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:

Bhaskar Steel & Ferro Alloys Ltd. (BSFAL) 8 MW captive power generation through waste heat recovery facility.
Version: 3.
Date: 7th December, 2007.

A.2. Description of the project activity:

Background
Bhaskar Steel & Ferro Alloys Ltd. (BSFAL) is a leading sponge iron manufacturing unit at western Orissa in India. The industrial facility is into the business of manufacturing of sponge iron and steel billet with an annual production capacity of 1,12,000 and 88,473 Tons respectively. With a strategy of innovation in every aspect of business and aim of establishing a balance between social and environmental demand as a part of the corporate responsibility the industrial facility invested in eco friendly technology for power generation.
The sponge iron manufacturing facility includes a single Direct Reduction Iron (DRI) kiln of 350 TPD. Manufacturing of DRI incorporates removal of oxygen content of the metallic oxide being carried out chemically at high temperature in the kiln. The project activity incorporates power generation through utilizing of the sensible heat content of the waste gas through effective waste heat recovery system.

Objective of the project activity:
The project activity primarily aims at reducing Green House Gas emission and abates environmental pollution through deployment of waste heat recovery based power generation there by restraining from the use of highly fossil fuel intensive grid power. The project proponent being a proactive corporate entity with a view to be in tune with the sustainable development priorities of the country has incorporated the project activity for generating cleaner power. The generation of power through utilization of the sensible heat content of waste gas which would have otherwise vented to the atmosphere would also result in lowering of local thermal pollution. The project activity through generation of onsite electrical energy will help in reducing T&D losses that would have occurred in the process of grid power procurement to the industrial premise in the baseline scenario. The incorporation of the project activity will also result in conservation of fossil fuel in the fossil fuel fired power plant and thereby arriving at an optimal energy mix in furtherance of the aim of national energy security.

Salient Feature of the project activity:
The project activity incorporates 8 MW waste heat recovery based power generating unit at the industrial facility. The industrial facility also possesses a 4 MW coal and char based (FBC) steam generating unit. The superheated steam generated from the both the units is fed to a common steam header and directed to the turbo generator. The total power generated hereby is consumed by the industrial unit.
The project activity would thus result in displacement of an equivalent amount of grid electricity which is predominantly of fossil fuel origin that would have been generated in the absence of the project activity. The project activity is expected to result in an emission reduction of 32351 tCO_2 equivalent per annum and total emission reductions of 323511 tCO_2 equivalent for the entire crediting period of ten years.

Project's Contribution towards Sustainable Development

The issue of environmental pollution and climate change has emerged as a matter of concern in the national and global level in the back drop of rapid industrialisation. Industrialisation as on one hand emerged as a backbone of economic development; energy utilised hereby on the other hand is acting as a vital component beyond industrial growth. The increasing trend in use of electrical energy for industrial process generated predominantly from fossil fuel based power plant will not only bring about environmental hazards but also deplete natural resources and enhance concern over national energy security.

Ministry of Environment and Forest, Government of India has stipulated four indicators of sustainable development for satisfying of the sustainability criteria of host country. The pillars of sustainable development are depicted as follows:

Social well being
Economic well being
Environmental well being
Technological well being

Social well being:

- The project activity has resulted in generation of employment opportunities for professional, skilled and unskilled labour for development, engineering, procurement, operation and maintenance of the project activity.
- The development of project specific infrastructure has also resulted in employment and income generation for local personals (from the nearby villages of Tumkela, Gumlei and Bonai)although for a temporary basis.
- In addition various kinds of electromechanical work would generate employment opportunities for local contractor on regular and permanent basis.
- Improvement of the general infrastructure in and around the project site which includes upgrading of the access road and green belt development.
- Involvement of engineering company to study and engineers the project and as such contributed towards capacity building in terms of technical knowledge of the employee.
- Successful implementation of project activity would promote the application of waste heat recovery based power generation in similar type of industry. The main barrier towards deployment of the project activity includes lack of awareness of the potential of energy generation through incorporation of waste heat recovery system. So incorporation of project activity would minimize the barrier existing due to the lack of technical know how.
- BSFAL is also in the process of manufacturing of fly ash bricks so such initiative would also enhance the livelihood and income of the local people.

Economic well being:

- The project activity being located in the rural area has resulted in increased economic security of vulnerable section of the rural community. Such happened through direct employment and temporary employment along with growth and development of ancillary industries locally.
- The project has also resulted business opportunities for various consultant, vendors, supplier etc during various stages of its implementation.

Environmental well being:

- The project activity will reduce green house gas emission associated with generation of electrical energy from combustion of fossil fuel in grid connected power plant that would have generated otherwise.
- Would reduce emission intensity of different pollutant like SOx, NOx, and suspended particulate, reduce average effluent intensity, average solid waste intensity, harmful pollutant like mercury and others and fugitive emission of green house gases associated with extraction and transportation of fossil fuel used for generation of equivalent quantum of power in the fossil fuel fired generating station.

Fossil fuel Emission Level – Pounds per Billion Btu of Energy Input[1] for power generation.

Pollutant	Waste heat recovery based power generation	Oil based power generation.	Coal based power generation.
Carbon dioxide	0	164,000	208,000
Nitrous Oxide	0	448	457
Sulphur dioxide	0	1,122	2,591
Particulates matter	0	84	2,744
Mercury	0	0.007	0.016

- Incorporation of the project activity would reduce the impact of local thermal pollution through considerable reduction of waste gas temperature that would have occurred in the baseline scenario.

The project activity apart from reducing greenhouse gas emissions will be contributing towards better quality environment for the employees and the nearby communities.

Technological Well Being:

Incorporation of project activity would act as cornerstone towards promotion of such technology and help in enhancing the technical know how about the project activity. The success of the project activity will catalyze more Waste Heat Recovery (WHR) based power projects in similar type of industry.

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 [Ministry of Environment And Forests (MoEF)] (Host)	Bhaskar Steel and Ferro Alloys Limited (Private entity)	No

[1] EIA- Natural Gas issues and Trend 1998.

Bhaskar Steel and Ferro Alloys Limited shall be the single point of contact for all communication with CDM executive board and national CDM authority and will be the sole owner of the CERs generated from the aforesaid project activity. Detailed contact address of the facility is provided in Annex I.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

The project activity is located at village – Bad Tamkela under P.O. – Rajamunda, Bonai Subdivision, Sundargarh District of Orissa in India.

A.4.1.1. Host Party(ies):

India.

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

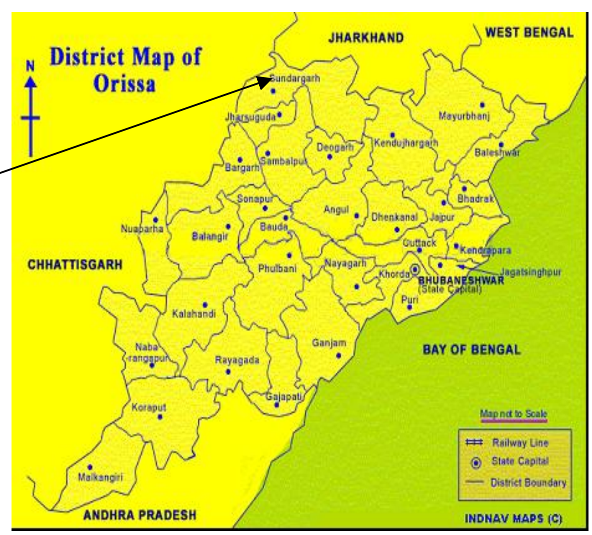
Orissa.

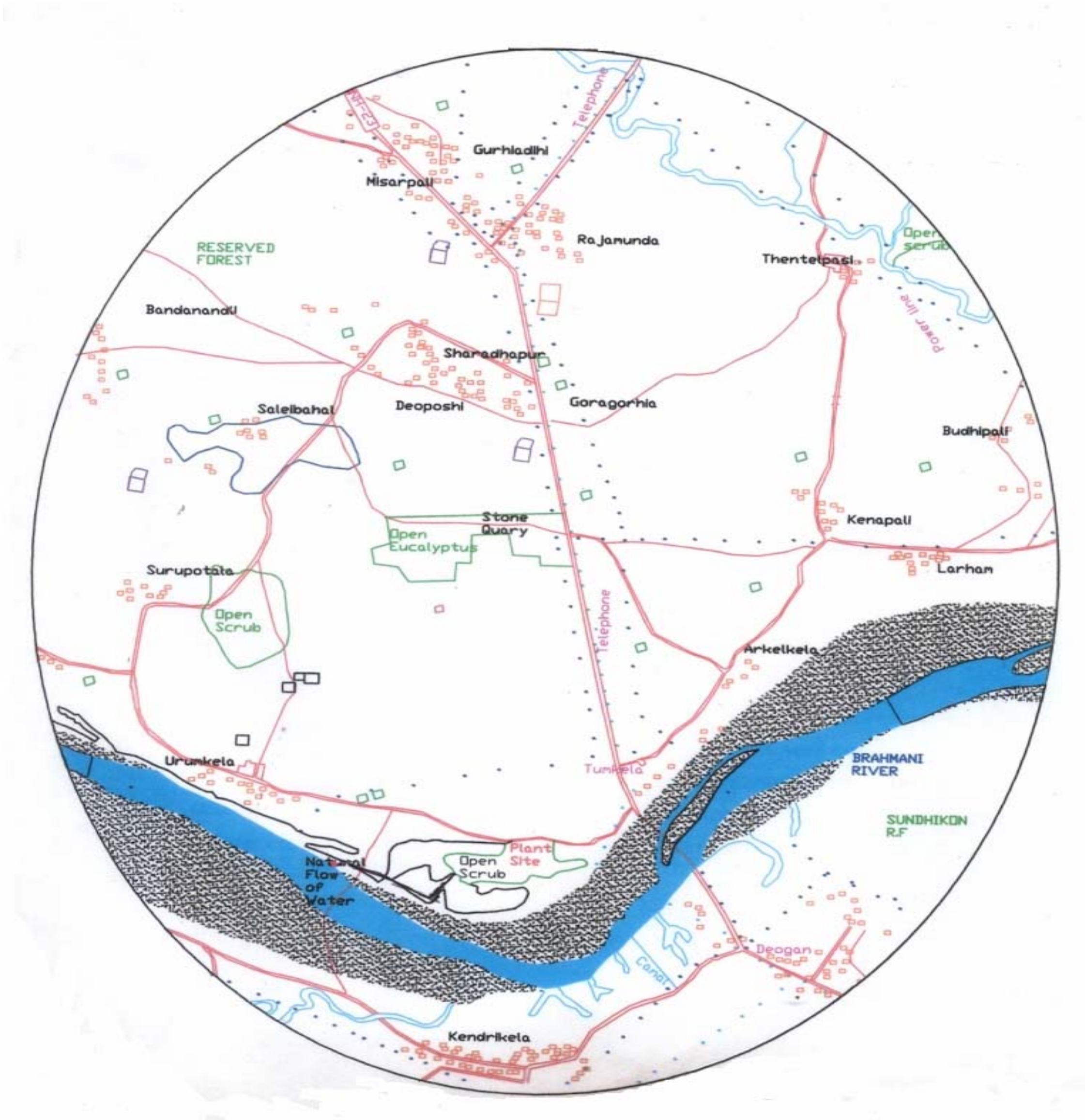
A.4.1.3. City/Town/Community etc:

Sundargarh District.

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

The project site located at 84^{0}30’East longitude and 21^{0}30’North latitude and about 66 Km away from the nearest city of Rourkela.





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

As per the "Sectoral scopes related approved methodologies and DOEs" available on the UNFCCC website for accreditation of Designated Operational Entities[2], the project activity has been categorized under

Sectoral Scope - (1) Energy industries (renewable / non-renewable sources).

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[2] http://cdm.unfccc.int/DOE/scopes.html

Sectoral Scope - (4) Manufacturing industries.

Thus, approved consolidated methodology ACM0012/Version 02; "*Consolidated baseline methodology for GHG emission reductions for waste gas or waste heat or waste pressure based energy system*" is applicable for the project activity.

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

The project activity involves 8 MW waste heat recovery based captive power generation through utilization of the sensible heat content of the off gas emanating from DRI kiln. Flue gas is available from the DRI kiln at cent percent capacity utilization in range of 90,000 Nm^3/hr.
The exhausted flue gas from the sponge iron kiln is received at the After-Burning Chamber (ABC). The waste gases are passed through ABC to remove traces of carbon monoxide. The WHR based power plant primarily consists of waste heat recovery boiler (WHRB), Economizer, Turbo generator sets (TG) and other auxiliaries.

Waste Heat Recovery Boiler
Waste heat from the flue gas emanating from the Sponge Iron Kiln is utilized in a WHRB to produce steam. The high temperature and pressure steam is utilized for generating of power. The salient technical parameters of the heat recovery boiler are as follows.

Technical specification of Waste Heat Recovery Boiler

Description	Technical Particulars
Type	Heat recovery, Natural Circulation semi outdoor, Balanced draft, Bi drum installation.
Fuel to be burned/utilised	Flue gas from Kiln
Steam pressure at super heater outlet	65 kg/cm^2
Steam temperature at super heater outlet	485 ^oC
Steaming capacity	35 TPH
Feed water temperature inlet to economiser	126 ^oC

The gas from DRI is circulated through three passes of WHRB to transfer the sensible heat energy of the waste gas to water and generate steam. About 55% of heat is recovered during those passes. The WHRB is attached with auxiliary systems like Evaporator steam drum, Mud drum, Bank of super heaters, Economizer, Atemperator, Air fans, Electrostatic Precipitator (ESP) , Internal piping etc. After heat extraction at WHRB, the flue gas is passed through economizer for optimum heat recovery from the flue gas; and about 25 % of heat is recovered further. After final heat transfer the flue gas leaves the heat exchanger system at a temperature of around 170 ^oC.
The exhaust gases are discharged from boiler to ESP and then into the atmosphere through 1x100% Induced Draft fans and chimney. The flue gas after maximum heat transfer in the boiler is led to exhaust stack through Electrostatic Precipitator (ESP) which reduces Suspended Particulate Matter (SPM) load to a large extent. The particulate matter collected in the hoppers is conveyed to existing ash silo by a conveyor belt. Bag filters have been installed at all points where there is possibility of any fugitive emission of flue dust.

