of the methodology as given below:

$$PE_{AF,y} = \sum FF_{i,y} \times NCV_i \times EF_{CO2,i}$$

Where:

$PE_{AF,y}$ = Project activity emissions from on-site consumption of fossil fuels by the power plant, in case they are used as supplementary fuels, due to non-availability of waste energy *i.e.* surplus

BFG to the project activity or due to any other reason (in tonnes of CO_2)

$FF_{i,y}$ = Quantity of fossil fuel type *i* combusted to supplement waste energy in the project activity during the year y (in tonnes)

NCV_i = Net calorific value of the fossil fuel type *i* combusted as supplementary fuel (in TJ/ton)

$EF_{CO2,i}$ = CO_2 emission factor per unit of energy of the fuel type i (in tCO_2/TJ)

'y' is any year within the proposed crediting period of the project activity.

The above project emissions will result from fossil fuel consumption anywhere in the project activity power plant but not in the boilers. This is because the fossil fuel consumption in the boilers has already been accounted for while determination of f_{WCM} and the baseline emissions have been accordingly calculated. No such fossil fuel consumption in the project activity power plant is considered while computing the *ex-ante* emission reductions resulting from the project activity. However the same will be monitored during the proposed crediting period and in case of any consumption of auxiliary fuel in the project activity power plant (outside the boilers) for supplementing the heat content of the surplus BFG, emission from the same will be determined as given above and will be accounted for during the computation of emission reductions, annually on an *ex-post* basis.

Determination of Project Emissions due to electricity consumption for gas cleaning equipment or other supplementary electricity consumption

As stated above in Section B.3 of the PDD, no additional waste gas (*i.e.* surplus BFG) cleaning will be required in the project scenario than that in the baseline scenario. Therefore there will not be any additional electricity consumption due to cleaning of waste gas (*i.e.* surplus BFG) in the project scenario. However there may be supplementary electricity consumption in the project activity power plant under circumstances of turbine outages wherein the electricity will be sourced from the Southern Regional Grid to cater to the auxiliary power consumption of the power plant equipments. The same will be determined as:

$$PE_{EL,y} = EC_{PJ,y} \times EF_{CO2,El,y}$$

Where:

$PE_{EL,y}$ = Project activity emissions from other supplementary electricity consumption (in tonnes of CO_2)

$EC_{PJ,y}$ = Additional electricity consumed in year y as a result of the implementation of the project activity (MWh)

$EF_{CO2,EL,y}$ = CO_2 emission factor for electricity consumed by the project activity in year y (tCO_2/MWh)

As stated above, supplemental electricity will be consumed from the Southern Regional Grid. Therefore,

$$EF_{CO2,EL,y} = EF_{elec,i,j,y} = EF_{elec,gr,j,y}$$

The same will require to be calculated following the guidance provided in the "Tool to calculate the emission factor for an electricity system". In accordance with this guidance, the Central Electricity

Authority (CEA) of Government of India has calculated the CO_2 emission factor for the Southern Regional Grid and the same is made available in the 'Baseline Carbon Dioxide Emission Database/Version 03[17]'. The emission factor of Southern Regional Grid, as published by CEA, will be followed for the computation of project emissions resulting from the project activity and the same will remain fixed for the entire crediting period.

For the purpose of *ex-ante* computation of project emissions, no such electricity consumption has been considered. However the same will be monitored during the proposed crediting period and emission from the same will be determined as given above and will be accounted for during the computation of emission reductions, annually on an *ex-post* basis.

Computation of Leakage Emissions

The methodology does not require the project proponent to consider any leakage emissions.

Computation of Emission Reductions

As per the methodology, the emission reductions resulting from the project activity will be computed as

$$ER_y = \left(BE_y - PE_y\right)$$

where,

ER_y = Emission reductions resulting from the project activity during the year y (in tonnes of CO_2)

BE_y = Baseline emissions during the year y (in tonnes of CO_2)

PE_y = Project emissions during the year y (in tonnes of CO_2)

'y' is any year within the proposed crediting period of the project activity.

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

The following parameters, required for the computation of baseline emissions and project emissions (and hence emission reductions resulting from the project activity), are standard parameters which will not be monitored throughout the crediting period and will remain fixed for the entire crediting period. The same will be available during validation of the project activity.

Fixed parameters for the computation of Baseline Emissions

Data / Parameter:	$Q_{WCM,BL}$
Data unit:	Nm^3/annum
Description:	Quantity of waste energy *i.e.* Surplus BFG generated prior to the start of

[17] Source: http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm

	the project activity
Source of data used:	Manufacturer's Specification
Value applied:	489345789
Justification of the choice of data or description of measurement methods and procedures actually applied :	The parameter is calculated based on: ▪ Production associated with the relevant waste energy *i.e.* surplus BFG generation as it occurs in the baseline scenario ▪ Amount of waste energy *i.e.* surplus BFG per unit of product generated by the process (that generates waste energy *i.e.* surplus BFG) in the industrial facility
Any comment:	The parameter is calculated based on two parameters of higher accuracy level (as described below). Therefore the reliability of the parameter is ensured. This Parameters is related to the computation of f_{cap}

Data / Parameter:	$Q_{BL,product}$
Data unit:	tonnes/annum
Description:	Production (*i.e.* hot metal production) associated with the relevant waste energy *i.e.* surplus BFG generation as it occurs in the baseline scenario
Source of data used:	Manufacturer's Specification
Value applied	224595
Justification of the choice of data or description of measurement methods and procedures actually applied :	The parameter is considered from the Manufacturer's Specification on MBF-3 operation under normal operating conditions.
Any comment:	Consideration of manufacturer's data (third party data) will ensure the reliability of the parameter. This Parameters is related to the computation of f_{cap}

Data / Parameter:	$q_{wcm,product}$
Data unit:	Nm^3/ton
Description:	Amount of waste energy *i.e.* surplus BFG per unit of product (*i.e.* hot metal) generated by the process (that generates waste energy *i.e.* surplus BFG) in the industrial facility
Source of data used:	Manufacturer's Specification
Value applied	2179
Justification of the choice of data or description of measurement methods and procedures actually applied :	The parameter is considered from the Manufacturer's Specification on MBF-3 operation under normal operating conditions.
Any comment:	Consideration of manufacturer's data (third party data) will ensure the reliability of the parameter. This Parameters is related to the computation of f_{cap}

The Parameters related to computation of $f_{WCM\_}$ will be monitored during the proposed crediting period of the project activity. Please refer to Section B.7.1 of the PDD for further details.

Data / Parameter:	$EF_{elec,i,j,y}$ (= $EF_{elec,gr,j,y}$)
Data unit:	tCO_2/MWh
Description:	CO_2 emission factor for the electricity source *i* (*i.e.* the Southern Regional Grid), displaced due to the project activity during the year y
Source of data used:	'Baseline Carbon Dioxide Emission Database/Version 03[18]', published by Central Electricity Authority (CEA), Government of India
Value applied	0.8546
Justification of the choice of data or description of measurement methods and procedures actually applied :	The parameter is calculated by the Central Electricity Authority (CEA), Government of India following the 'Tool to calculate the emission factor for an electricity system'.
Any comment:	This Parameters related to computation of $EF_{elec,i,j,y}$ The parameter is calculated following the tool approved by UNFCCC by the Central Electricity Authority (CEA), Government of India. Consideration of the data from a government database will ensure the reliability of the parameter.

Fixed parameters for the computation of Project Emissions

Project Emissions due to auxiliary fossil fuel consumption

The parameters required for the computation of project emissions due to auxiliary fossil fuel consumption will be monitored during the proposed crediting period of the project activity. Please refer to Section B.7.1 of the PDD for further details.

Project Emissions due to electricity consumption for supplementary electricity consumption

Data / Parameter:	$EF_{CO2,EL,y}$ ($=EF_{elec,i,j,y} = EF_{elec,gr,j,y}$)
Data unit:	tCO_2/MWh
Description:	CO_2 emission factor for electricity consumed by the project activity in year y
Source of data used:	'Baseline Carbon Dioxide Emission Database/Version 03[19]', published by Central Electricity Authority (CEA), Government of India

[18] Source: http://www.cea.nic.in/planning/c%20and%20e/user_guide_ver3.pdf

[19] Source: http://www.cea.nic.in/planning/c%20and%20e/user_guide_ver3.pdf

Value applied	0.8546
Justification of the choice of data or description of measurement methods and procedures actually applied :	The parameter is calculated by the Central Electricity Authority (CEA), Government of India following the 'Tool to calculate the emission factor for an electricity system'.
Any comment:	The parameter is calculated following the tool approved by UNFCCC by the Central Electricity Authority (CEA), Government of India. Consideration of the data from a government database will ensure the reliability of the parameter.

B.6.3 Ex-ante calculation of emission reductions:

Computation of *ex-ante* Baseline Emissions

In accordance with the guidelines of Section B.6.1, the *ex-ante* baseline emission is computed as:

$$BE_y = BE_{En,y} = BE_{Elec,y} = f_{cap} \times f_{wcm} \times \sum_j \sum_i \left(EG_{i,j,y} \times EF_{Elec,i,j,y}\right)$$

The following section details the *ex-ante* computation of baseline emissions in a step-wise manner:

Determination of f_{cap}

In accordance with the guidelines of Section B.6.1, the *ex-ante* f_{cap} is determined as given below:

$$f_{cap} = \frac{Q_{WCM,BL}}{Q_{WCM,y}}$$

In accordance with the guidelines of Section B.6.1, $Q_{WCM,BL}$ is calculated as:

$$\begin{aligned} Q_{WCM,BL} &= Q_{BL,product} \times q_{wcm,product} \\ &= 224595 \times 2179 \\ &= 489345789 \end{aligned}$$

Where,

Notation	Parameter Description	Unit	Value
$Q_{BL,product}$	Production associated with the relevant waste energy *i.e.* surplus BFG generation as it occurs in the baseline scenario determined as given below	ton	224595
$q_{wcm,product}$	Amount of waste energy *i.e.* surplus BFG per unit of product generated by the process (that generates waste energy *i.e.* surplus BFG) in the industrial facility	Nm^3/ton	2179

$Q_{WCM,BL}$	Quantity of waste energy *i.e.* Surplus BFG generated prior to the start of the project activity, calculated as given below	Nm^3	489345789

For *ex-ante* computation of baseline emission, $Q_{WCM,y}$ is considered to be same as that of $Q_{WCM,BL}$. However the same will be monitored on an *ex-post* basis during the crediting period of the project activity. Therefore for *ex-ante* computation of baseline emission:

Notation	Parameter Description	Unit	Value
$Q_{WCM,y}$	Quantity of WECM *i.e.* surplus BFG used for energy generation during year y	Nm^3	489345789

Therefore for *ex-ante* computation of baseline emission:

$$f_{cap} = \frac{Q_{WCM,BL}}{Q_{WCM,y}} = \frac{489345789}{489345789} = 1$$

Determination of f_{WCM}

In accordance with the guidelines of Section B.6.1, the *ex-ante* f_{WCM} is determined as given below:

$$f_{WCM} = \frac{\dfrac{\sum_{h=1}^{8760} Q_{WCM,h} \times NCV_{WCM,y}}{H_r}}{EG_{tot,y}}$$

For *ex-ante* computation of baseline emissions,

Notation	Parameter Description	Unit	Value
$Q_{WCM,h}$	Quantity of WECM *i.e.* surplus BFG recovered in hour	Nm^3/h	63548
$NCV_{WCM,y}$	Net Calorific Value of WECM *i.e.* surplus BFG in year y	TJ/Nm^3	0.0000026752
$EG_{tot,y}$	Total annual energy produced at the power plant	TJ/year	379

For *ex-ante* computation of baseline emissions, H_r is calculated as:

$$H_r = \frac{\sum_{h=1}^{8760}\sum_{i=1}^{I} Q_{i,h} \times NCV_i}{EG_{tot,y}}$$

$$= \frac{\left(Q_{WCM,h} \times NCV_{WCM,y} + Q_{i,h} \times NCV_i\right)}{EG_{tot,y}}$$

$$= \frac{(63548 \times 0.0000026752 + 0.491 \times 0.0418)}{379}$$

$$= 3.9$$

Notation	Parameter Description	Unit	Value
$Q_{WCM,h}$	Quantity of WECM *i.e.* surplus BFG recovered in hour	Nm^3/h	63548
$NCV_{WCM,y}$	Net Calorific Value of WECM *i.e.* surplus BFG in year y	TJ/Nm^3	0.0000026752
$Q_{i,h}$	Amount of individual fuel i *i.e.* furnace oil consumed at the energy generation unit *i.e.* the power plant during hour h	ton/h	0.491
NCV_i	Net Calorific Value (annual average) of individual fuel (WECM *i.e.* surplus BFG and other fuel) i *i.e.* furnace oil consumed at the energy generation unit *i.e.* the power plant	TJ/ton	0.0418
$EG_{tot,y}$	Total annual energy produced at the power plant	TJ/year	379
H_r	Average heat rate of the power plant where electricity is produced (1/efficiency), calculated as given below		3.9

Therefore for *ex-ante* computation of baseline emission:

$$f_{WCM} = \frac{\dfrac{\sum_{h=1}^{8760} Q_{WCM,h} \times NCV_{WCM,y}}{H_r}}{EG_{tot,y}}$$

$$= \frac{\left(\dfrac{63548 \times 0.0000026752}{3.9}\right)}{379}$$

$$= 0.88$$

<u>Determination of $EG_{i,j,y}$</u>

For *ex-ante* computation of baseline emissions, $EG_{i,j,y}$ = 94779 MWh/annum. However the same will be monitored on an ex-post basis during the crediting period of the project activity.

Determination of $EF_{elec,i,j,y}$

For *ex-ante* computation of baseline emissions, $EF_{elec,i,j,y}$ is determined following the guidance provided in the 'Tool to calculate the emission factor for an electricity system/ Version 02' as a combined margin emission factor for Southern Regional Grid and the same is found to be 0.8546 tCO_2/MWh. The same will remain fixed for the entire crediting period for the project activity under consideration.