FBC Boiler

The project proponent has deployed FBC unit comprising of boiler and auxiliary system will be capable of generating 4MW. The FBC will operate on coal fine and Char. Char will be obtained internally as a byproduct of the sponge iron manufacturing process.

Technical Specification of the FBC boiler

Description	Technical Particulars
Type	Fluidized bed combustion boiler
Fuel to be utilized	Coal char and coal fines
Steam pressure at super heater outlet	65 kg/cm^2
Steam temperature at super heater outlet	485 ^oC
Steaming capacity	18 TPH
Feed water temperature inlet to economiser	126 ^oC

Both the boilers will be complete with evaporator steam drum, mud drum, bank of super heaters, economizer, atemperator, air fans, internal piping etc.

Steam Turbine Generator and auxiliaries

The steam turbine is a condensing type and is attached with auxiliary systems like Condenser, Air evacuation system, 2x100% Condensate extraction pumps, Generator cooling systems, Gland vent condenser, Lubricating oil system, Steam piping, Feed water piping, Turbine control and Supervisory system. The technical parameters of the steam turbine are as follows.

Technical Parameters of Steam Turbine

Description	Technical Particulars
Type	Single cylinder, multi stage impulse bleeding cum condensing.
Rated capacity	12 MW (8+4 MW)
Steam pressure at turbine inlet	62 kg/cm^2
Steam temperature at turbine	480 ^oC
Inlet Steam flow	51.6 TPH
Exhaust steam pressure	0.1 Ata
Exhaust flow to condenser	46.1 TPH

The steam turbine generator is rated for 15 MVA (12 MW) with 0.8 lagging power factor and delivering power at 11 KV, 3 phase and 50 Hz star connected in IP55 enclosure. The generator is provided with brush less/static excitation system. The generator has the class “F” insulation and is designed for air-cooling.

DCS Control System:

The control system of the captive power plant is built around a central DCS based control system. The DCS system is state-of-the art microprocessor based control system built around CS 1000 supplied by Yokogawa. The DCS system consists of around 740 IO’s of series AMM, AMC, ADM and ACM. The redundant CPU’s are fixed in a PFCD with R4300 Processor and the Processor is connected to the Work Station and Engineering station by redundant VL NET proprietary (10MB/s).

The DRI kiln has a planned shutdown for a period of 45 days in an operating year. No supplementary fuel is used in WHRB. Therefore, due to unavailability of flue gas (as fuel) power plant remains shutdown during this period. A stoppage of 20 days has been taken in to account considering manufacturing uncertainties. Hence, the total days of operation of the power plant is considered to be 300 days per annum. With current generation pattern the unit is expected to generate around 31104 MWh of power (net generation) per annum. The total electrical energy produced will be used for captive requirement. The technology used to generate electricity is environmentally safe and abides by all legal norms and standards in the field of environment.

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

The project activity is chosen for a fixed crediting period of ten years. The Project is expected to reduce 32351 tonnes of CO2e per annum and 323511 tonnes of CO2e for the entire crediting period of ten years.

Year	Annual Estimation of emission reductions in tonnes of CO2 e
April 2008 – March 2009	32351
April 2009 – March 2010	32351
April 2010 – March 2011	32351
April 2011 – March 2012	32351
April 2012– March 2013	32351
April 2013 – March 2014	32351
April 2014 – March 2015	32351
April 2015– March 2016	32351
April 2016 – March 2017	32351
April 2017 – March 2018	32351
Total estimated reductions (tonnes of CO_2 e)	**323511**
Total number of crediting years	**10**
Annual average over the crediting period of estimated reductions (tonnes of CO2 e)	**32351**

A.4.5. Public funding of the project activity:

There is no public funding to the project activities.

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:

Methodology: ACM0012
Title: Consolidated baseline methodology for GHG emission reductions for waste gas or waste heat or waste pressure based energy system.
Version: 02.
Sectoral Scope: 1 and 4
Reference: EB 35

(The methodology also refers to Tools for demonstration and assessment of additionality. Version 4. and Tool to calculate the emission factor for an electricity system.)

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

The applicability criterion of the methodology implies it's adaptation for the project activities that results in generation of electricity utilizing sensible heat content of the waste gas in the industrial facility. The justification for adaptation of the methodology on the basis of applicability criteria are as follows:

Applicability Criteria	Justification
Applicability Criteria 1 The consolidated methodology is for project activities that utilize waste gas and/or waste heat (henceforth referred to as waste gas/heat) as 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). The consolidated methodology is also applicable to project activities that use waste pressure to generate electricity.	**Justification** The project activity incorporates power generation through utilization of the sensible heat content of the waste gas emanating from the DRI kiln. The heat extracted from waste gas is utilized to generate superheated steam in the waste heat recovery boiler; the superheated steam is thereby used in the turbine to generate power. This satisfies the aspect of the mentioned applicability criteria of generation of electricity from the waste heat at the industrial facility.
Applicability Criteria 2 If project activity is use of waste pressure to generate electricity, electricity generated using waste gas pressure should be measurable.	**Justification** The project activity utilises the sensible heat content of the waste gas for the purpose of electricity generation.
Applicability Criteria 3 Energy generated in the project activity may be used within the industrial facility or exported outside the industrial facility;	**Justification** The energy generated by the industrial facility will be used up for catering of the industrial electrical demand. There won't be any surplus power generated from the system that could be exported outside. This satisfies the aspect of the mentioned

Applicability Criteria	Justification
	applicability criteria of utilizing the power generated at the industrial facility.
Applicability Criteria 4 The electricity generated in the project activity may be exported to the grid.	**Justification** The electricity generated will be used up in the industrial facility.
Applicability Criteria 5 Energy in the project activity can be generated by the owner of the industrial facility producing the waste gas/heat or by a third party (e.g. ESCO) within the industrial facility.	**Justification** The project proponent/industrial facility has deployed the waste heat recovery based power generating unit and is generating energy utilising the same. This satisfies the aspect of the mentioned applicability criteria of generation of power by the owner of the industrial facility producing the waste gas/heat.
Applicability Criteria 6 Regulations do not constrain the industrial facility generating waste gas from using the fossil fuels being used prior to the implementation of the project activity.	**Justification** There are neither any national or sectoral policies nor circumstances that impose obligation to the proposed project activity of using of fossil fuel in the Sponge iron manufacturing process. Moreover the release of waste heat form the DRI kiln after adequate cleaning and removing of the pollutant are neither restricted by any law nor does it violate the normative environmental criteria. Apart the industry has received consent to establish and operate. This satisfies the aspect of the mentioned applicability criteria that there has been no constrain for the industrial facility generating waste gas from using the fossil fuels being used prior to the implementation of the project activity.
Applicability Criteria 7 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.	**Justification** The project activity is a Greenfield power generation project in other words is an incorporation of new facilities. This satisfies the choice of the methodology that is applicable for new facility.
Applicability Criteria 8 The waste gas/pressure utilized in the project activity was flared or released into the atmosphere in the absence of the project activity at existing facility. This shall be proven by either one of the following: o By direct measurements of energy content and amount of the waste gas for at least three years prior to the start of the project activity. o Energy balance of relevant sections of the plant to prove that the waste gas/heat was not a source of energy before the implementation of the project activity. For the energy balance the representative	**Justification** The project activity is deployed in the same time along with the industrial facility. The practice in the sector suggests releasing of waste gas emanated from the DRI kiln into the atmosphere. However the management thought of tapping the heat content of waste gas for the purpose of power generation and promoting the energy efficiency and energy conservation initiatives. The time taken by the project proponent to submit the project activity for validation was pretty long in lieu of their engagement in sorting out of the internal management problem and financial

Applicability Criteria	Justification
process parameters are required. The energy balance must demonstrate that the waste gas/heat was not used and also provide conservative estimations of the energy content and amount of waste gas/heat released. o Energy bills (electricity, fossil fuel) to demonstrate that all the energy required for the process (e.g. based on specific energy consumption specified by the manufacturer) has been procured commercially. Project participants are required to demonstrate through the financial documents (e.g. balance sheets, profit and loss statement) that no energy was generated by waste gas and sold to other facilities and/or the grid. The bills and financial statements should be audited by competent authorities. o Process plant manufacturer's original specification/information, schemes and diagrams from the construction of the facility could be used as an estimate of quantity and energy content of waste gas/heat produced for rated plant capacity/per unit of product produced. o On site checks by DOE prior to project implementation can check that no equipment for waste gas recovery and use has been installed prior to the implementation of the CDM project activity	constraint leading to the initiation of commercial production before the project related documentation could be submitted for validation. The Detailed Project Report prepared by a third party engineering company for the industrial facility, consents does not indicate of any other utilisation of waste gas. The same can be confirmed by on site checks by DOE prior to project implementation that no equipment for waste gas recovery and use has been installed prior to the implementation of the CDM project activity. This satisfies the choice of the methodology.
Applicability Criteria 9 The credits are claimed by the generator of energy using waste gas/heat/pressure. o In case the energy is exported to other facilities an agreement is signed by the owner's 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.	**Justification** The project proponent is generating the energy utilising the heat content of waste gas and utilising the same at the industrial and will be the sole owner of the credits claimed from the aforesaid project activity. This satisfies the choice of the methodology that is applicable to the project activity where the credits are claimed by the generator of energy using waste gas/heat/pressure.
Applicability Criteria 9 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: o The remaining lifetime of equipments currently being used; and o Credit period.	**Justification** The project activity is the deployment of a new facility and thus would claim credit for the entire fixed crediting period of 10 years.

Applicability Criteria	Justification
Applicability Criteria 10 Waste gas/pressure that is released under abnormal operation (emergencies shut down) of the plant shall not be accounted for.	**Justification** The project activity will utilise the waste gas emanated directly from the DRI kiln during normal condition and shall not take into account waste gas released under abnormal operation of the plant.
Applicability Criteria 11 Cogeneration of energy is from combined heat and power and not combined cycle mode of electricity generation.	**Justification** The project activity incorporates generation of electricity and is not a cogeneration facility.

The project activity being considered under "Consolidated baseline methodology for GHG emission reductions for waste gas or waste heat or waste pressure based energy system – ACM0012 / Version 02" on account of its fulfillment of all the applicability criteria as depicted in the methodology.

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

The spatial extent of the project boundary encompasses all the anthropogenic emissions by sources of greenhouse gases under the control of the project participants that are significantly and reasonably attributable to the project activity.
The project activity incorporates waste heat recovery based power generation from which no excess electricity is exported outside the industrial facility. In the absence of project activity the industrial facility would have acquired grid connectivity. Therefore the project activity includes emission from the grid based power that are avoided or offset as a result of electricity supplied from the project activity.

The geographical extent project boundary shall include the following:
1. The industrial facility where waste gas/heat/pressure is generated (generator of waste energy);
The above boundary includes the DRI kiln from where the waste gas is being generated, Dust Settling Chamber.

2. The facility where process heat in element process/steam/electricity is generated (generator of process heat/steam/electricity). Equipment providing auxiliary heat to the waste heat recovery process shall be included within the project boundary; and
The boundary includes the WHR boiler and its accessories, Turbine Generator and its accessories, Steam Condenser.

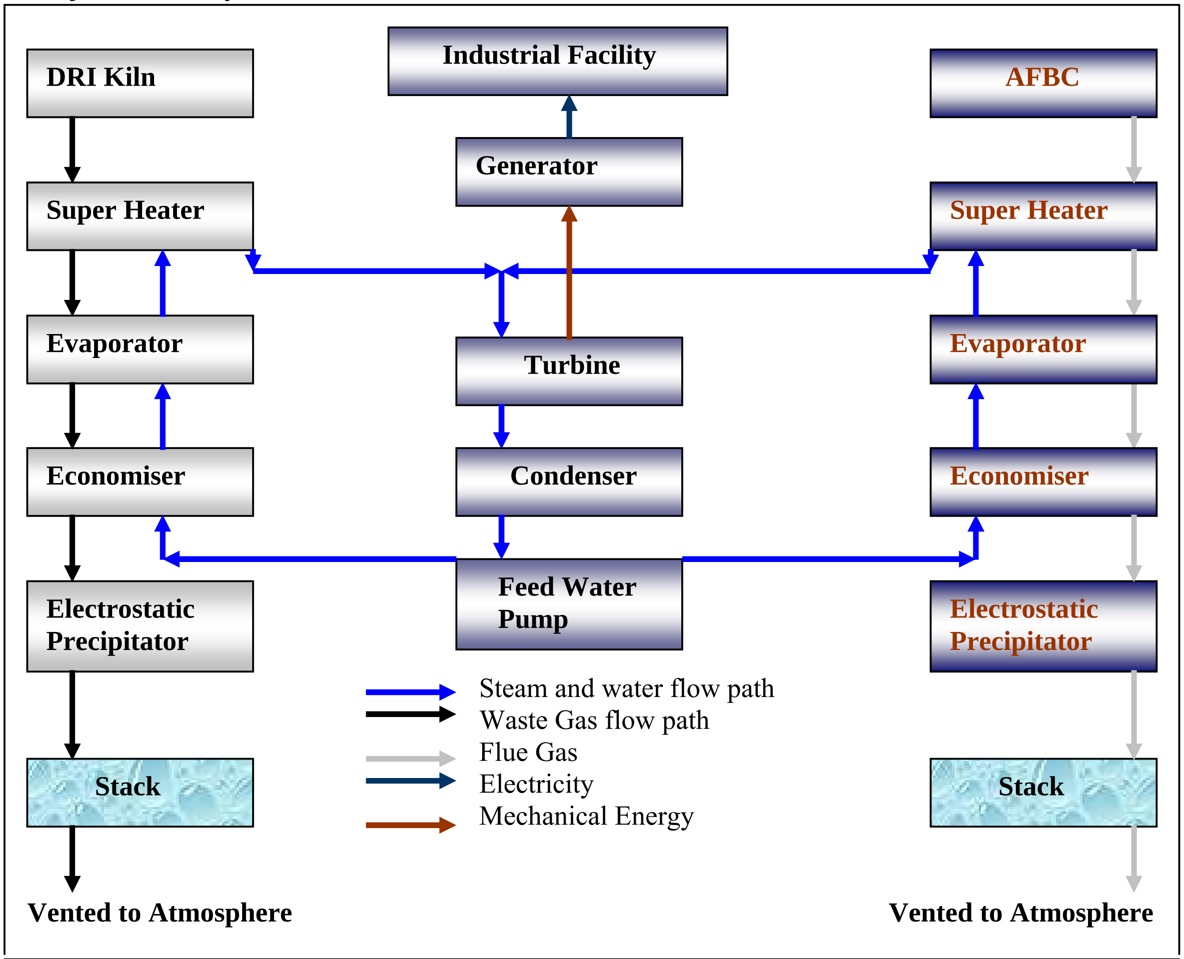
3. The facility/s where the process heat in element process/steam/electricity is used (the recipient plant(s)) and/or grid where electricity is exported, if applicable.
The boundary includes captive consumption units.