Therefore, the *ex-ante* baseline emission is calculated as:

$$BE_y = f_{cap} \times f_{wcm} \times \sum_j \sum_i \left(EG_{i,j,y} \times EF_{Elec,i,j,y} \right)$$
$$= 1 \times 0.88 \times 94779 \times 0.8546$$
$$= 71581$$

Where:

Notation	Parameter Description	Unit	Value
f_{cap}	Energy that would have been produced in project year y using waste energy (*i.e.* surplus BFG) generated in base year expressed as a fraction of total energy produced using waste source in year y, determined as given below.	-	1
f_{wcm}	Fraction of total electricity generated by the project activity using waste energy (*i.e.* surplus BFG), calculated as given below	-	0.88
$EG_{i,j,y}$	Quantity of electricity supplied to the recipient *j* by generator, that in the absence of the project activity would have been sourced from the i^{th} source (*i.e.* the Southern Regional Grid) during the year y	MWh/year	94779
$EF_{elec,i,j,y}$	CO_2 emission factor for the electricity source *i* (*i.e.* the Southern Regional Grid), displaced due to the project activity during the year y	tCO_2/MWh	0.8546
$BE_{En,y}$	Baseline emissions during the year y	tonnes of CO_2	71581

Computation of *ex-ante* Project Emissions

In accordance with the guidelines of Section B.6.1, the *ex-ante* project emission is computed as:

$$PE_y = PE_{AF,y} + PE_{EL,y}$$

The following section details the *ex-ante* computation of project emissions in a step-wise manner:

Determination of $PE_{AF,y}$

In accordance with the guidelines of Section B.6.1, the *ex-ante* $PE_{AF,y}$ is determined as given below:

$$PE_{AF,y} = \sum FF_{i,y} \times NCV_i \times EF_{CO2,i}$$

Where:

Notation	Parameter Description	Unit
$PE_{AF,y}$	Project activity emissions from on-site consumption of fossil fuels by the power plant, in case they are used as supplementary fuels, due to non-availability of waste energy *i.e.* surplus BFG to the project activity or due to any other reason	tonnes of CO_2
$FF_{i,y}$	Quantity of fossil fuel type *i* combusted to supplement waste energy in the project activity during the year y	tonnes of CO_2
NCV_i	Net calorific value of the fossil fuel type *i* combusted as supplementary fuel	TJ/ton
$EF_{CO2,i}$	CO_2 emission factor per unit of energy of the fuel type i	tCO_2/TJ

However no such fossil fuel consumption in the project activity power plant is considered during computation of *ex-ante* project emissions *i.e.* for *ex-ante* computation of project emissions,

$$FF_{i,y} = 0$$

The same will, however, be monitored during the proposed crediting period and in case of any consumption of auxiliary fuel in the project activity power plant (outside the boilers) for supplementing the heat content of the surplus BFG, emission from the same will be determined as given above and will be deducted as project emissions annually on an *ex-post* basis.

Therefore, for *ex-ante* computation of project emissions;

$$PE_{AF,y} = 0$$

Determination of $PE_{EL,y}$

In accordance with the guidelines of Section B.6.1, the *ex-ante* $PE_{EL,y}$ is determined as given below:

$$PE_{EL,y} = EC_{PJ,y} \times EF_{CO2,El,y}$$

Where:

Notation	Parameter Description	Unit
$PE_{EL,y}$	Project activity emissions from other supplementary electricity consumption	tonnes of CO_2

$EC_{PJ,y}$	Additional electricity consumed in year y as a result of the implementation of the project activity	MWh
$EF_{CO2,EL,y}$	CO_2 emission factor for electricity consumed by the project activity in year y	tCO_2/MWh

However no such supplementary electricity consumption in the project activity power plant under circumstances of turbine outages is considered during computation of *ex-ante* project emissions. *i.e.* for *ex-ante* computation of project emissions,

$$EC_{PJ,y} = 0$$

The same will, however, be monitored during the proposed crediting period and in case of any consumption of supplementary electricity in the project activity power plant, emission from the same will be determined as given above and will be deducted as project emissions annually on an *ex-post* basis.

Therefore, for *ex-ante* computation of project emissions;

$$PE_{EL,y} = 0$$

Therefore, the *ex-ante* project emission is calculated as:

$$\begin{aligned} PE_y &= PE_{AF,y} + PE_{EL,y} \\ &= 0 + 0 \\ &= 0 \end{aligned}$$

Where:

Notation	Parameter Description	Unit	Value
$PE_{AF,y}$	Project activity emissions from on-site consumption of fossil fuels by the power plant, in case they are used as supplementary fuels, due to non-availability of waste energy *i.e.* surplus BFG to the project activity or due to any other reason	tonnes of CO_2	0
$PE_{EL,y}$	Project activity emissions from on-site consumption of electricity for gas cleaning equipment or other supplementary electricity consumption	tonnes of CO_2	0
PE_y	Project emissions during the year y	tonnes of CO_2	0

Computation of *ex-ante* Leakage Emissions

In accordance with the guidelines of Section B.6.1, there is no leakage emission from the project activity.

Computation of *ex-ante* Emission Reductions

In accordance with the guidelines of Section B.6.1, the emission reductions resulting from the project activity is computed as:

$$ER_y = (BE_y - PE_y)$$
$$= (71581 - 0)$$
$$= 71581$$

Where:

Notation	Parameter Description	Unit	Value
BE_y	Baseline emissions during the year y	tonnes of CO_2	71581
PE_y	Project emissions during the year y	tonnes of CO_2	0
ER_y	Emission reductions resulting from the project activity during the year y	tonnes of CO_2	71581

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

Year	Estimation of Proposed project activity Emission reductions (tonnes of CO_2 e)	Estimation of baseline Emissions reductions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of emission reductions (tonnes of CO_2 e)
Year 1	0	71581	0	71581
Year 2	0	71581	0	71581
Year 3	0	71581	0	71581
Year 4	0	71581	0	71581
Year 5	0	71581	0	71581
Year 6	0	71581	0	71581
Year 7	0	71581	0	71581
Year 8	0	71581	0	71581
Year 9	0	71581	0	71581
Year 10	0	71581	0	71581
Total (tonnes of CO_2 e)	**0**	**7,15,810**	**0**	**7,15,810**

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

Title: Consolidated monitoring methodology for GHG emission reductions from waste energy recovery projects

Reference: Approved consolidated monitoring methodology ACM0012/ Version 03.2 Sectoral Scope 01 and 04, EB 51

B.7.1 Data and parameters monitored:

The approved consolidated monitoring methodology requires the project proponent to monitor the following parameters for the computation of baseline emissions, project emissions and hence the emission reductions resulting from the project activity. The parameters and the monitoring procedures are detailed below:

Parameters to be monitored for the computation of Baseline Emissions

1. Parameters related to computation of f_{cap}

Data / Parameter:	$Q_{WCM,y}$
Data unit:	Nm^3/annum
Description:	Quantity of WECM *i.e.* surplus BFG used for energy generation during year y
Source of data to be used:	Plant Records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	489345789
Description of measurement methods and procedures to be applied:	The parameter will be monitored continuously with flow meter before it enters the power plant boiler and recorded on a daily basis. The same will also be available in the power plant Programmable Logic Control (PLC) System. The data will be archived both electronically and in paper for the entire crediting period and two years after.
QA/QC procedures to be applied:	The flow meter will be calibrated on an annual basis. The Head (Power Plant) will be responsible for regular calibration of the flow meter.
Any comment:	The uncertainty level of the parameter will be low since the same will be monitored with calibrated meter. Furthermore the parameter can be cross-checked with the difference between the 'BFG generation (from MBF-3) data' and the 'BFG consumption (from MBF-3) data' at other consumption areas in the steel plant.

2. Parameters related to computation of f_{WCM}

Data / Parameter:	$Q_{WCM,h}$
Data unit:	Nm^3/h
Description:	Quantity of WECM *i.e.* surplus BFG recovered in hour h
Source of data to be used:	Plant Records
Value of data applied	63458

for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	The parameter will be monitored continuously with flow meter before it enters the power plant boiler and recorded on a daily basis. The same will also be available in the power plant Programmable Logic Control (PLC) System and will be integrated to determine the annual quantity of WECM *i.e.* surplus BFG used for energy generation (*i.e.* $Q_{WCM,y}$). The data will be archived both electronically and in paper for the entire crediting period and two years after.
QA/QC procedures to be applied:	Yes-The flow meter will be calibrated on an annual basis. The Head (Power Plant) will be responsible for regular calibration of the flow meter.
Any comment:	The uncertainty level of the parameter will be low since the same will be monitored with calibrated meter. Furthermore the parameter can be cross-checked with the difference between the 'BFG generation (from MBF-3) data' and the 'BFG consumption (from MBF-3) data' at other consumption areas in the steel plant.

Data / Parameter:	$NCV_{WCM,y}$
Data unit:	TJ/Nm^3
Description:	Net Calorific Value of WECM *i.e.* surplus BFG in year y
Source of data to be used:	Plant Records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	2.6752×10^{-6}
Description of measurement methods and procedures to be applied:	The parameter will be monitored in-house on a monthly basis following the standard testing procedure and an annualised average value will be considered. The data will be archived both electronically and in paper for the entire crediting period and two years after.
QA/QC procedures to be applied:	Yes-The process of collection of BFG samples and adherence to the standard testing procedure will be reviewed annually by the Head (Power Plant).
Any comment:	BFG samples will be collected manually with the help of bladders. Composition of BFG will be determined with the help of Orsat Apparatus with laboratory grade chemicals following the standard testing procedure. Net calorific value of BFG will therefore be determined based on the standard calorific values of individual components in BFG. The standard testing procedure and values used for determination of composition and net calorific value of BFG will ensure the reliability of the parameter and hence the uncertainty level of the parameter will be low.

Data / Parameter:	$Q_{i,h}$
Data unit:	Nm^3/h and ton/h
Description:	Amount of individual fuel (WECM *i.e.* surplus BFG and other fuel) i consumed at the energy generation unit *i.e.* the power plant during hour h

Source of data to be used:	Plant Records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	BFG- 63458 Nm^3/h Furnace Oil- 0.491 ton/h LPG- 0 (It is to be noted that the LPG consumption is found to be negligible and hence for *ex-ante* computation of emission reduction, the same has been considered to be zero. But the same will be monitored on an *ex-post* basis during the crediting period of the project activity.)
Description of measurement methods and procedures to be applied:	Surplus BFG consumed in the power plant boiler will be monitored as per the guidance provided for the parameter $Q_{WCM,h.}$ In case of Furnace Oil and LPG consumption in the power plant boiler, it will be monitored continuously with flow meter and recorded on a daily basis. The same will also be available in the power plant Programmable Logic Control (PLC) System and will be integrated to determine the annual quantity of Furnace Oil and LPG used for energy generation in the power plant boiler. The data will be archived both electronically and in paper for the entire crediting period and two years after.
QA/QC procedures to be applied:	Yes-The flow meters will be calibrated on an annual basis. The Head (Power Plant) will be responsible for regular calibration of the flow meter.
Any comment:	The uncertainty level of the parameter will be low since the same will be monitored with calibrated flow meter.

Data / Parameter:	NCV_i
Data unit:	TJ/Nm^3 and TJ/ton
Description:	Net Calorific Value (annual average) of individual fuel (WECM *i.e.* surplus BFG and other fuel) i consumed at the energy generation unit *i.e.* the power plant
Source of data to be used:	Plant Records/ National Sources/ 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value of data applied for the purpose of calculating expected emission reductions in section B.5	BFG- 2.6752×10^{-6} Furnace Oil- 0.0418 LPG- 0.0473
Description of measurement methods and procedures to be applied:	The net calorific value of BFG consumed in the power plant boiler will be monitored as per the guidance provided in $NCV_{WCM,y}$. In case of Furnace Oil consumed in the power plant boiler, the net calorific value of Furnace Oil will be determined on a monthly basis following the standard testing practice. An annualised average value will be considered. In absence of plant specific data, country specific data or IPCC default values will be used. In case of LPG, country specific data or IPCC default values will be used. The data will be archived both electronically and in paper for the entire crediting period and two years after.
QA/QC procedures to be applied:	Yes-For Furnace Oil, the adherence to the monthly testing practice will be reviewed annually by the Head (Power Plant).
Any comment:	Determination of the parameter following the standard testing practice will ensure the reliability of the parameter. In absence of authentic plant specific data, country specific data or IPCC default values will be used to

	ensure reliability of the parameter.

Data / Parameter:	$EG_{tot,y}$
Data unit:	TJ/year
Description:	Total annual energy (electricity) produced at the power plant
Source of data to be used:	Plant Records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	379
Description of measurement methods and procedures to be applied:	The parameter will be measured continuously with energy meter and will be recorded on a monthly basis. The same will also be available in the power plant Programmable Logic Control (PLC) System and will be integrated to determine the annual electricity generation at the power plant. The data will be archived both electronically and in paper for the entire crediting period and two years after.
QA/QC procedures to be applied:	Yes-The energy meter will be calibrated on an annual basis. The Head (Power Plant) will be responsible for regular calibration of the energy meter.
Any comment:	The uncertainty level of the parameter will be low since the same will be monitored with calibrated energy meter. The parameter can also be cross-checked with the sum of the 'quantity of electricity supplied to the recipient *j* by generator ($EG_{i,j,y}$)' and the 'auxiliary electricity consumption of the power plant equipments'.

Data / Parameter:	H_r
Data unit:	-
Description:	Average heat rate of the power plant where electricity is produced
Source of data to be used:	Plant Records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	3.9
Description of measurement methods and procedures to be applied:	The parameter is calculated on an annual basis following the guidance of the methodology based on the following parameters: ▪ Amount of individual fuel (WECM *i.e.* surplus BFG and other fuel) i consumed at the energy generation unit *i.e.* the power plant during hour h ($Q_{i,h}$) ▪ Net Calorific Value (annual average) of individual fuel (WECM *i.e.* surplus BFG and other fuel) i consumed at the energy generation unit *i.e.* the power plant (NCV_i) and ▪ Total annual energy (electricity) produced at the power plant ($EG_{tot,y}$) The data will be archived both electronically and in paper for the entire crediting period and two years after.
QA/QC procedures to	Yes-QA/OC procedure as explained under the individual parameters (*i.e.*

be applied:	$Q_{i,h}$, NCV_i and $EG_{tot,y}$) will be followed.
Any comment:	The uncertainty level of the parameter will be low since the same will be calculated with parameters of lower uncertainty levels.

3. Parameters related to computation of $EG_{i,j,y}$

Data / Parameter:	$EG_{i,j,y}$
Data unit:	MWh
Description:	Quantity of electricity supplied to the recipient *j* by generator, that in the absence of the project activity would have been sourced from the i^{th} source (*i.e.* the Southern Regional Grid) during the year y
Source of data to be used:	Plant Records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	94779
Description of measurement methods and procedures to be applied:	The parameter will be measured continuously with energy meters and will be recorded on a monthly basis. The same will also be available in the power plant Programmable Logic Control (PLC) System and will be integrated to determine the annual quantity of electricity supplied to the recipients by the power plant. The data will be archived both electronically and in paper for the entire crediting period and two years after.
QA/QC procedures to be applied:	Yes-The energy meters will be calibrated on an annual basis. The Head (Power Plant) will be responsible for regular calibration of the energy meters.
Any comment:	The uncertainty level of the parameter will be low since the same will be monitored with calibrated energy meters. The parameter can also be cross-checked as the difference between the 'total annual energy (electricity) produced at the power plant ($EG_{tot,y}$)' and the 'auxiliary electricity consumption of the power plant equipments'.

4. Parameters related to computation of $EF_{elec,i,j,y}$

The parameter will be monitored once at the start of the crediting period and will remain fixed for the entire crediting period. Please refer to Section B.6.2 of the PDD for further details.