	Source	Gas	Included?	Justification/Explanation
Baseline	Electricity generation grid or captive source	CO_2	Included	Main source of emission.
		CH_4	Excluded	Excluded for simplification, This is conservative.
		N_2O	Excluded	Excluded for simplification, This is conservative.
	Fossil fuel consumption	CO_2	Excluded	There has been no use of fossil fuel

	Source	Gas	Included?	Justification/Explanation
	in boiler for thermal energy.			in the boiler for the purpose of thermal energy generation.
		CH_4	Excluded	Excluded for simplification, This is conservative.
		N_2O	Excluded	Excluded for simplification, This is conservative.
	Fossil fuel consumption in cogeneration plant.	CO_2	Excluded	There has been no co generating unit in the baseline scenario hence no chance of associated emission thereby.
		CH_4	Excluded	Excluded for simplification This is conservative.
		N_2O	Excluded	Excluded for simplification This is conservative.
	Baseline emissions from generation of steam used in the flaring process, if any.	CO_2	Excluded	The waste gas emanated from the DRI kiln would have been vented to the atmosphere in absence of the project scenario as such baseline emission from generation of steam used is the flaring process impossible.
		CH_4	Excluded	Excluded for simplification This is conservative.
		N_2O	Excluded	Excluded for simplification This is conservative.
Project Activity	Supplemental fossil fuel consumption at the project plant.	CO_2	Included	Fossil fuel consumption for supplying electrical energy to the auxiliary system during power plant start up is envisaged.
		CH_4	Excluded	Excluded for simplification This is conservative.
		N_2O	Excluded	Excluded for simplification This is conservative.
	Supplemental electricity consumption.	CO_2	Excluded	The same is not applicable owing to the fact that there wont be any supplemental energy consumption related to the project activity.
		CH_4	Excluded	Excluded for simplification This is conservative.
		N_2O	Excluded	Excluded for simplification This is conservative.
	Project emission from cleaning of gas	CO_2	Excluded	There has been no use of fossil fuel for the purpose of cleaning of waste gas and thereby no associated emission.
		CH_4	Excluded	Excluded for simplification This is

	Source	Gas	Included?	Justification/Explanation
				conservative.
		N_2O	Excluded	Excluded for simplification This is conservative.

Project Boundary



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

The baseline for a CDM project activity is the scenario that reasonably represents the anthropogenic emission by source of green house gas that would occur in absence of the project activity. The baseline scenario represents the most potential alternatives from among the different scenarios or option existing before the project proponent. Different scenarios may be elaborated as potential alternatives with evolution of the situation existing before proposed CDM project activity.

The baseline scenario is identified as the most plausible baseline scenario among all realistic and credible alternative(s). Realistic and credible alternatives should be determined for:
• Waste gas/heat/pressure use in the absence of the project activity; and
• Power generation in the absence of the project activity; and
• Steam/heat generation in the absence of the project activity
The project activity incorporates deployment of 8 MW waste heat recovery based power generation project. Therefore the baseline scenario will be selected for the power generation in the absence of the project activity.

Multiple sub-systems generating energy in the project activity scenario
The steam and/or power requirement of the system(s) in the project boundary should be determined, which can be met from one or more than one sub-system(s) in the project activity scenario. While determining the baseline scenario, project participants shall identify the realistic and credible alternatives to the project activity, which would provide output equivalent to the combined output of the all the sub-systems in the project activity scenario. These alternatives may comprise of one system or more than one sub-system(s). Therefore the alternatives, identified for the project activity, should provide the same steam and/or power output as in the project activity scenario and should include the alternate use of the waste gas heat utilized in the project activity. These alternatives shall be determined as suitable combinations of the following options available for meeting the 'steam requirement' and/or 'power requirement' and for ensuring 'alternate use of waste gas and/or waste heat' as described below:
The project participant shall exclude baseline options that:
• Do not comply with legal and regulatory requirements; or
• Depend on fuels (used for generation of heat and/or power), that are not available at the project site.

Step 1: Define the most plausible baseline scenario for the generation of heat and electricity using the following baseline options and combinations.
The baseline candidates should be considered for following facilities:
• For the industrial facility where the waste gas/heat/pressure is generated; and
• For the facility where the energy is produced; and
• For the facility where the energy is consumed.

For use of Waste gas

Alternatives for use of waste Gas	Description of Alternatives	Justification of the Choice of Alternatives
W1	Waste gas is directly vented to atmosphere without incineration	There are neither any national or sectoral policies nor circumstances that prevent the venting of waste gas from the sponge iron unit to the atmosphere. The waste gas emanated from the DRI kiln of the sponge iron manufacturing unit contains traces of carbon monoxide. Carbon monoxide being a harmful and poisonous gas cannot be directly released to the atmosphere. As such the traces of carbon monoxide need to be removed from the waste gas before venting it to atmosphere. Therefore the waste gas from the DRI kiln is made to pass through ABC (After Burning Chamber) where the traces of carbon monoxide is being burnt

Alternatives for use of waste Gas	Description of Alternatives	Justification of the Choice of Alternatives
		out in presence of air. Therefore the alternative is cannot not be chosen as the most plausible and realistic alternative baseline scenario under conservative approach.
W2	Waste gas is released to the atmosphere after incineration or waste heat is released to the atmosphere (waste pressure energy is not utilized);	As mentioned in the aforesaid justification the traces of carbon monoxide in the waste gas needs to be removed and as such being combusted in the After Burning Chamber. This satisfies the alternative that mentions about the waste gas being released to the atmosphere after incineration. As such the alternative is considered to be a realistic one and can be considered to be the baseline scenario.
W3	Waste gas/heat is sold as an energy source;	There is no scope for selling of waste gas outside the industrial premise due to the fact that there has been no such industrial facility in the vicinity that could use the same. As such the alternative pertaining to the use of waste gas is deemed to be unrealistic and thus cannot be considered to be the baseline scenario.
W4	Waste gas/heat/pressure is used for meeting energy demand.	In majority of the sponge iron industry in India the common practice is to vent the waste gas emanated from the DRI kiln to the atmosphere. Very few of the industrial unit has incorporated waste heat recovery based power generating unit. Moreover in the integrated manufacturing unit of sponge iron and steel billet there has been no other application of use of the sensible heat content of the waste gas in the manufacturing process. The energy requirement of the sponge iron is met through coal and electrical energy. Therefore the alternative of using waste gas for meeting up of the industrial energy demand under the current infrastructure. Thereby the alternatives do not seem to be a realistic one.

From the above analysis of the baseline alternatives for use of waste gas it can be concluded that W1, W3 and W4 is not a realistic and credible one. Therefore the baseline scenario in context of the use of waste gas would be W2 which in congruence with the common practice in the sector where waste gas is being released to the atmosphere after removing the trace of carbon monoxide in the ABC.

For Power generation

A. Comparison of the Alternatives on the basis of its adoptability in accordance to the National and Sectoral policies, Project Requirement, Availability and constraint of the Technology.

Alternatives for Power Generation	Description of the Alternatives	Justification of the Choice of Alternatives
P1	Proposed project activity not undertaken as a CDM project activity.	The Proposed project of utilisation of waste gas in WHR system for the purpose of power generation is in accordance with the host country policy of power generation. The electricity generated from the use of waste gas can be used to cater the industrial electrical demand. Moreover the technology for utilisation of waste gas for the purpose of power generation is available in the country. Therefore the alternative can be considered for further discussion for the choice of the most realistic and credible alternative.
P2	On-site or off-site existing/new fossil fuel fired cogeneration plant.	The incorporation of the Cogeneration unit is permitted by the policy of the host country. But for the purpose of the industrial activity there won't be other use of steam. Therefore the installation of fossil fuel fired cogeneration plant is not practical for the industry and thus the alternative is opted out for further consideration.
P3	On-site or off-site existing/new renewable energy based cogeneration plant.	The incorporation of the Cogeneration unit is permitted by the policy of the host country. But for the purpose of the industrial activity there won't be other use of steam. Therefore the installation of renewable energy based cogeneration plant is not practical for the industry and thus the alternative is opted out for further consideration.
P4	On-site or off-site existing/new fossil fuel based existing captive or identified plant.	The incorporation of the captive power generating unit using fossil fuel at the industrial facility is permitted by the policies of the host country. In accordance with the availability of the technology the project proponent can opt for power generation using : • Coal. • Diesel/Fuel oil. • Natural gas. **Coal based captive power generating unit:** Orissa is one of the three states (others are Chattisgarh and Jharkhand) which have most of the coal deposits in India. The incorporation of the coal based captive power generating unit at the industrial premise are not restricted by any law would result with provision of power for the industry. Moreover the coal based CPP has other advantage like high PLF, well easily available raw material in and around the industrial facility above all a lower cost

Alternatives for Power Generation	Description of the Alternatives	Justification of the Choice of Alternatives
		per unit of power generation. Therefore the alternative can be opted for further consideration. **Oil based captive power generation** The option of deployment of diesel generator at the industrial facility could be carried out through lower capital investment in compared to the other fossil fuel or renewable based power generation option. Moreover the facilities of diesel oil based generation have advantage of quick start up and require comparatively lower area. Therefore the alternative can be opted for further consideration. **Natural gas Based power generation** The unavailability of the natural gas in this part of the country rules out the possibility of use of natural gas for power generation in the present scenario. Although such possibility may evolve with the formation of national gas grid or upcoming of transnational gas pipe line in the future. But such option is fully dependent on the strategic policy and political decision and is thus cannot be considered as a feasible option at present scenario or in the near future. The unavailability of natural gas rules out the possibility to consider it as the baseline scenario.
P5	On-site or off-site existing/new renewable energy based existing captive or identified plant.	The incorporation of the renewable based power generating unit for catering of power requirement of the industrial facility is permitted by the policies of the host country. In accordance with the availability of the technology the project proponent can opt for power generation using : • Wind Based power generation. • Hydro power plant. • Biomass based power generation. **Wind based power generation** The alternative of putting up of WTG at the windy site and wheeling the generated power to the industrial premise is in compliance with all applicable legal and regulatory requirements and could be considered as an alternative. The uncertainty involved in power generation due to its dependency on the nature and speed of the wind is a push back for the choice of the on the part of the project proponent as the industry is a continuous process industry and requires uninterrupted power. Therefore the installation of wind based power

<table>
<tr><th>Alternatives for Power Generation</th><th>Description of the Alternatives</th><th>Justification of the Choice of Alternatives</th></tr>
<tr><td></td><td></td><td>generating unit is not practical for the industrial alternative and can be opted out for further consideration.
Hydro Power Generation
Orissa is among the fourteen Indian states permitting the deployment of small hydro power project by individual project proponent. But the higher time requirement for setting up of the project activity and dependability on the water yield is a concern towards obtaining of the uninterrupted power. These rules out the possibility for incorporation of such initiative on the part of the project proponent and can be opted out for further consideration.
Biomass based power generation
The use of biomass in the FBC system for power generation is in compliance with all normative statutory and environmental criteria of the host country. But the incorporation of the option involves constraint due to:
• The project proponent has to procure biomass from an unorganised sector which possesses no proper directives and mechanism to ensure its sustained availability at a desired price. Moreover the availability of the biomass is directly related to
▪ Climatic condition – That determines the growth of biomass.
▪ Pricing – Wide fluctuation and increasing trend in the price of biomass.
• Increase of moisture – There lies high risk of increase of moisture content of the fuel during the rainy season. So it needs to be protected which incurs additional investment.
• The ash obtained from the biomass is of low density which may result in sintering or slagging of ash resulting in clinker formation and consequent blocking of the system. Due to aforesaid problems the system will require frequent shut down for maintenance. Hence, may impact on generation of uninterrupted power.
From the above justification it is evident that the consideration of biomass based power generation is not a viable option for generating uninterrupted power and thus is opted out for further consideration.</td></tr>
<tr><td>P6</td><td>Sourced Grid-connected power</td><td>There are neither any national or sectoral policies</td></tr>
</table>

Alternatives for Power Generation	Description of the Alternatives	Justification of the Choice of Alternatives
	plants.	that impose obligation for uses of grid power in the industrial process. Moreover the use of grid power for the industrial process does not violate the normative environmental criteria. There are no operational or technical barriers related to electricity usage. Therefore the alternative can be considered for further discussion for the choice of the most realistic and credible alternative.
P7	Captive Electricity generation from waste gas (if project activity is captive generation with waste gas, this scenario represents captive generation with lower efficiency than the project activity).	The waste heat recovery based power generation is an well established technology and the efficiency level under optimum utilisation of the system is quite constant so the alternatives of captive generation using waste gas with lower efficiency than the project activity is not possible and is opted out for further consideration.
P8	Cogeneration from waste gas (if project activity is cogeneration with waste gas, this scenario represents cogeneration with lower efficiency than the project activity)	For the purpose of the industrial activity there won't be any need of steam. Therefore the installation of cogeneration plant with higher or lower efficiency seems to be impractical and as such the alternative can be opted out for further consideration.

B. Comparison of the alternatives on the basis of Investment and Financial analysis.

Baseline options	Capital cost	Cost of power	Synopsis
Project activity	38.6 million/MW (on actual basis)	Rs1.101/KWh (on actual basis)	• Comparatively higher investment in comparison to grid power. • Comparatively lower cost of generation.
Grid power	Rs 5 milion/ MW[3]	Energy charge: Rs 3.00 / kWh[4]	• Low initial capital investment. • Easy government approval. • Less financial burden.
Coal based CPP	Rs. 42.5 – 45 million / MW[5]	Rs 1.78 – 1.92 / kWh[6]	• Comparatively higher capital cost in comparison to grid based power.

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[3] Source: The total cost for infrastructure development and deposits for procurement estimated by independent electrical license holder under GOI.

[4] Source : http://www.orierc.org/Orders/Tariff/03-04

Baseline options	Capital cost	Cost of power	Synopsis
		Rs 1.36 / KWh (for coal and char based CPP)	• Lower variable cost of power generation.
Diesel Generator	Rs.7.5 – 9.0 million / MW[7]	Rs 11 – 11.39 / kWh[8]	• Comparatively lower capital cost in comparison to coal based power plant. • High variable cost due to higher diesel price. • Price of diesel is very high and is expected to increase in the foreseeable future.

From the above figures of the initial investment required for option of power availability, it is observed that procuring power from the grid is the most viable option in terms of initial investment. Moreover the procurement of grid power is the most common scenario in the sector as such analysis on investment is carried out on the basis of grid power.

Baseline Option	Return on Equity	Comments
Coal and Char based CPP	1.75%	The return is lower than the expected of 14% from investment in the power sector.
Project Activity	10.69%	The return is lower than the expected of 14% from investment in the power sector.
Diesel based CPP	-	The return on equity cannot be computed because of the high cost of power generation , on computing the NPV analysis the result is in line with -20,000.

Alternatives for Power Generation	Description of the Alternatives	Justification of the Choice of Alternatives
P1	Proposed project activity not undertaken as a CDM project activity.	The alternative is in compliance with all applicable legal and regulatory requirements and may be a part of the baseline. Owing to the high capital investment, lower return, uncertainty involved in power generation owing to its dependability on production and easily available grid connection at the industrial premise rules out the possibility of considering the alternative as a credible and realistic one.

[5] Captive Power Plants: Case Study of Gujarat, India
[6] Captive Power Plants: Case Study of Gujarat, India
[7] Guide book for National Certification Examination for Energy Managers and Energy Auditors; Bureau of Energy Efficiency
[8] Guide book for National Certification Examination for Energy Managers and Energy Auditors; Bureau of Energy Efficiency

Alternatives for Power Generation	Description of the Alternatives	Justification of the Choice of Alternatives
		Conclusion: The alternative option cannot be considered as a Baseline Scenario. The high capital cost involved for deployment of power generating unit and the risk involved in the availability of desired quantum of power from the unit owing to its high dependency on the manufacturing unit or the lower return on investment is a push back for the project proponent for adaptation of the alternative. Hence without the CDM revenue, this alternative was not a feasible option for the project proponent to adopt.
P4	On-site or off-site existing/new fossil fuel based existing captive or identified plant.	**Coal based captive power generation** From the above financial analysis it is evident that the higher cost involved in terms of capital investment and the lower return on investment is a push back for the project proponent for adaptation of the same. The financial unattractiveness of the alternative rules out the possibility to consider it as the baseline scenario. **Oil based captive power generation** From the above analysis it can be projected that investment in oil based power generation facility The higher per unit cost of power generation is the major push back for the industrial facility for adaptation of such initiatives. The financial unattractiveness of the alternative rules out the possibility to consider it as the baseline scenario Conclusion: The alternatives cannot be considered as a Baseline Scenario.
P6	Sourced Grid-connected power plants.	The lower capital investment for procuring grid based power in compared to comparatively high capital investment for other alternatives facilitates the choice of the alternative as the most financially feasible option or the baseline scenario. Conclusion: This alternative option is the Baseline Scenario

From the above analysis it is concluded that the most plausible and realistic option for power generation in the baseline scenario is P6 i.e. sourced grid connected power plant.

As the project activity is not a cogeneration unit therefore the alternatives for heat generation is not discussed.

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

Demonstrate that the identified baseline fuel is available in abundance in the host country and there is no supply constraint.

From the above analysis of the baseline scenario it is established that the grid power procurement is the most plausible and realistic option for the project proponent. The Power generation scenario in the eastern region is as follows:

Generation Source	Capacity (MW)
Coal based Power Plant	14,149.88
Hydro	2496.53
Renewable	46.76

Coal based thermal power plant comprises more than 80% of the total power generating unit in the eastern region. With hard coal reserves around 206 billion tonnes, of which 75 billion tonnes are proven, Indian coal offers a unique fuel source to domestic energy market for the next century and beyond[9].

From the above it can be easily concluded that the fuel for the identified baseline energy source is available in abundance in the host country and there is no supply constraint.

STEP 3: Step 2 and/or step 3 of the latest approved version of the "Tool for the demonstration and assessment of additionality"

The same shall be used to identify the most plausible baseline scenarios by eliminating non feasible options (e.g. alternatives where barriers are prohibitive or which are clearly economically unattractive).

Barriers	P1 (Proposed project activity not undertaken as a CDM project activity).	P4 (On-site or off-site new fossil fuel based captive plant).	P6 (Sourced Grid-connected power plants).
Operational Barrier (discussed in details under section B.5)	Existing	No such barrier exists.	No such barrier exists.

From the analysis of the barrier it can be said that the same would not prevent the implementation of the other alternatives.

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.

In accordance with the analysis of the baseline scenario under Step 1 it is being concluded that the most plausible and realistic alternatives for use of waste gas would be W2 and that for power generation is P6 i.e. sourced grid connected power plant.

Project scenario: Generation of Electricity only

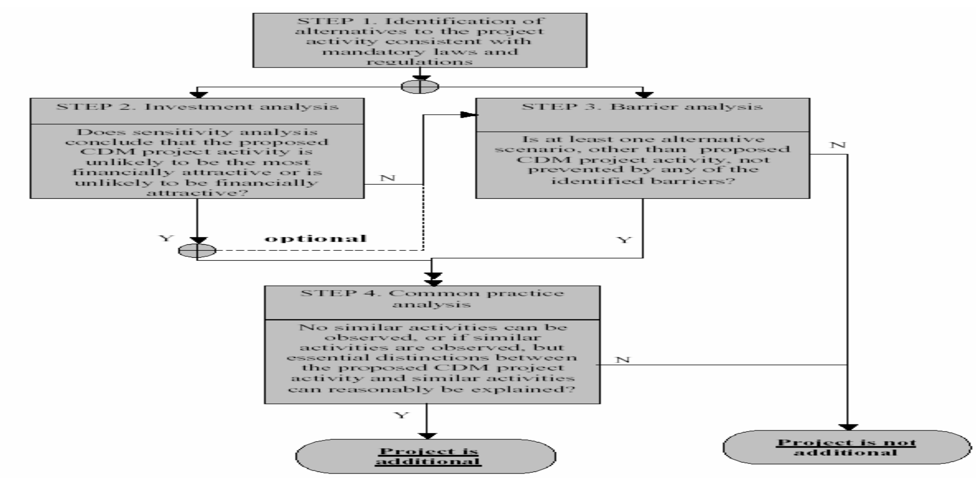
Scenario	Baseline Options		Description
	Waste Gas	Power	

[9] file:///E:/Energy%20Policy%20and%20Scenario/Coal/energy_overview_COAL.htm

1	W2	P6	In accordance to the selected baseline scenario the project proponent in absence of the project activity would have released the waste gas emanated from the DRI kiln of the sponge iron manufacturing unit to the atmosphere after the trace of carbon monoxide is removed in the after burning chamber. On the other hand the industrial facility would have procured power from the nearest substation.

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 GHG gases by sources are reduced below those that would have occurred in the 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 04)” ,



Demonstration and Assessment of additionality

In accordance with the Additionality Tool version 3 the additionality of the project would be depicted through adaptation of the steps as mentioned in the tool. The steps include

- Identification of alternatives to the project activity;
- Investment analysis to determine that the proposed project activity is not the most economically or financially attractive
- Barriers analysis; and
- Common practice analysis.

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

Sub –Step 1.a Define alternatives to the project activity:
The alternatives to the proposed project activity i.e. alternatives of use of waste gas in the baseline scenario and alternatives for power generation is discussed in brief in section B.4.
Out come of Step 1a:
Out of the alternatives the option of the proposed project activity without consideration of CDM benefit, existing new captive power generation on site using coal and oil are feasible but economically unattractive owing to huge investment in comparison to existence of techno commercially viable option of obtaining grid power. The alternative option of importing electricity from the grid is the most viable and economically most attractive option on the part of the project proponent. Similarly the venting of waste gas to the atmosphere after incineration is identified to be the most plausible and realistic baseline scenario.

Out come of Sub-step 1.b. Consistency with mandatory laws and regulations:
All the alternatives mentioned in the section B.4 are in compliance with applicable legal and regulatory requirements.

Conclusion: The pros and cons of the alternatives identified through the above analysis resulted in identification of the alternatives that are in compliance with the mandatory laws and regulation and are feasible on the part of project proponent. The import of the grid power being the most feasible and financially attractive and is determined as the baseline scenario.
In order to further establish the additionality of the project activity additionality test has been carried out on the basis of investment and other prohibitive barrier.

Step 2: Investment Analysis
Investment analysis is carried out to determine whether the project activity is the economically or financially less attractive than at least one other alternative, without the revenue from the sale of certified emission reductions (CERs). Investment analysis has been carried out using following sub steps:
Sub-step 2a. Determine appropriate analysis method
Sub-step 2 b. – Option I. Apply simple cost analysis
- Option II. Apply investment comparison analysis
- Option III. Apply benchmark analysis

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

Sub-step 2a. Determine appropriate analysis method
According to the "Tool for the demonstration and assessment of additionality (Version 03)" one of the three options viz; Simple Cost Analysis, Investment Comparison Analysis and Benchmark Analysis must be applied to determine the financial additionality of the project.

Investment analysis method	Criteria for adaptation	Remarks	Conclusion
Option I: Simple cost analysis	Simple cost analysis is applicable to the project activity that generates no financial and economic benefit other than CDM related income.	Apart from the capital investment incurred in incorporation of the project activity the variable cost of power generation is low in compared to the cost of baseline power. Hence there is a saving in	Simple cost analysis cannot be adopted.

Investment analysis method	Criteria for adaptation	Remarks	Conclusion
		terms of money on the part of the project proponent considering the running cost in comparison to the baseline scenario. .	
Option II: Investment comparison analysis	Identification of financial indicator most suitable for the project type and decision making context.	The investment of the project activity is much higher in compared to the baseline scenario. Project IRR or equity IRR can be carried out to establish the investment analysis. Indian power sector project has proposed bench mark return on equity for power sector projects.	Benchmark analysis would be more suitable for the current study.
Option III: Benchmark analysis	Identification of financial indicator most suitable for the project type. Identification the relevant benchmark value, such as the required rate of return (RRR) on equity. The benchmark is to represent standard returns in the market, considering the specific risk of the project type, but not linked to the subjective profitability expectation or risk profile of a particular project developer	Post tax return on equity has been identified as the as the most realistic and credible option for carrying out of the analysis. Indian power sector (CERC – Central Electricity Regulatory commission) has stipulated benchmark return on equity on public and private sector project and is being considered for financial analysis.	Most plausible analysis method.

Conclusion: The comparative analysis of all the methodologies that could be adopted to estimate the investment analysis of the project activity suggests the adaptation of Benchmark analysis for the present case.

Sub-step 2 b. – Option III. Apply benchmark analysis

Indian Power sector has stipulated benchmark return on equity for power sector project. The return was fixed at 16% [10] during 2001 and was valid until 2004 which was later revised and fixed at 14% and would be valid until 2009[11]. The benchmark returns represent the standard of the market considering the specific risk of the project type. Incentives, foreign exchange variations and efficiency in operations are additional to this benchmark.

The study carried out on Return on equity (Using fundamental approach Pogues method) for Central Power sector Utilities by Crisil Advisory Service indicate the return in the range of 16.5- 21.4%[12].

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[10] Source: http://cercind.gov.in/28052005/annualreport.pdf

[11] Source: http://cercind.gov.in/28052005/annualreport.pdf

[12] Source: http://cercind.gov.in/rep1304.pdf

Central Power sector Utilities	Return on equity
NLC	16.5%
NTPC	17.8%
PGCIL	20.8%
NHPC	21.4%
NEEPCO	19.3%

Conclusion: Post tax return on equity has been identified as the most plausible financial indicator for carrying out of the investment analysis.

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

Calculation of the financial indicator:
Financial analysis has been carried out by the project proponent before the deciding on the deployment of the project activity. The financial analysis indicates unattractiveness owing to its lower return in comparison the investment return in the power sector. The assumptions used for estimation of the financial indicator are depicted below.

Particulars	Assumption
Plant Capacity	12 MW
Operational days	300 days
Plant load Factor	60%
Auxiliary Consumption	10%
Net Power generation	46656 MWh
Electricity Tariff	INR 3/KWh

Capital Expenditure:

Project Cost	INR. in million
Land and land development cost	12.00
Building and Civil construction	35.00
Plant & Machinery	325.60
Miscellaneous Fixed Assets	47.10
Provision for Contingencies	9.00
Installation, erection and commissioning	4.00
Pre-operative expenses	19.30
Technical know how	4.00
Preliminary expenses	0.40
Margin for working capital	10.40
Cost of Diesel generator needed for plant start up	6.73

Source of Finance:

Project Cost	INR. in million

Total cost	457.44
Loan	220.00
Equity	244.20
Particulars	**Assumption**
Interest on term loan	11.75%
Loan Term (in years)	5

Generation Cost:

Particulars	Rate in INR	Unit
Variable Cost of Power Generation at 60% PLF		
Unit Fuel cost	0.62	Rs/kwh
Consumables	0.35	Rs/kwh
Total Per unit cost	**0.97**	Rs/kwh
Fixed Cost of Power Generation at 60% PLF		
Operation and Maintenance	178.00	Lakh INR
Interest on Working Capital	6.00	Lakh INR
Total fixed cost	184.00	Lakh INR
Unit Generated	50.54	Lakh unit
Fixed Charge/KWh drawn	**0.36**	Rs/kwh
Total Charge(Fixed +variable)	**1.33**	Rs/kwh

Diesel based power generation:

Particulars	Unit	Value
Total capacity	MW	1.3
Operating hours	hrs p.a.	360
Specific fuel consumption	Lt/KWH	0.4
PLF		90%
Electricity Generated	KWH p.a.	421200
Fuel required	Lt	168480
Price of diesel	INR / lt	36

Considering the aforesaid assumption the value of return on equity had been estimated at 10.60 % (A brief of the calculation pertaining to estimation of the return on equity is provided as Annexure). The above analysis revel that the return on equity lower than the bench mark return of 14% for the power sector and hence was not attractive enough to proceed on business as usual basis. However with the consideration of the CDM revenue the return on equity would be increased to 13.88% i.e. about 14%.