Parameters to be monitored for the computation of Project Emissions

Parameters related to computation of Project Emissions due to fossil fuel consumption

Data / Parameter:	$FF_{i,y}$
Data unit:	tonnes
Description:	Quantity of fossil fuel type *i* combusted in the project activity during the year y
Source of data to be used:	Plant Records

Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	The parameter will correspond to fossil fuel consumption (LPG) in the power plant boiler for pilot flame. The same will be measured with a properly calibrated flow meter/weighing system and recorded on a daily basis. The data will be archived both electronically and in paper for the entire crediting period and two years after. The value for this parameter has been kept zero (0) for ex-ante calculation. The same shall be monitored ex-post and would be considered under project emission.
QA/QC procedures to be applied:	Yes-The flow meter/weighing system will be calibrated on an annual basis. The Head (Power Plant) will be responsible for regular calibration of the flow meter/weighing system.
Any comment:	Regular calibration of the flow meter/weighing system will ensure the reliability of the parameter.

Data / Parameter:	$NCV_{Supplementary,i}$
Data unit:	TJ/ton
Description:	Net calorific value of the fossil fuel type *i* combusted as supplementary fuel
Source of data to be used:	Plant Records/ National Sources/ 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.0473 (for LPG) 0.0418 (for Furnace Oil)
Description of measurement methods and procedures to be applied:	The parameter will be determined following the standard testing practice on a monthly basis as and when required. An annualised average value will be considered. In absence of plant specific data, country specific data or IPCC default values will be used. The data will be archived both electronically and in paper for the entire crediting period and two years after.
QA/QC procedures to be applied:	Yes-Adherence to the standard testing practice will be reviewed by the Head (Power Plant) as and when required.
Any comment:	Determination of the parameter following the standard testing practice will ensure the reliability of the parameter. In absence of authentic plant specific data, country specific data or IPCC default values will be used to ensure reliability of the parameter.

Data / Parameter:	$EF_{CO2,i}$
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor per unit of energy of the fuel type i
Source of data to be used:	Plant Records/ National Sources/ 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Value of data applied for the purpose of calculating expected emission reductions in section B.5	63.1 (considering LPG) 77.4 (considering Furnace Oil)
Description of measurement methods and procedures to be applied:	The parameter will be determined following the standard testing practice on a monthly basis as and when required. An annualised average value will be considered. In absence of plant specific data, country specific data or IPCC default values will be used. The data will be archived both electronically and in paper for the entire crediting period and two years after.
QA/QC procedures to be applied:	Yes-Adherence to the standard testing practice will be reviewed by the Head (Power Plant) as and when required.
Any comment:	Determination of the parameter following the standard testing practice will ensure the reliability of the parameter. In absence of authentic plant specific data, country specific data or IPCC default values will be used to ensure reliability of the parameter.

Parameters related to computation of Project Emissions due to supplementary electricity consumption

Data / Parameter:	$EC_{PJ,y}$
Data unit:	MWh
Description:	Additional electricity consumed in year y as a result of the implementation of the project activity
Source of data to be used:	Plant Records
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0
Description of measurement methods and procedures to be applied:	The parameter will correspond to supplementary electricity consumption in the project activity power plant under circumstances of turbine outages wherein the electricity will be sourced from the Southern Regional Grid to cater to the auxiliary power consumption of the power plant equipments. The parameter will be measured continuously with energy meters and will be recorded on a daily basis under circumstances of turbine outages. The same will also be available in the power plant Programmable Logic Control (PLC) System and will be integrated to determine the annual quantity of additional electricity consumed as result of project activity implementation. The data will be archived both electronically and in paper for the entire crediting period and two years after.
QA/QC procedures to be applied:	Yes-The energy meters will be calibrated on an annual basis. The Head (Power Plant) will be responsible for regular calibration of the energy meters.
Any comment:	The uncertainty level of the parameter will be low since the same will be monitored with calibrated energy meters. Calibration of energy meters will be conducted on an annual basis.

The parameter-'CO_2 emission factor for electricity consumed by the project activity in year y ($EF_{CO2,EL,y}$)' will be monitored once at the start of the crediting period and will remain fixed for the entire crediting period. Please refer to Section B.6.2 of the PDD for further details.

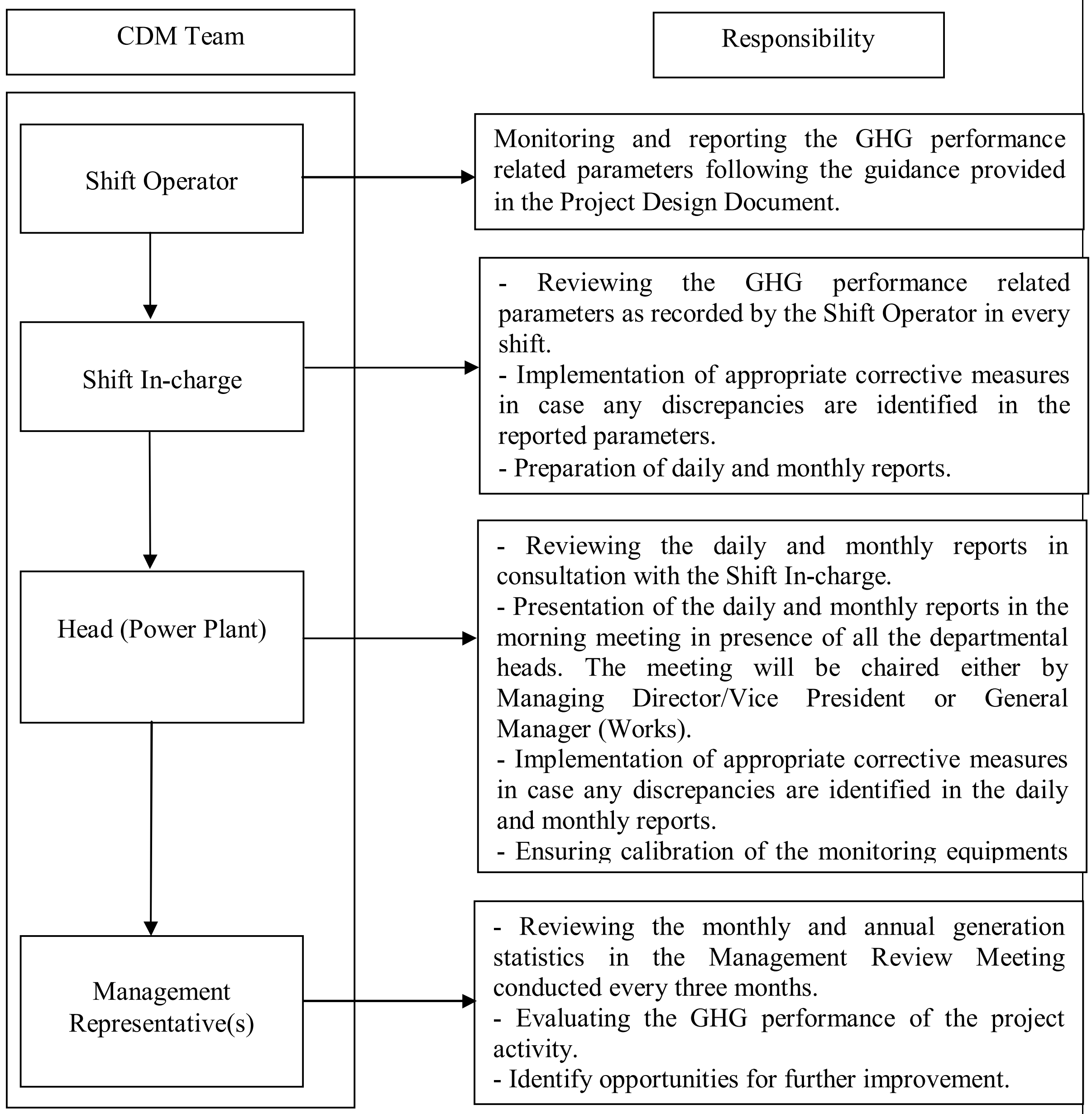
B.7.2 Description of the monitoring plan:

The project activity will result in emission reductions by generating power with the thermal energy content of the surplus BFG emanated from MBF-3 thereby offsetting more carbon intensive power generation at the Southern Regional Grid. The financial performance of the project activity depends significantly on the CDM revenue to be availed through sale of Certified Emission Reduction (CER) units accrued from the project activity. This will require proper monitoring of all the relevant GHG performance parameters. Therefore the project proponent has developed a robust monitoring protocol which will be followed throughout the proposed crediting period in order to ensure proper operation of the project activity resulting in generation of carbon credits. This includes a range of data measurement, estimation and collection options/techniques in each case indicating preferred options consistent with good practices to allow project managers and operational staff, auditors, and verifiers to apply the most practical measurement approaches for the project activity. The same is explained below:

Monitoring Plan
1.0 Objective
▪ To ensure proper monitoring and recording of all the parameters required for the computation of emission reductions from the project activity ▪ To ensure proper evaluation of the project activity performance at regular intervals ▪ To identify the discrepancies in the data monitoring, recording and archiving system and to open up the opportunities for future improvement
2.0 Instrumentation and Control System
The instrumentation and control system is the key aspect for salubrious functioning of any monitoring and verification system of a project activity. The project activity has employed the state of the art monitoring and control equipment that will measure, record, report, monitor and control various key parameters like quantity of surplus BFG utilised for power generation, total power generated, net power generation, additional electricity consumption in the power plant equipments under circumstances of turbine outages, any fossil fuel consumption, its calorific value and CO_2

emission factor. The instrumentation and control system for the power plant will be designed with monitoring devices having adequate provisions to control and monitor the various operating parameters for safe and efficient operation of the Boiler and the Steam Turbo-Generator set. All instruments and meters shall be calibrated at regular intervals (as indicated in Section B.7.1 against each parameter) so that the accuracy of measurement can be ensured all the time. The calibration frequency too is a part of the monitoring system. In case of any discrepancy identified in the monitoring equipment, the same will be tested for accuracy and if required, replaced immediately with stand-by monitoring equipment. The Head (Power Plant) will be responsible for periodic testing of the monitoring equipment and replacement of the same in case of emergency.
3.0 Roles and Responsibilities

The project proponent has developed a 'CDM Team' who will be involved in monitoring, reporting and verification of all the GHG performance related parameters. The following schematic diagram will explain the individual roles and responsibilities of all the members of the 'CDM Team':



4.0 Internal Audit

Internal Audit will be conducted once in a year in order to assess the GHG performance of the

project activity. Auditors will consist of people from different departments of Mukand Limited. The audit findings and the necessary corrective actions will be documented and reported to the Management Representative(s) for their immediate actions. The Plant Management will also be informed on the same. Compliance with the audit findings and evaluation of implementation of the corrective actions will be a part of the subsequent audit.
5.0 Experience and Training
The Head (Power Plant) will be qualified engineer/ diploma holder with prior work experience. The Shift In-charge will be diploma holder. All the Shift Operators will be provided with extensive on-the-job trainings under the guidance of the Shift In-charge which will include training on plant operations, data monitoring and report generation.

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)

Parameter	Details
Date of completing the final draft of this baseline selection and monitoring plan	08/10/2010
Name of person/ entity determining the baseline and establishing the monitoring plan	Mukand Limited
Note: The contact information for the project proponent, Mukand Limited, is provided in Annex-1 of this Project Design Document (PDD).	

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:

01/06/2007- Advance payment to ISGEC John Thompson (boiler supplier)

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

15 years 0 month

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

C.2.1. Renewable crediting period

Not Applicable

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

Not Applicable

C.2.1.2. Length of the first crediting period:

Not Applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/12/2011 or the date of registration of the project activity with UNFCCC or date of commissioning of the power plant, whichever is the latest.

C.2.2.2. Length:

10 years 0 month

SECTION D. Environmental impacts

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

A detailed environmental impact assessment has been conducted by Kirloskar Consultants for the steel plant of Mukand Limited which also includes all the environmental aspects of the project activity under consideration. The study primarily includes identifying the key environmental parameters and evaluating the impact of the project activity on these parameters throughout its lifetime. The same has been broadly classified during three distinct phases of the project activity implementation namely:

- Impacts during construction phase
- Impacts during operational phase
- Impacts during maintenance phase

The significant findings of the evaluation and the major environmental management plans that will be undertaken by Mukand Limited are detailed below:

Construction Phase		
Activity: The project activity entails the utilization of the surplus BFG for generation of steam and subsequently power. The construction phase of the project activity primarily involves construction of the entire power plant, erection of the BFG/Furnace Oil fired boiler, the Steam Turbo-Generator set and other power plant equipments. All these activities have minor impacts on the following baseline parameters as mentioned below		
Environmental /Social Parameters	Impacts / Activities	Recommendations/ Implementation / Remarks
Air	There will be negligible impacts on the local air quality during the construction phase of the project activity. The effects being temporary will not cause any major adverse impacts on the local air quality.	Mukand Limited will ensure that all the ambient air quality parameters are well within the statutory limits as suggested by the Pollution Control Board.
Soil	There will be a little amount of soil movement during the construction phase due to site levelling operations and erection of the utilities.	The impacts will be stabilized during the operational phase of the project activity. Hence, soil conservation and afforestation programmes will not be required.

Noise	There will be a change in noise levels during the construction phase due to various construction activities.	The colonies are located far away from the plant site thereby ensuring no significant adverse impacts on the local habitats.
Social and Economic Standard	No dislocation of population will be required to facilitate the construction activities since the same will be undertaken within the plant premise of Mukand Limited. Furthermore the project activity will generate job opportunities thereby improving the living standard of the employees.	No rehabilitation of population will therefore be required.

Operational Phase		
Activity: During operational phase, the project activity will utilize the surplus BFG as the fuel source in the boiler for the generation of steam and subsequently power in the Steam Turbo-generator set. Furnace Oil will also be used to supplement the thermal energy content of the surplus BFG. The effects are tabulated below:		
Environmental /Social Parameters	Impacts / Activities	Recommendations/ Implementation / Remarks
Energy Conservation	The project activity will utilise the surplus BFG, which is currently being flared, to generate useful energy in the form of power	This is an excellent initiative of 'waste to energy generation' thereby preventing the loss of energy.
Natural Resource Conservation	The project activity will replace import of electricity from the fossil-fuel dominated grid connected power plants, thus resulting in the conservation of fossil fuel.	This is a positive step towards non-renewable resource – fossil fuel conservation.
Ambient Air Quality	The Ambient Air Quality at different locations inside the steel plant and the township is well within the statutory limits. The project activity will further improve the local air quality by preventing the emissions of CO_2 due to fossil fuel combustion at the grid connected power plants.	This is a positive step towards air quality improvement. Mukand Limited will be monitoring constantly all the Ambient Air Quality parameters and non-conformance of any one of them with the prescribed standard will be addressed with top priority.
Solid Waste Management	The project activity will offset electricity import from the fossil fuel dominated grid connected power plants through utilization of surplus BFGs for power	Since in the project scenario, only surplus BFG will be used as the primary fuel source for power