Sub-step 2d. Sensitivity analysis

Sensitivity analysis has been carried out to demonstrate the financial attractiveness is robust to reasonable variations under critical assumption. Owing to the uncertainty involved in attainment of desired quantum of waste gas sensitivity analysis has been carried as follows

Variation in power generation	Equity IRR without CDM	Equity IRR with CDM
Increase by 2.5%	11.47 %	14.78 %
Increase by 5%	12.34 %	15.67 %
Increase by 7.5%	13.18 %	16.54 %
Decrease by 2.5%	9.70 %	12.96 %
Decrease by 5%	8.79 %	12.03 %
Decrease by 7.5 %	7.87 %	11.08 %

Variation in fixed cost (Salary and wages, Overhead, O&M, Cost due to DG set)	Equity IRR without CDM	Equity IRR with CDM
Increase by 2.5%	10.51%	13.80%
Increase by 5%	10.43%	13.72%
Increase by 7.5 %	10.34%	13.64%
Decrease by 2.5%	10.68%	13.96%
Decrease by 5%	10.77%	14.04%
Decrease by 7.5 %	10.85%	14.12%

From the above sensitivity analysis it observed that the returns from the project are much lower than the expected returns of the similar type of project. With CDM revenue, the returns from the project more or less match the expected returns and partly mitigate the risks involved in the project. Thus, CDM benefits are necessary to make the project viable.

Conclusion: The above analysis revel that the CDM project activity has a less favourable financial indicator (Post Tax Return on Equity) of 10.6% than the benchmark of 14% demonstrating the financial unattractiveness of the project activity. Moreover the results of the sensitivity analysis conducted confirm that the financial IRR of the project activity without CDM revenues is lower than the benchmark required by the investors. The financial analysis indicates requirement of CDM revenue to sustain the operations of the project activity.
Hence on the basis of the above analysis the project activity can be considered to be additional.

Step 3: Barrier Analysis:
The project proponent is required to determine whether the proposed project activity faces barriers that:
(a) Prevent the implementation of this type of proposed project activity; and
(b) Do not prevent the implementation of at least one of the alternatives through the following sub-steps:

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

Operational Barrier
The quantity and quality of the waste gas is highly dependent on the production and efficiency of the kiln. The project activity had its associated barriers for successful implementation. The barriers identified are depicted below:

a. Waste gas non-availability and inconsistency of waste gas parameters
   Waste gas availability and consistency of waste gas parameters are the most important aspects that can affect the performance of the project activity. Any non-availability of waste gas or inconsistency of waste gas parameters will result in inadequate steam and power generation.

Non availability of Waste gas may occur due to DRI kiln shut downs, functional disturbances in the DRI kiln or due to any kind of network failure. And since the plant operations would be significantly dependent on the project activity for electricity, disruption in power generation would have a detrimental effect on entire plant operations.

b. Fluctuation in quality of Raw material
The fluctuation in the quality and quantity of waste gas may result from variation of the coal quality. For ideal operation of Direct Reduction of Iron the coal required should possess minimal carbon content of 40-45%. Any detoriation in the quality of coal will result in increase in coal consumption and thereby lowering production of Kiln. This would hamper the quality and quantity of waste gas thereby resulting in variation of the quantum of power generation.

c. The gas emanating from the DRI production process has high particulate load (SPM) that can create erosion and fouling problem on the gas side of the boiler tube which when occur would lead to stoppage of power generation.

d. The generation of power is dependent on the operation of DRI kiln. On other hand the power requirement in the industry fluctuating owing to the cyclic nature of power requirement in the induction furnace. Any slump in the demand of power in the industrial process would result in lower plant load factor and would adversely impact the project activity.

e. Variation in temperature of waste gas can hamper the power generation process. Moreover re stimulation of the production takes time. Hence power interruption for a short while can destabilise the manufacturing process besides causing production loss and damage to the boiler and accessories due to thermal shock.

f. The survey of Indian sponge iron industry reveal the constraints depicted as follows[13] :
   a) Raw Material
   b) Power
   c) Finance
   d) Labor
   The following problem is also being faced by the project proponent.

g. Variation in quality & quantity of raw material like iron ore will directly affect unhindered operation of kiln at full capacity and thus resulting in uninterrupted supply of waste gas at high temperature from DRI kilns. Interrupted supply of waste gas will result in disrupted power generation and would have a detrimental effect on plant operation.

Other Barrier

Lack of information on operation know-how: BSFAL belongs to sponge-iron manufacturing sector with limited knowledge and exposure of complications associated with production of power. The industry personnel lacked the necessary technical background to develop and implement a waste heat recovery based power plant. They had to strengthen their internal capacity by employing external expertise to implement and operate the project activity. They were provided with training to ensure smooth operation.

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

It has been observed in Sub-step 3a that the Project Activity has its associated barriers for successful implementation. The barriers mentioned above are directly related to Project Activity only and would not prevent the implementation of other alternatives of which the baseline scenario is one.

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[13] Source: Joint Plant Committee report "Survey of Sponge Iron Industry 2005-06".

BSFAL would not have faced any financial or technological barrier in case it continued to procure power from the grid. Therefore, it is most likely that in absence of the project activity BSFAL would opt for the business-as-usual scenario, i.e. releasing the waste heat into the atmosphere and procuring equivalent electricity from grid.

Conclusion: The above analysis indicates the barrier that prohibits the incorporation of the project activity.
Step 4. Common practice analysis
Sub-step 4a. Analyze other activities similar to the proposed project activity:
Sub-step 4b. Discuss any similar options that are occurring:

Study reveal that the import of grid power for industrial power requirement is the most realistic and credible alternative scenario for the sponge iron unit. Synopsis of few studies being carried out is presented herewith.

1. Survey of Indian Sponge iron industry revels that out of 147 surveyed Sponge Iron Industry of India, only 16 have captive power generation, only 4 out of these 16 are in Orissa[14].
2. At the time of implementation of the project activity in 2005, there were 73 sponge iron units[15] operational within the state and many more are in the process of starting operations. Out of this 73 sponge iron units, till date, only three plants (Orissa Sponge Iron Ltd[16] ., OCL India Ltd.[17], and Tata Sponge Iron Ltd.[18]) have implemented Clean Development Mechanism project modalities for their waste heat recovery based captive power project in order to reduce GHG emission and are eligible for the Carbon Credit revenues from sale of the carbon emission reductions.
3. Out of 73 sponge iron units in Orissa, 40 units are present in the Sundargargh district, from these only 4 units have Waste Heat Recovery based captive power generation facility[19].
4. CEA of Government of India has brought a study of captive power plants in India in august 2005. As per the study only seven waste heat recovery based captive power plants are in India out of total two hundred and eight captive power plants. The study indicates waste heat based CPP forms approximately 3.4% of the total installed CPP[20].

Hence the above study indicates that the Waste Heat Recovery based Captive Power Plant facility is not an established scenario in Iron and Steel manufacturing sector in Orissa on operational basis. Thus, the power generation through the WHR process would not have been feasible for establishment without the CDM opportunity.

Conclusion: the above facts and figures justifies that the project activity is not a common practice in the sponge iron sector nor a business as usual scenario in the state of Orissa.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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[14] Source: Joint Plant Committee report “Survey of Sponge Iron Industry 2005-06”.
[15] Source: Orissa Sponge Iron Manufacturers’ Association, Bhubaneswar, Orissa
[16] Source: http://cdm.unfccc.int/Projects/registered.html (UNFCCC Ref No.: 0515)
[17] Source: http://cdm.unfccc.int/Projects/registered.html (UNFCCC Ref. No.: 0367)
[18] Source: http://cdm.unfccc.int/Projects/registered.html (UNFCCC Ref. No.: 0274)

[19] Source: Letter from OSIMA dated 17/03/07
20 Source: *http://www.cea.nic.in/planning/ “Report on Tapping of Surplus Power from Captive Power Plants”*

The monitoring methodology is used in conjunction with the approved baseline methodology ACM0012 Version02 – "Consolidated baseline methodology for GHG emission reductions for waste gas or waste heat or waste pressure based energy system". The applicability criteria for the approved baseline methodology ACM0012 Ver02 and approved monitoring methodology ACM0012 Ver02 are identical and have been justified in section B.2 signifying the applicability of the said methodology to the project activity.
The project activity being a waste heat recovery based captive power generation, there are negligible project emissions generated during operation of the project activity. Though, the GHG emission from fossil fuel consumption during power plant start up has been considered out of conservatism.

Baseline Emissions
The baseline emissions for the year y shall be determined as follows:
$BE_y = BE_{En\ y} + BE_{fist\ y}$
Where:
BE_y Total baseline emissions during the year y in tons of CO2.
$BE_{En,y}$ Baseline emissions from energy generated by project activity during the year y in tons of CO2
$BE_{flst,y}$ Baseline emissions from generation of steam, if any, using fossil fuel, that would have been used for flaring the waste gas in absence of the project activity (tCO2e per year), This is relevant for those project activities where in the baseline steam is used to flare the waste gas.

Their is no need for flaring of the waste gas emanated from the DRI kiln in the baseline scenario, as such the emission from generation of steam if any using fossil fuel that would have been used for flaring of the waste gas in absence of the project activity is considered to be nil.
$BE_{fist\ y} = 0$
Therefore
$BE_y = BE_{En\ y}$

The baseline emission for the project activity would be calculated in accordance to *Baseline emission for Scenario 1*. (*Scenario 2 is opted out because of the fact that project activity is not a cogeneration system*)
Scenario 1 represents the situation where the electricity is obtained from a specific existing power plant or from the grid and heat from a fossil fuel based element process.
$BE_{En\ y} = BE_{Elec.\ y} + BE_{Ther.\ y}$

Where
$BE_{Elec,y}$ Baseline emissions from electricity during the year y in tons of CO2
$BE_{Ther,y}$ Baseline emissions from thermal energy (due to heat generation by element process) during the year y in tons of CO2

But as the project activity incorporates generation of electricity only and not heat therefore baseline emission from generation of thermal energy could be omitted for further consideration.

A) Baseline emissions from electricity ($BE_{electricity,y}$) that is displaced by the project activity:

$BE_{Elec,y} = f_{cap} * f_{wg} * \sum_j \sum_i (EG_{i,j,y} * EF_{Elec,i,j,y})$

Where
BEelec,y -Baseline emissions due to displacement of electricity during the year y in tons of CO2.

EGi,j,y -Quantity of electricity supplied to the recipient j by generator, which in the absence of the project activity would have been sourced from ith source (i can be either grid or identified source) during the year y in MWh, and

EFelec,i,j,y -CO2 emission factor for the electricity source i (i=gr (grid) or i=is (identified source)), displaced due to the project activity, during the year y in tons CO2/MWh

fwg -Fraction of total electricity generated by the project activity using waste gas. This fraction is 1 if the electricity generation is purely from use of waste gas. If the boiler providing steam for electricity generation uses both waste and fossil fuels, this factor is estimated using equation (1d). If the steam used for generation of the electricity is produced in dedicated boilers but supplied through common header, this factor is estimated using equation (1d/1e). NOTE: For project activity using waste pressure to generate electricity, electricity generated from waste pressure use should be measurable and this fraction is 1.

fcap -Energy that would have been produced in project year y using waste gas/heat generated in base year expressed as a fraction of total energy produced using waste gas in year y. The ratio is 1 if the waste gas/heat/pressure generated in project year y is same or less then that generated in base year. The value is estimated using equation (1f), or (1f) and (1f-1). The proportion of electricity that would have been sourced from the ith source to the jth recipient plant should be estimated based on historical data of the proportion received during the three most recent years.

Procurement of grid power is identified as the baseline for power generation from the project activity. In accordance to the methodology:

If the displaced electricity for recipient is supplied by a connected grid system, the CO2 emission factor of the electricity EFelec,gr,j,y shall be determined following the guidance provided in the "Tool to calculate the emission factor for an electricity system". If the total electricity generated by project activity is less than 60 GWh/year, then, project proponents can use approved small scale methodology AMS I.D to estimate the grid emission factor.

Calculation of CO2 emission factor of the electricity for electricity procured from the grid:

- The project activity is expected to generate 34.56 GWh per annum and is less than the threshold generation of 60 GWh/year and thus can be use the approved small scale methodology AMS I.D to estimate the grid emission factor. In accordance to the methodology
  (a) A combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system'.
  (b) The weighted average emissions (in kg CO2e/kWh) of the current generation mix.

The project proponent has decided to opt for combined margin emission factor for calculation of the CO2 emission factor of the electricity procured from the grid. The combined margin emission factor is calculated using the latest version of "Tool to calculate the emission factor for an electricity system".
(Detailed procedure for estimation of grid emission factor which includes operating margin, build margin and combined margin emission factor is demonstrated in the Annex 3 below)

The combined margin emission factor is calculated using operating margin emission factor and build margin emission factor. Operating margin emission factor is calculated using Simple operating margin as the share of the low cost/must run resources constitute less than 50% of the total annual generation.

Operating Margin emission factor

The operating margin emission factor for the eastern regional grid is estimated by simple operating margin. The Operating margin will be estimated through adoption of the ex post data for power generation, and procurement from the other regional grid.

The operating margin emission factor is estimated at 1.13 tCO2/MWh.
The Build margin is calculated as the average emissions intensity of the 20% most recent capacity additions in the grid based on net generation.
The Build margin emission factor is estimated at 0.97 tCO2/MWh.
The Combined Margin emission factor is estimated form the operating and build margin emission factor, factoring into alternative weights.
The Combined Margin emission factor is estimated at 1.05 tCO2/MWh.

B) Baseline emission from thermal energy generation.
The project activity does not incorporate thermal energy generation as such does not require estimation of baseline emission from thermal energy generation.

Calculation of the energy generated (electricity) in units supplied by waste gas/heat and other fuel.
The quantum of electricity generated using waste gas is calculated in accordance with situation 2. The project activity confirms with the applicability of the situation where it is not possible to measure the net calorific value of the waste gas and the steam generated with different fuels in dedicated boiler are fed into a turbine through common steam header takes into account that the relative share of the total generation from the waste gas is calculated by considering the total steam produced and the amount of steam generated from each boiler. The fraction of energy produced by the waste gas in project activity is calculated as follows.

$$f_{wg} = \frac{ST_{whr,y}}{ST_{whr,y} + ST_{other,y}}$$

Where,
$ST_{whr,y}$ Energy content of the steam generated in waste heat recovery boiler fed to turbine via common steam header
$ST_{other,y}$ Energy content of steam generated in other boilers fed to turbine via common steam header
The project activity also confronts with the criteria for the adoption of the calculation method

- All the boilers have to provide superheated steam.
- The calculation should be based on the energy supplied to the steam turbine. The enthalpy and the steam flow rate must be monitored for each boiler to determine the steam energy content. The calculation implicitly assumes that the properties of steam (temperature and pressure) generated from different sources are the same. The enthalpy of steam and feed water will be determined at measured temperature and pressure and the enthalpy difference will be multiplied with quantity measured by steam meter.
- Vented steam should be deducted from the steam produced with waste gas/heat.

Capping of the Baseline Emission
As an introduction of element of conservativeness, this methodology requires that baseline emissions should be capped irrespective of planned/ unplanned or actual increase in output of plant, change in operational parameters and practices, change in fuels type and quantity resulting into increase in waste gas generation. In case of planned expansion a separate CDM project should be registered for additional capacity. Project proponents shall use method 1 to estimate the cap if data is available. In case of project activities using waste pressure to generate electricity or is implemented in a new facility, method 2 shall be used.

As the project activity is implemented in new facility, method 2 is used to calculate the same which is as follows:

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

$$Q_{WG,BL} = Q_{BL,product} * q_{wg,product}$$

Where,

$Q_{WG,BL}$ Quantity of waste gas generated prior to the start of the project activity (Nm^3)

$Q_{BL,product}$ Production by process that most logically relates to waste gas generation in baseline. This is estimated based on 3 years average prior to start of project activity.

$q_{wg,product}$ Amount of waste gas/heat/pressure the industrial facility generates per unit of product generated by the process that generates waste gas/heat/pressure.

The above factor is considered to be 1 in accordance to the methodology that states the ratio could be considered as 1 if the waste gas generated in the year y is same or less than that generated in the base year. For capacity expansion if any in the future the expanded unit will be treated as a new facility.

Project Emission

Project Emissions include emissions due to combustion of auxiliary fuel to supplement waste gas and electricity emissions due to consumption of electricity for cleaning of gas before being used for generation of heat/energy/electricity.

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

Where:

PEy Project emissions due to project activity.

$PE_{AF\,y}$ -Project activity emissions from on-site consumption of fossil fuels by the Cogeneration plant(s), in case they are used as supplementary fuels, due to non-availability of waste gas to the project activity or due to any other reason.

$PE_{EL\,y}$ -Project activity emissions from on-site consumption of electricity for gas cleaning equipment.

As per with the project activity there has been no such consumption of fossil fuel and related emission. Therefore the project emission can be considered to be nil.

Leakage

No leakage calculation is applicable under this methodology.

Emission Reduction

The emission reduction is estimated as a difference between the baseline emission and the project emission factoring into leakage.

$$ER_y = BE_y - PE_y$$

Where,

ER_y are the total emissions reductions during the year y (in tons of CO_2),

BE_y are the baseline emissions for the project activity during the year y (in tons of CO_2),

PE_y are the emissions from the project activity during the year y (in tons of CO_2), As the project emission for the project activity is nil therefore it can be concluded that the emission reduction from the project activity is equivalent to baseline emission.

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

Data / Parameter:	**EF $_{elec,i,j,y}$ (OM)**
Data unit:	**tCO_2/MWh**
Description:	The above parameter refers to operating margin emission factor of the grid power.
Source of data used:	The data is obtained CO2 Baseline Database for the Indian Power Sector, User Guide (Version 2, Date June, 2007) http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm
Value applied:	1.13 tCO2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	The operating margin emission factor is estimated by simple operating margin emission factor and is calculated as the generation weighted average CO_2 emission per unit net generation (tCO_2/MWh) of all generating power plants serving the system, not including low cost/ must run power plants/units. The estimation is done based on data on fuel consumption and net electricity generation of each power plant/unit. The data pertaining to the operating margin is estimated on ex-post basis and is obtained from Version 2 of CO2 Baseline Database for the Indian Power Sector.
Any comment:	The CEA under Government of India has published the baseline emission factor to facilitate adoption of authentic baseline emissions data and also to ensure uniformity in the calculations of CO2 emission reductions by CDM project developers, Central Electricity Authority (CEA), in cooperation with GTZ CDM-India, has compiled the database. CEA will be updating the database at the end of each financial year.

Data / Parameter:	**EF $_{elec,i,j,y}$ (BM)**
Data unit:	**tCO_2/MWh**
Description:	The above parameter refers to build margin emission factor of the grid power.
Source of data used:	The data is obtained CO2 Baseline Database for the Indian Power Sector, User Guide (Version 2, Date June, 2007) http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm
Value applied:	0.97 tCO2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	The build margin emission factor is calculated using Option 1 of the tool for estimation of emission factor for an electricity system. In accordance to the option For the first crediting period, the build margin emission factor ex-ante based is calculated on the most recent information available on units already built for sample group at the time of CDM-PDD submission to the DOE for validation. The data pertaining to the Build margin is estimated on ex-post basis and is obtained from Version 2 of CO2 Baseline Database for the Indian Power Sector.
Any comment:	The CEA under Government of India has published the baseline emission factor to facilitate adoption of authentic baseline emissions data and also to ensure uniformity in the calculations of CO2 emission reductions by CDM project developers, Central Electricity Authority (CEA), in cooperation with GTZ CDM-India, has compiled the database. CEA will be updating the database at

	the end of each financial year.

Data / Parameter:	**EF** $_{elec,i,j,y}$
Data unit:	**tCO_2/MWh**
Description:	The above parameter refers to emission factor of the grid power/ combined margin emission factor.
Source of data used:	The data is obtained CO2 Baseline Database for the Indian Power Sector, User Guide (Version 2, Date June, 2007) http://www.cea.nic.in/planning/c%20and%20e/Government%20of%20India%20website.htm
Value applied:	1.05 tCO2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	The Combined Margin emission factor is estimated form the operating and build margin emission factor, factoring into alternative weights. The combined margin emissions factor is calculated as follows: $EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$ $EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$ $= 1.13 \times 0.5 + 0.97 \times 0.5$ $= 1.04633375$ ≈ 1.05 tCO_2/MWh The alternative weights for either are taken as 50%.
Any comment:	The combined margin emission factor is calculated using "Tool to calculate the emission factor for an electricity system" the calculation of grid emission coefficient.

B.6.3 Ex-ante calculation of emission reductions:

Baseline Emissions
The baseline emissions for the year y shall be determined as follows:
$BE_y = BE_{En\ y} + BE_{fist\ y}$
Where:
BE_y Total baseline emissions during the year y in tons of CO2.
$BE_{En,y}$ Baseline emissions from energy generated by project activity during the year y in tons of CO2
$BE_{flst,y}$ Baseline emissions from generation of steam, if any, using fossil fuel, that would have been used for flaring the waste gas in absence of the project activity (tCO2e per year), This is relevant for those project activities where in the baseline steam is used to flare the waste gas.

Their is no need for flaring of the waste gas emanated from the DRI kiln in the baseline scenario, as such the emission from generation of steam if any using fossil fuel that would have been used for flaring of the waste gas in absence of the project activity is considered to be nil.
$BE_{fist\ y} = 0$
Therefore
$BE_y = BE_{En\ y}$

The baseline emission for the project activity would be calculated as
$BE_{En\ y} = BE_{Elec.\ y} + BE_{Ther.\ y}$
Where
$BE_{Elec,y}$ Baseline emissions from electricity during the year y in tons of CO2

$BE_{Ther,y}$ Baseline emissions from thermal energy (due to heat generation by element process) during the year y in tons of CO_2

But as the project activity incorporates generation of electricity only and not heat therefore baseline emission from generation of thermal energy could be omitted for further consideration.

A) Baseline emissions from electricity ($BE_{electricity,y}$) that is displaced by the project activity:

$BE_{Elec,y} = f_{cap} * f_{wg} * \sum_j \sum_i (EG_{i,j,y} * EF_{Elec,i,j,y})$

Where

BEelec,y -Baseline emissions due to displacement of electricity during the year y in tons of CO2.
EGi,j,y -Quantity of electricity supplied to the recipient j by generator,
EFelec,i,j,y -CO2 emission factor for the electricity source
fwg -Fraction of total electricity generated by the project activity using waste gas.
fcap -Energy that would have been produced in project year y using waste gas/heat generated in base year expressed as a fraction of total energy produced using waste gas in year y.

Emission factor for the electricity source ($EF_{Elec,i,j,y}$)
The emission factor for the electricity source is being estimated at 1.05 tCO2/MWh

Quantity of Electricity supplied to the recipient plant
$EG_{gross\ i,j,y}$ = Gross Power generated by the combined unit of 12 MW
= 51840 MWh p.a.
$EG_{auxiliary\ i,j,y}$ = Auxiliary Power consumed by the combined unit of 12 MW
= 5184 MWh p.a.

$EG_{net\ i,j,y} = EG_{gross\ i,j,y} - EG_{auxiliary\ i,j,y}$
= 51840 – 5184
= 46656 MWh p.a

Fraction of total electricity generated by the project activity using waste gas

$$f_{wg} = \frac{ST_{whr,y}}{ST_{whr,y} + ST_{other,y}}$$

Where,
$ST_{whr,y}$ Energy content of the steam generated in waste heat recovery boiler fed to turbine via common steam header
$ST_{other,y}$ Energy content of steam generated in other boilers fed to turbine via common steam header

Parameters	Unit	WHR boiler	AFBC
Capacity	TPH	35	18
Capacity	KGPH	35000	18000
Temperature of Steam	^{0}C	485	485

Parameters	Unit	WHR boiler	AFBC
Enthalpy of Steam	KJ/Kg	3375.81	3375.81
Temperature of Feed water	^{0}C	126	126
Enthalpy of Feed water	KJ/Kg	529.25	529.25
Difference of Enthalpy	KJ/Kg	2846.57	2846.57

Therefore

$$f_{wg} = \frac{ST_{whr,y}}{ST_{whr,y} + ST_{other,y}}$$

= (35000*2846.57)/ (35000*2846.57 + 18000*2846.57)
= 0.66

Energy that would have been produced in project year y using waste gas/heat generated in base year expressed as a fraction of total energy produced using waste gas in year y.
fcap = 1

Baseline emissions from electricity ($BE_{electricity,y}$) that is displaced by the project activity:

$BE_{Elec,y} = f_{cap} \times f_{wg} \times \sum_j \sum_i (EG_{i,j,y} \times EF_{Elec,i,j,y})$
=1 × 0.66 × 46656 × 1.05
= 32351 tCO2/MWh

Project Emission
PEy = 0

Emission reduction
ERy = BEy –PEy
= 32351- 0
= 32351 tCO2/MWh

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

The emission reduction estimated as a difference of the baseline in project emission is depicted below:

Year	Estimation of project activity emissions (tonnes of CO2 e)	Estimation of baseline emissions (tonnes of CO2 e)	Estimation of leakage (tonnes of CO2 e)	Estimation of overall emission reductions (tonnes of CO2 e)
April 2008 – March 2009	0	32351	0	32351
April 2009 – March 2010	0	32351	0	32351
April 2010 – March 2011	0	32351	0	32351
April 2011 – March 2012	0	32351	0	32351
April 2012– March 2013	0	32351	0	32351
April 2013 – March 2014	0	32351	0	32351

Year	Estimation of project activity emissions (tonnes of CO2 e)	Estimation of baseline emissions (tonnes of CO2 e)	Estimation of leakage (tonnes of CO2 e)	Estimation of overall emission reductions (tonnes of CO2 e)
April 2014 – March 2015	0	32351	0	32351
April 2015– March 2016	0	32351	0	32351
April 2016 – March 2017	0	32351	0	32351
April 2017 – March 2018	0	32351	0	32351

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

In accordance to the guidelines for completing PDD The following two sections (B.7.1 and B.7.2) has provide a detailed description of the monitoring plan, including an identification of the data to be monitored and the procedures that will be applied during monitoring.
The data monitored and required for verification and issuance will be kept for a minimum of two years after the end of the crediting period or the last issuance of CERs for this project activity, whichever occurs later.

B.7.1 Data and parameters monitored:

Data / Parameter:	$EG_{i,j,y}$
Data unit:	MWh / yr
Description:	The above parameter refers to the total quantum of electricity generation from the entire captive power generation facility comprising of 8MW Waste heat recovery and 4 MW coal and char based units.
Source of data to be used:	Daily report generated based on energy meters reading. The cumulative value of the energy generated is mentioned in the monthly and yearly report.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	51840 MWh / yr. (However the power generated from the coal and char based captive power unit wouldn't be used for estimation of emission reduction.)
Description of measurement methods and procedures to be applied:	Total power generation from the facility will be monitored on daily basis through energy meter incorporated at the industrial premise.
QA/QC procedures to be applied:	Quality control and quality assurance procedures are planned for monitoring of the project related data as the data will be used as a supporting documentation to calculate baseline emission. The uncertainty level of data archived is low as the measuring instruments will be calibrated on an annual basis. A back up meter will be kept as for emergency preparedness. The energy meter is a three phase four wire device being tested and calibrated by electrical department under Government of Orissa. The meter is tested O.K on the basis of 1. Insulation Resistance Test 2. Dielectric Strength Test

	3. Running with no load 4. Starting Current Test The performance of the meter tested has been certified as satisfactory with 0.7% error. The meter will be calibrated as per national standard and will be calibrated at an interval of one year.
Any comment:	The data measured will be archived on a daily basis both in paper and electronic spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be archived for a period of two years after the end of the crediting period.