Operational Phase		
Activity: During operational phase, the project activity will utilize the surplus BFG as the fuel source in the boiler for the generation of steam and subsequently power in the Steam Turbo-generator set. Furnace Oil will also be used to supplement the thermal energy content of the surplus BFG. The effects are tabulated below:		
Environmental /Social Parameters	Impacts / Activities	Recommendations/ Implementation / Remarks
	generation. Hence there will no solid waste from the power plant.	generation, it will not lead to any solid waste generation. So solid waste management plan is not required.
Ground Water Quality	The ground water quality is dependent on the natural geological formations and can be affected by industrial discharges under unfavourable structural geological conditions, which permit leaching into the ground water table. Ground water quality in the region is found to be well within the prescribed limits of IS: 10500	Quantity of wastewater generated due to the project activity will be 230 m^3/day which will be sent to Guard Pond and it is completely used for gardening and dust suppression. Therefore the impact on ground water is insignificant
Noise Generation	During the operation of turbines and generators, minimum amount of noise will be generated. However no increment in noise level is envisaged with the implementation of the project activity.	Regular noise monitoring will be done inside and outside the works premises to identify noise prone areas and immediate measures will be undertaken in case the noise level exceeds the stipulated level.
Social	This project activity will lead to employment opportunities for the local people thereby improving the quality of life of low-income classes. A pollution free work area will ensure safety and health of the employees at the workplace.	Mukand Limited is always committed to provide better work area environment at shop floor. Upkeep of the workplace, proactive maintenance and effective running of the pollution control devices contribute substantially in maintaining the work area environment.

Maintenance Phase

Activity: Every year, there will be a shut down period for the boiler and turbine for proper maintenance of the utilities. Since this will be for a very short span of time, hence no significant environmental effects are envisaged during this phase. The only impact during this phase, as envisaged, is detailed below:		
Environmental /Social Parameters	Impacts / Activities	Recommendations/ Implementation / Remarks
Solid Waste Management	In the maintenance phase some boiler soot, oily cloth, waste and scrap will be generated after cleaning but it will not cause any adverse impact on the environment.	All out efforts will be made to increase the reuse and recycle of solid wastes to improve the business performance as well as the environmental performance of the organization.

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

The above evaluation demonstrates that the project activity is a cleaner mean of power generation which will reduce the dependency of Mukand Limited on import of electricity from fossil fuel dominated grid connected power plants. Furthermore, by utilizing the surplus BFG, which otherwise would have been flared and thus wasted, the project activity will reduce thermal pollution of the local environment. Therefore the project activity primarily has positive environmental impacts. However the project performance will be monitored as a part of the regular Environmental Management Plan of Mukand Limited and negative impacts, if any, will immediately be taken care off.

SECTION E. Stakeholders' comments

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

Mukand Limited, as a policy matter, considers the consultation of local stakeholders as an integral component of any new projects or up-gradation or modernisation of the existing facilities. Representatives of Mukand Limited will identify and consult with the relevant stakeholders for their comments and approvals regarding such initiatives of Mukand Limited. The stakeholder consultation is generally carried out in a transparent manner as described below:

- Suitable stakeholders in the jurisdiction of Mukand Limited are identified for consultation
- The stakeholders are provided with salient information about the project activity either verbally or through written communications
- All the aspects of the project activity are clearly explained to the stakeholders and they are requested to give their comments, feedbacks and suggestions
- Comments from stakeholders are discussed by the Management of Mukand Limited and is given due weightage in the companies' future course of action

<u>Identification of Stakeholders</u>

In line with the vision of Mukand Limited, the following stakeholders are identified for the project activity under consideration:

- Local People
- Employees of Mukand Limited
- Consultants/ Equipment Suppliers/ Contractors
- Karnataka State Pollution Control Board
- Ministry of Environment & Forests, Government of India (MoEF)

The stakeholders can be broadly classified into-Non-government Parties and Government Parties. Mukand Limited has already approached the Government Parties for obtaining necessary approvals for the project activity implementation. For Non-government Parties (like the local people from Kanakpura and Ginigera Villages, employees and equipment suppliers/contractors), the stakeholder meeting was held on 17^{th} July 2007. The meeting was addressed by the Management Representatives of Mukand Limited in the local language. They have explained the audience about the Kyoto Protocol and Clean Development Mechanism and shared salient information about the project activity at Mukand Limited. The project activity's contribution towards reduction of Green House Gas emissions thereby addressing the issues related to Climate Change and Global Warming

was also elaborated. Furthermore, the socio-economic development of the local people, as result of the project activity implementation has also been briefed in this meeting. The attendants have been requested to provide their feedback on the project activity. The same is elaborated below in the following section.

E.2. Summary of the comments received:

The comments received from various stakeholders are detailed below:

Non-Government Parties

Local People

The project activity is implemented in a country like India, which is a purely democratic country. Hence the comments received from the local people or their elected representatives will give a proper reflection of the opinions of the local people about the project activity. Local population comprises of local people in and around the project site and the employees of Mukand Limited. Implementation of the project activity will not require any dislocation of local population as the same will be implemented within the plant premise of Mukand Limited. It will lead to an improvement in the local environment. Furthermore, it will generate scopes for employment for the local people during the construction and operational phases. With such employment opportunities, their living standard will be improved. Hence the local community have expressed their support on understanding the various benefits of project activity. They appreciated that the project activity would result in overall air quality improvement by avoidance of surplus BFG flaring and generation of power from it. There were no comments/concerns raised by the local people for the project activity.

Employees of Mukand Limited

Mukand Limited has always been committed towards the satisfaction and welfare of their employees by ensuring the scopes for proper professional and personal growth, implementing adequate health, safety and welfare measures, developing world class working environment and by maintaining ethical standards in their business activities. The project activity is an excellent initiative of Mukand Limited which will have local as well as global environmental benefits. The employees have welcomed the initiative of the authority and are providing their support for its successful implementation.

Consultants/ Equipment Suppliers/ Contractors

Consultants will get involved 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, supervision of project implementation, successful commissioning and trial runs. The equipment suppliers and contractors will be involved for supplying boiler, turbine and other equipments as per the specifications. Hence the project activity will create a lot of business opportunities for them. The project proponent has consulted with the above stakeholders and has been appreciated for their initiative.

Government Parties

Karnataka State Pollution Control Board (KSPCB)

Karnataka State Pollution Control Board (KSPCB) has prescribed standards of environmental compliances and monitors the adherence to the standards. The project activity will have positive environmental impacts. The project proponents' consistent efforts will be there to ensure environmental compliance in and around the plant site. The project activity has already received Consent to Establish from the Karnataka State Pollution Control Board.

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Ministry of Environment & Forests, Government of India (MoEF)

The project activity is an energy conservation project where the surplus BFG will be utilised further for power generation thereby contributing to energy conservation as well as non-renewable natural resource (fossil fuel) conservation at the grid connected power plants. Guidelines proposed by the Ministry of Environment & Forests, Government of India will be followed thoroughly in order to ensure environmental quality. The project activity has already received the Environmental Clearance from the Ministry of Environment and Forests, Government of India. The Project Design Document and the Project Concept Note have been submitted to the Ministry of Environment and Forests, Government of India and the Host Country Approval has been received.

Global Stakeholder Consultation

As per the requirement of UNFCCC, the Project Design Document is hosted on the web-site of the Designated Operational Entity for public comments. No comments have been received during the global stakeholder consultation.

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

The feedback received from the stakeholders' forms one of the significant inputs to the strategic plan development and the consequent strategic objective setting of Mukand Limited. Their concerns are integrated into the strategy map that forms a basis for finalisation of objectives and targets for implementation. Mukand Limited has been interacting with the stakeholders on a continuous basis for the project activity under consideration. They have received only positive feedbacks for the project activity from all the stakeholders being consulted. All these relevant comments are considered while preparation of the Project Design Document.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Mukand Limited
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Represented by:	
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ANNEX 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is available for the project activity under consideration.