Data / Parameter:	$EG_{I,j,y\ AUX}$
Data unit:	MWh / yr
Description:	The above parameter refers to the auxiliary consumption of the entire captive power generation facility.
Source of data to be used:	Metered data recorded in log book/ daily report, monthly report and yearly report.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	5184 MWh / yr
Description of measurement methods and procedures to be applied:	Daily report generated based on the data from energy meters incorporated at the industrial premise.
QA/QC procedures to be applied:	Quality control and quality assurance procedures are planned for monitoring of the project related data as the data will be used as a supporting documentation to calculate baseline emission. The uncertainty level of data archived is low as the measuring instruments will be calibrated on an annual basis. The energy meter is a three phase four wire device being tested and calibrated by electrical department under Government of Orissa. The meter is tested O.K on the basis of 5. Insulation Resistance Test 6. Dielectric Strength Test 7. Running with no load 8. Starting Current Test The performance of the meter tested has been certified as satisfactory with 0.7% error. The meter will be calibrated as per national standard and will be calibrated at an interval of one year.
Any comment:	The data measured will be archived on a daily basis both in paper and electronic spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be archived for a period of two years after the end of the crediting period

Data / Parameter:	**$EG_{,j,y\ NET}$**
Data unit:	MWh / yr
Description:	The above parameter pertains to the net quantum of electricity generated from the project activity per annum.
Source of data to be used:	The value will be obtained from the monthly and yearly report.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	46656 MWh / yr.
Description of measurement methods and procedures to be applied:	This is calculated as the difference between the total power generated for a year and the auxiliary power consumption during the same period.
QA/QC procedures to be applied:	Quality control and quality assurance procedures are planned for calculating of the value.
Any comment:	The data calculated will be archived on a monthly basis both in paper and electronic spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be archived for a period of two years after the end of the crediting period.

Data / Parameter:	**S_{WB}**
Data unit:	Tonne
Description:	The above parameters pertains to quantum of Steam generated from the waste heat recovery boiler and is measured through flow meter.
Source of data to be used:	The value will obtained from the daily log sheet. The cumulative value of the same will be obtained from the monthly and yearly report.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	On actual basis.
Description of measurement methods and procedures to be applied:	The steam flow meter is being linked with the DCS system, and as such the steam flow data is being obtained from the central monitoring system.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. It is a critical parameter that would used to calculate the net / effective WHR based power generation. The calibration of industrial meters would be carried out once in a year.
Any comment:	The data measured will be archived on a daily basis both in paper and electronic spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be archived for a period of two years after the end of the crediting period

Data / Parameter:	**S_{AFBC}**
Data unit:	Tonne
Description:	The above parameters pertains to quantum of Steam generated from the AFBC boiler and is measured by flow meter.
Source of data to be used:	The value will obtained from the daily log sheet. The cumulative value of the same will be obtained from the monthly and yearly report.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	On actual basis.
Description of measurement methods and procedures to be applied:	The steam flow meter is being linked with the DCS system, and as such the steam flow data is being obtained from the central monitoring system.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. It is a critical parameter that would used to calculate the net / effective WHR based power generation. The calibration of industrial meters would be carried out once in a year.
Any comment:	The data measured will be archived on a daily basis both in paper and electronic spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be archived for a period of two years after the end of the crediting period

Data / Parameter:	**T_1**
Data unit:	^0C
Description:	The above parameter pertains to Average Temperature of WHRB steam at the WHRB steam header.
Source of data to be used:	The value will obtained from the daily log sheet. The average value of the same will be obtained from the monthly and yearly report.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	485 ^0C.
Description of measurement methods and procedures to be applied:	The Temperature transmitter is being linked with the DCS system, and as such the steam temperature data is being obtained from the central monitoring system.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. It is a critical parameter that would used to estimate the enthalpy required to estimate the heat content of the waste heat recovery steam. The calibration of industrial meters would be carried out once in a year.
Any comment:	The data measured will be archived on a hourly basis both in paper and electronic spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be archived for a period of two years after the end of the crediting period

Data / Parameter:	T_2
Data unit:	^0C
Description:	The above parameter pertains to Average Temperature steam at the AFBC steam header.
Source of data to be used:	The value will obtained from the daily log sheet. The average value of the same will be obtained from the monthly and yearly report.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	485 ^0C.
Description of measurement methods and procedures to be applied:	The Temperature transmitter is being linked with the DCS system, and as such the steam temperature data is being obtained from the central monitoring system.
QA/QC procedures to be applied:	QA/QC procedures have been planned. Manager operation and maintenance would be responsible for maintenance and calibration of the meters. The level of uncertainty level of data is low. It is a critical parameter that would used to estimate the enthalpy required to estimate the heat content of the AFBC steam. The calibration of industrial meters would be carried out once in a year during the stoppage period.
Any comment:	The data measured will be archived on a hourly basis both in paper and electronic spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be archived for a period of two years after the end of the crediting period

Data / Parameter:	T_3
Data unit:	^0C
Description:	The above parameter pertains to temperature of feed water to the WHRB system.
Source of data to be used:	The value will obtained from the daily log sheet. The average value of the same will be obtained from the monthly and yearly report.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	126 ^0C.
Description of measurement methods and procedures to be applied:	The Temperature transmitter is being linked with the DCS system, and as such the steam temperature data is being obtained from the central monitoring system.
QA/QC procedures to be applied:	QA/QC procedures have been planned. The level of uncertainty level of data is low. It is a critical parameter that would used to estimate the enthalpy required to estimate the heat content of the waste heat recovery steam. The calibration of industrial meters would be carried out once in a year.
Any comment:	The data measured will be archived on a hourly basis both in paper and

	electronic spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be archived for a period of two years after the end of the crediting period

Data / Parameter:	T_4
Data unit:	^0C
Description:	The above parameter pertains to temperature of feed water to the AFBC system.
Source of data to be used:	The value will obtained from the daily log sheet. The average value of the same will be obtained from the monthly and yearly report.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	126 ^0C.
Description of measurement methods and procedures to be applied:	The Temperature transmitter is being linked with the DCS system, and as such the steam temperature data is being obtained from the central monitoring system.
QA/QC procedures to be applied:	QA/QC procedures have been planned. Manager operation and maintenance would be responsible for maintenance and calibration of the meters. The level of uncertainty level of data is low. It is a critical parameter that would used to estimate the enthalpy required to estimate the heat content of the AFBC steam. The calibration of industrial meters would be carried out once in a year during the stoppage period.
Any comment:	The data measured will be archived on a hourly basis both in paper and electronic spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be archived for a period of two years after the end of the crediting period

Data / Parameter:	P_1
Data unit:	kg / cm^2
Description:	The above parameter pertains to steam pressure at the outlet of waste heat recovery boiler.
Source of data to be used:	The value will obtained from the daily log sheet. The average value of the same will be obtained from the monthly and yearly report.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	62 kg / cm^2
Description of measurement methods and procedures to be applied:	The pressure gauge provided at the waste heat recovery boiler steam header. DCS system will receive data from pressure gauge.
QA/QC procedures to be applied:	The level of uncertainty level of data is low. It is a critical parameter that would used to estimate the enthalpy which is required to estimate the heat content of

	the steam. The calibration of industrial meters would be carried out once in a year.
Any comment:	The data measured will be archived on a hourly basis both in paper and electronic spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be archived for a period of two years after the end of the crediting period

Data / Parameter:	**P_2**
Data unit:	kg / cm^2
Description:	The above parameter pertains to steam pressure at the outlet of AFBC boiler.
Source of data to be used:	The value will obtained from the daily log sheet. The average value of the same will be obtained from the monthly and yearly report.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	62 kg / cm^2
Description of measurement methods and procedures to be applied:	The pressure gauge provided at the waste heat recovery boiler steam header. DCS system will receive data from pressure gauge
QA/QC procedures to be applied:	The level of uncertainty level of data is low. It is a critical parameter that would used to estimate the enthalpy which is required to estimate the heat content of the steam. The calibration of industrial meters would be carried out once in a year.
Any comment:	The data measured will be archived on a daily basis both in paper and electronic spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be archived for a period of two years after the end of the crediting period

Data / Parameter:	**h_1**
Data unit:	KJ/Kg
Description:	The above parameter pertains to Enthalpy of the steam at WHR boiler outlet.
Source of data to be used:	The value will be obtained in the monthly report.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	3375.81 KJ/Kg
Description of measurement methods and procedures to be applied:	Enthalpy is estimated from the WHRB boiler steam parameter. Noted from standard Steam table Mollier Diagram from the avg. temperature (T_1) and pressure (P_1) of the WHRB boiler steam.
QA/QC procedures to be applied:	
Any comment:	The data calculated will be archived daily both in paper and electronic

	spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be kept for a period of two years after the end of the crediting period.

Data / Parameter:	h_2
Data unit:	KJ/Kg
Description:	Enthalpy of the steam at AFBC boiler outlet.
Source of data to be used:	The value will be obtained from the internal log sheet.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	3375.81 KJ/Kg
Description of measurement methods and procedures to be applied:	Enthalpy is estimated from the WHRB boiler steam parameter. Noted from standard Steam table Mollier Diagram from the avg. temperature (T_1) and pressure (P_1) of the WHRB boiler steam.
QA/QC procedures to be applied:	
Any comment:	The data calculated will be archived daily both in paper and electronic spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be kept for a period of two years after the end of the crediting period.

Data / Parameter:	h_3
Data unit:	KJ/Kg
Description:	The above parameter pertains to Enthalpy of the feed water at WHR boiler inlet.
Source of data to be used:	The value will be obtained from the internal log sheet.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	529.25
Description of measurement methods and procedures to be applied:	Enthalpy is estimated from standard Steam table Mollier Diagram from the avg. temperature (T_1) and pressure (P_1) of the WHRB boiler steam.
QA/QC procedures to be applied:	
Any comment:	The data calculated will be archived daily both in paper and electronic spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be kept for a period of two years after the end of the crediting period.

Data / Parameter:	**H_4**
Data unit:	KJ/Kg
Description:	The above parameter pertains to Enthalpy of the feed water at AFBC boiler inlet.
Source of data to be used:	The value will be obtained from the internal log sheet.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	529.25 KJ/Kg
Description of measurement methods and procedures to be applied:	Enthalpy is estimated from standard Steam table Mollier Diagram from the avg. temperature (T_1) and pressure (P_1) of the WHRB boiler steam.
QA/QC procedures to be applied:	
Any comment:	The data calculated will be archived daily both in paper and electronic spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be kept for a period of two years after the end of the crediting period.

Data / Parameter:	$ST_{whr, y}$
Data unit:	kJ/hr
Description:	The above parameter refers to the total energy content of the steam generated from WHRB.
Source of data to be used:	The total energy content is calculated based on the difference of enthalpy of steam generated in the WHRB and enthalpy of feed water.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	99629950 kJ/hr
Description of measurement methods and procedures to be applied:	The total energy (kcal) content of the steam generated in WHRB is calculated by = Difference between enthalpy of steam at WHRB outlet and enthalpy of feed water (kcal/kg) * Total steam flow from WHRB (kgs/day) The data will be recorded on daily basis.
QA/QC procedures to be applied:	Quality control & quality assurance procedure are planned as the data is required to calculate total electricity generation from the project activity.
Any comment:	The data measured will be daily archived both in paper and electronic spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be maintained till 2 years after crediting period

Data / Parameter:	$ST_{other, y}$
Data unit:	kJ/hr
Description:	The above parameter refers to the total energy content of the steam generated from AFBC.
Source of data to be used:	The total energy content is calculated based on the difference of enthalpy of steam generated in the AFBC boiler and enthalpy of feed water and multiplied by the quantity of steam generated.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	51238260 kJ/hr
Description of measurement methods and procedures to be applied:	The total energy (kcal) content of the steam generated in AFBC boiler is calculated by = Difference between enthalpy of steam at AFBC boiler outlet and enthalpy of feed water (kcal/kg) * Total steam flow from AFBC boiler (kgs/day) = $h_2 * S_2$ The data will be recorded on daily basis.
QA/QC procedures to be applied:	Quality control & quality assurance procedure are planned as the data monitored is required to calculate total electricity generation from the WHR based captive power unit.
Any comment:	The data measured will be daily archived both in paper and electronic spreadsheet whereby the paper documentation will be kept with the industrial facility for the period of one year and the electronic data will be maintained till 2 years after the crediting period.

B.7.2 Description of the monitoring plan:

Monitoring refers to the collection and archiving of all relevant data necessary for determining the baseline, measuring anthropogenic emissions by sources of greenhouse gases (GHG) within the project boundary of a CDM project activity and leakage, as applicable.

Data Monitoring

The project activity incorporates generation of electrical energy through deployment of waste heat recovery gas based power generation unit. The monitoring involves recording and archiving of the total quantum of electricity generated from the combined system. The total power generated utilizing steam generated from the waste heat recovery system and coal and char based FBC system. Therefore the gross power generated from the waste heat recovery system is estimated by factoring into the total heat content of the steam generated by the waste heat recovery system and the heat content of the steam generated from the FBC. The total heat content of the steam is found out through the estimation of the enthalpy of the steam.

The auxiliary electricity consumption is also estimated in the same process factoring into the total auxiliary consumption and heat content of the steam generated from both the system. Therefore the project proponent needs to monitor

Responsibility

The project proponent considers this as utmost importance for the efficiency and effectiveness of the machines and the monitoring system. The monitoring of the data and parameters will be carried out by plant personnel.