Annex 3

BASELINE INFORMATION

The methodology requires the project proponent to compute the emission reductions resulting from the project activity as a difference between the baseline emissions and the project emissions. There will be no leakage emissions in the project activity as per the methodology. The following section gives a step-by-step computation of emission reductions resulting from the project activity:

Determination of f_{cap}

Determination of f_{cap}				
Parameter	**Notation**	**Unit**	**Value**	**Source/ Remarks**
Production of Hot Metal in MBF-3	-	tpd	700	Specification provided by Technical Consultant
Annual Operation of Blast Furnace	-	days/year	345	Specification provided by Technical Consultant
Average Availability of Blast Furnace	-	%	93	Specification provided by Technical Consultant
Surplus Blast Furnace Gas (BFG) from MBF-3	-	Nm^3/h	63548	
Production associated with the relevant waste energy *i.e.* surplus BFG generation as it occurs in the baseline scenario	$Q_{BL,product}$	ton	224595	
Amount of waste energy *i.e.* surplus BFG per unit of product generated by the process (that generates waste energy *i.e.* surplus BFG) in the industrial facility	$q_{wcm,product}$	Nm^3/ton	2179	
Quantity of waste energy *i.e.* Surplus BFG generated prior to the start of the project activity	$Q_{WCM,BL}$	Nm^3	489345789	
Quantity of WECM *i.e.* surplus BFG used for energy generation during year y	$Q_{WCM,y}$	Nm^3	489345789	
Energy that would have been produced in project year y using waste energy (*i.e.* surplus BFG) generated in base year expressed as a fraction of total energy produced using waste source in year y	f_{cap}		**1**	

Determination of f_{wcm}

Determination of f_{wcm}			
Parameter	**Notation**	**Unit**	**Value**
Power Generation			
Gross Power Generation	-	MW	12.5
Auxiliary Power Consumption	-	MW	1.3
Net Power Generation	-	MW	11.3
Annual Operaional Days	-	days/year	350
Gross Electricity Generated	-	MWh/year	105310
Auxiliary Electricity	-	MWh/year	10531
Net Electricity Generated	-	MWh/year	94779
f_{wcm} Computation			
Total annual energy produced at the power plant	$EG_{tot,y}$	TJ/year	379
Quantity of WECM *i.e.* surplus BFG recovered in hour h	$Q_{WCM,h}$	Nm^3/h	63548
Net Calorific Value of WECM *i.e.* surplus BFG in year y	$NCV_{WCM,y}$	TJ/Nm^3	2.6752E-06
Amount of individual fuel (Furnace Oil) i consumed at the energy generation unit i.e. the power plant during hour h	$Q_{i,h}$	ton/h	0.491
Net Calorific Value (annual average) of individual fuel (Furnace Oil) i consumed at the energy generation unit i.e. the power plant	NCV_i	TJ/ton	0.0418
Average heat rate of the power plant where electricity is produced	H_r		3.9
Fraction of total electricity generated by the project activity using waste energy (*i.e.* surplus BFG)	f_{wcm}		**0.88**

Determination of $EF_{elec,i,j,y}$

Determination of $EF_{elec,i,j,y}$					
Parameter	**Unit**	**2004-2005**	**2005-2006**	**2006-2007**	**Source/ Remarks**
Southern Grid - Simple OM excl imports	tCO2/MWh	1.00	1.01	1.00	CEA Database - Version 3.0
Southern Grid - Net Generation in OM	GWh	105568.47	100978.38	109116.38	CEA Database - Version 3.0
Southern Grid - Absolute emissions in OM	tCO2	105603623.83	101760966.27	109251805.62	Calculated
Check	tCO2	105603623.83	101760966.27	109251805.62	CEA Database - Version 3.0
Net electricity import from ER	GWh	286.2	99.81	1551.69	CEA Database - Version 3.0
ER simple OM excl imports	tCO2/MWh	1.20	1.16	1.13	CEA Database - Version 3.0
Absolute emissions from imports	tCO2	344511.3972	115624.9299	1751354.347	Calculated
Absolute emissions incl imports	tCO2	105948135.22	101876591.20	111003159.96	Calculated
Net generation incl imports	GWh	105854.67	101078.19	110668.07	Calculated
Southern Grid - Simple OM incl imports	tCO2/MWh	1.000882947	1.007898888	1.003027906	Calculated
Check	tCO2/MWh	1.000882947	1.007898888	1.003027906	CEA Database - Version 3.0
Weighted Generation Operating Margin	tCO2/MWh	1.003863219			Calculated
Build Margin	tCO2/MWh	0.70545970236			CEA Database - Version 3.0
wOM		0.5			Tool to calculate Emission Factor for an Electricity System
wBM		0.5			Tool to calculate Emission Factor for an Electricity System
Combined Margin	tCO2/MWh	0.854661461			Calculated

Computation of Emission Reductions

Computation of Emission Reductions				
Parameter	**Notation**	**Unit**	**Value**	**Comments/ Assumptions**
Computation of Baseline Emissions (BE_y)				
Energy that would have been produced in project year y using waste energy (*i.e.* surplus BFG) generated in base year expressed as a fraction of total energy produced using waste source in year y	f_{cap}		1	
Fraction of total electricity generated by the project activity using waste energy (*i.e.* surplus BFG)	*fwcm*		0.88	
Quantity of electricity supplied to the recipient *j* by generator, that in the absence of the project activity would have been sourced from the ith source (*i.e.* the Southern Regional Grid) during the year y	$EG_{i,j,y}$	MWh/year	94779	
CO_2 emission factor for the electricity source *i* (*i.e.* the Southern Regional Grid), displaced due to the project activity during the year y	$EF_{elec,i,j,y}$ = $EF_{elec,gr,j,y}$	tCO_2/MWh	0.85466146	
Baseline Emissions from energy generated by project activity during the year y	$BE_{En,y}$	tCO_2/year	71581	
Baseline Emissions during the year y	**BE_y**	**tCO_2/year**	**71581**	
Computation of Project Emissions (PE_y)				
Project Emissions due to auxiliary fossil fuel consumption ($PE_{AF,y}$)				
Quantity of fossil fuel type *i* combusted to supplement waste energy in the project activity during the year y	$FF_{i,y}$	tonnes/year	0	Furnace Oil combusted in the boilers in the project scenario have already been accounted for while determining the parameter f_{WCM}
Net calorific value of the fossil fuel type *i* combusted as supplementary fuel	NCV_i	TJ/ton	0.0418	http://www.iocl.com/Products/Furnaceoil.aspx
CO_2 emission factor per unit of energy of the fuel type i	$EF_{CO2,i}$	tCO_2/ton	77.4	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Project activity emissions from on-site consumption of fossil fuels by the power plant, in case they are used as supplementary fuels, due to non-availability of waste energy i.e. surplus BFG to the project activity or due to	$PE_{AF,y}$	tCO_2/year	0	

any other reason				
Project Emissions due to electricity consumption ($PE_{EL,y}$)				
Additional electricity consumed in year y as a result of the implementation of the project activity	$EC_{PJ,y}$		0	
CO_2 emission factor for electricity consumed by the project activity in year y	$EF_{CO2,EL,y}$	tCO_2/MWh	0.855	
Project activity emissions from other supplementary electricity consumption	$PE_{EL,y}$	tCO_2/year	0	
Project Emissions during the year y	**PE_y**	**tCO_2/year**	**0**	
Emission Reductions resulting from the project activity during the year y	**ER_y**	**tCO_2/annum**	**71581**	

Annex 4

MONITORING INFORMATION

Please refer to section B.7.2 for details.

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