The responsibility of the personnel entitled to monitor data on the thermal side will be as follows:

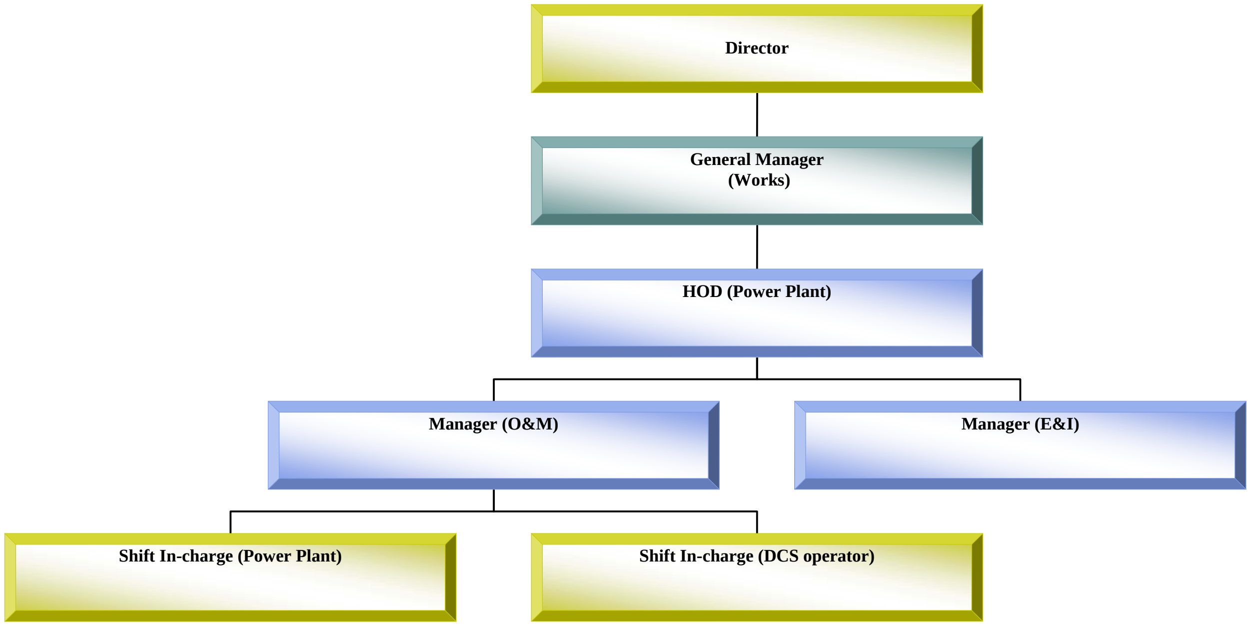
1. The DCS operator will be entitled to collect data from the DCS System. The operator would be entitled to monitor :
   - Quantum of steam generated from the waste heat recovery system.
   - Quantum of steam generated from the AFBC system
   - Temperature of the steam generated from the waste heat recovery system.
   - Temperature of the steam generated from the AFBC.
   - Pressure of the steam generated from the waste heat recovery system.
   - Pressure of the steam generated from the AFBC.

   The data monitored would be archived in the internal log sheet as per the monitoring requirement.
2. The manager operation and maintenance would validate the reading archived by the DCS operator and prepare the daily report based on the monitored data archived in the internal log sheet by the operator. The daily report will incorporate
   - Steam output from waste heat recovery boilers (Tonnes).
   - Steam output from AFBC system (Tonnes).
   - Temperature of the steam generated from the waste heat recovery system.
   - Temperature of the steam generated from the AFBC.
   - Pressure of the steam generated from the waste heat recovery system.
   - Pressure of the steam generated from the AFBC.
   - Uncertainty in power generation.
3. Manager (E&I) would be entitled to monitor the efficiency and effectiveness of the machines and the monitoring system on a daily basis and will immediately notify the HOD power plant of any discrepancies. The Manager (E&I) will be entitled for timely calibration of the meter.
4. HOD (Power Plant) will be entitled to prepare the monthly report based on the daily report submitted by the manager (O&M). The persons would be entitled to estimate
   - Steam output from waste heat recovery boilers (Tonnes).
   - Steam output from AFBC system (Tonnes).
   - Average temperature of the steam generated from the waste heat recovery system.
   - Average temperature of the steam generated from the AFBC.
   - Average pressure of the steam generated from the waste heat recovery system.
   - Average pressure of the steam generated from the AFBC.
   - Total energy content of the steam from WHRB.
   - Total energy content of the steam from AFBC.
5. The General Manager power plant will be entitled to ensure the validity and correctness of the data and estimation provided in the monthly and responsible preparation of yearly report.
6. The director who is also heading the CDM internal team will be entitled to check the monthly report on a quarterly basis and responsible for ensuring the transparency in the monitoring system and data.

The responsibility of the personals entitled to monitor data on the electrical side will be as follows:

1. The Shift in charge captive power plant will be entitled to collect data from the energy meter. The operator would be entitled to monitor :
   - Gross power generated from the 12 MW power plants.
   - Auxiliary power consumption of the 12 MW power plants.
2. The manager operation and maintenance will be entitled to validate the reading archived by the Shift in charge captive power plant and prepare the daily report based on the monitored data archived in the internal log sheet by the operator. The daily report will incorporate
   - Gross power generated from the 12 MW power plants.
   - Auxiliary power consumption of the 12 MW power plants.
3. Manager (E&I) would be entitled to monitor the efficiency and effectiveness of the machines and the monitoring system on a daily basis and will immediately notify the HOD power plant of any discrepancies. The Manager (E&I) will be entitled for timely calibration of the meter.
4. HOD (Power Plant) will be entitled to prepare the monthly report based on the daily report submitted by the manager (O&M). The persons would be entitled to estimate
   - Gross Power generated from the waste heat recovery boiler.
   - Auxiliary power consumption by waste heat recovery boiler.
   - Net power generated from the waste heat recovery boiler.

   The HOD power plant will be responsible for monitoring of power required for power plant start up i.e. power generated by the diesel generator for the same. He would also be responsible for estimation of diesel consumption
5. The general manager power plant will be entitled to ensure the validity and correctness of the data and estimation provided in the monthly and responsible preparation of yearly report. The general manager would also be responsible for estimation of the emission reduction as a result of the project activity.
6. The director who is also heading the CDM internal team will be entitled to check the monthly report on a quarterly basis and responsible for ensuring the transparency in the monitoring system and data



Completeness

For Electricity generation data:

Energy meter has been incorporated for measuring the gross power generation and auxiliary consumption of the 12 MW units. This meter will be maintained by E&I team under the supervision of the Manager (E&I).

The gross generation and the auxiliary consumption pertaining to the waste heat recovery system will be estimated by the monitoring team. Net generation will be estimated as a difference of gross generation and auxiliary consumption.

The General Manager works will also be entitled to ensure for completeness of data recorded to be presented to the verification agency. The team will also keeps an account of the failure and maintenance etc.

For Thermal Energy Generation data:

The monitoring team apart from recording and archiving of the monitored data will also be entitled to estimate the thermal output from the individual system and the cumulative of the thermal energy recovered. This meter will be maintained by E&I team under the supervision of the Manager (E&I).

The General Manager- Works will also be entitled to ensure for completeness of data recorded to be presented to the verification agency. The team will also keeps an account of the failure and maintenance etc.

Meters

Main meter			
Sl. No.	**Meter**	**Meter Specification**	**Purpose**
1	Energy Meter	Make – L&T	Measurement of auxiliary consumption.
2	Energy Meter	Make – L&T	Measurement of gross power generation.
3	Pressure gauge	PT-120 Make – Rosemount India Ltd.	Measurement of steam pressure of the WHR unit.
4	Pressure gauge	PT-404. Make – Rosemount India Ltd.	Measurement of steam pressure of AFBC unit.
5	Steam flow	FT- 727 Make – Rosemount India Ltd.	Measurement of steam flow of the WHR unit.
6	Steam flow	FT-401. Make – Rosemount India Ltd.	Measurement of steam flow of AFBC unit.
7	Thermocouple	Make – General instruments limited	Measurement of steam temperature of the WHR unit.
8	Thermocouple	Make – General instruments limited	Measurement of steam temperature of AFBC unit.
Other meters in the CPP			
9	Differential pressure transmitter	Make – Rosemount India Ltd.	Feed water flow transmitter
10	Differential pressure transmitter	Make – Rosemount India Ltd.	Drum level transmitter.
11	Differential pressure transmitter	Make – Rosemount India Ltd.	Drum level transmitter for switch
12	Differential pressure transmitter	Make – Rosemount India Ltd.	Steam flow transmitter.
13	Differential pressure transmitter	Make – Rosemount India Ltd.	Furnace drat transmitter.
14	Pressure gauge	Make – Approved vendor(Provided by Thermax)	Feed water pressure economiser inlet

15	Pressure gauge	Make – Approved vendor(Provided by Thermax)	Feed water pressure economiser outlet
16	Pressure gauge	Make – Approved vendor(Provided by Thermax)	Drum pressure
17	Pressure gauge	Make – Approved vendor(Provided by Thermax)	Steam outlet pressure
18	Pressure gauge	Make – Approved vendor(Provided by Thermax)	Attempreator Spray press.
19	Pressure gauge	Make – Approved vendor(Provided by Thermax)	Instrument air.
20	Pressure gauge	Make – Approved vendor(Provided by Thermax)	HP dosing Pump 1
21	Pressure gauge	Make – Approved vendor(Provided by Thermax)	HP dosing Pump 2
22	Thermo well	General instrument Ltd.	Steam to attemperator inlet temperature
23	Thermo well	General instrument Ltd.	Steam to attemperator outlet temperature
24	Thermo well	General instrument Ltd.	Steam outlet temperature
25	Thermo well	General instrument Ltd.	Flue gas boiler bank outlet
26	Thermo well	General instrument Ltd.	Flue gas economiser outlet
27	Thermo well	General instrument Ltd.	Flue gas AHP outlet
28	Thermo well	General instrument Ltd.	Flue gas ID fan inlet
29	Thermo well	General instrument Ltd.	Hot air to plenum chamber.
30	Thermo well	General instrument Ltd.	Economiser inlet temperature
31	Thermo well	General instrument Ltd.	Economiser outlet temperature

Frequency

The frequency of the monitoring refers to the interval at which the parameters are to be monitored. While the data to be monitored on a daily basis are to be measured at an interval of twenty four hours, whereas few parameters are to be monitored on an hourly basis.

Sl. No	Parameters	Frequency of Monitoring
1	Gross Electricity Generation	Daily basis.
2	Auxiliary Power Consumption	Daily basis.
3	Flow of steam from WHRB	Daily basis.
4	Flow of steam from AFBC	Daily basis.
5	Pressure for steam coming out of WHRB	Hourly Basis.
6	Pressure for steam coming out of AFBC	Hourly Basis.
7	Temperature of steam coming out of WHRB	Hourly Basis.
8	Temperature of steam coming out of AFBC	Hourly Basis.
9	Power generated and diesel consumption for power generation for power plant start up.	Yearly Basis.

Uncertainty of Data in Monitoring /Emergency Preparedness

The back up metering system will provide fail-safe measure in case of problem with the primary metering system. For exceptional circumstances related to the failure of the metering system, immediate replacement would be carried out.

Gas monitoring

Sl. No	Data to monitored	Metering	Emergency Preparedness
1	Gross generation and auxiliary consumption	Gross generation and auxiliary consumption are monitored through three phase energy meter.	Under malfunctioning of meter pertaining to measurement of gross generation and auxiliary consumption from which the net generation from the waste heat recovery system is estimated will be carried out through adaptation of the step mentioned below. • Use of backup gross power generation meter for measuring of gross power. • Whereas the auxiliary consumption can be calculated as a difference between the gross power generated and net power supplied to the industrial unit from the captive power generating unit. The net power supplied to the industrial facility from captive unit is measured through separate metering system.
2	Temperature of steam generated form WHR system	Thermocouple	The temperature of steam is required to determine the enthalpy of the steam. Under malfunctioning of the thermocouple the same can be obtained from the pressure data and temperature of the steam at the common steam header.

Sl. No	Data to monitored	Metering	Emergency Preparedness
3	Temperature of steam generated form WHR system	Thermocouple	The temperature of steam is required to determine the enthalpy of the steam. Under malfunctioning of the thermocouple the same can be obtained from back up temperature meter
4	Pressure of steam generated form WHR system	Pressure gauge	The pressure of steam is required to determine the enthalpy of the steam. Under malfunctioning of the pressure gauge the same can be obtained from the back up temperature meter.
5	Pressure of steam generated form WHR system	Pressure gauge	Under the condition of mal functioning of the pressure gauge there exist back up meter to monitor the same.

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)

Baseline study is done by Bhaskar Steel and Ferro Alloys Limited and Verve Consulting Pvt. Ltd. team. .

Date of completion of baseline: 7/12/07

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:

21/05/2005

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

25 years from the date of commencement of operations.

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

C.2.1. Renewable crediting period

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

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:

31/3/2007 or from date of registration whichever is later.

C.2.2.2. Length:

10 years

SECTION D. Environmental impacts

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

Environmental degradation is the major challenges that a country faces in the back drop of growing economy. Economic growth, in its turn, bears a dichotomous relationship to environmental degradation. Rapid economic growth results in environmental degradation through use of natural resources and generation of pollution. Pollution is inevitable generation of waste stream from production of secondary form of energy through use of primary fossil fuel. Pollution results changes in ecosystem, leading to possibly catastrophic disruption of livelihood along with adverse impacts on human health, as well the health of other living entities and global climate.

Environmental performance forms an integral part of the project proponent's endeavor towards sustainable development. Any project activity can cause impacts on environment either positive or negative depending on the type of the activity, throughout the project lifetime.

After conceiving the project activity, it was found that the project returns benefits to the local, regional and global environment in various ways –

Air Pollution mitigation:

- Reduced additional GHG emission related to thermal power production, which includes a huge emission in percentage including carbon dioxide, sulphur dioxide, oxides of nitrogen, and suspended particulate matter, which would have occurred in absence of this project in business-as-usual-scenario case.
- Further reduction of suspended particulate matter in flue gas (< $100 mg/NM^3$) through successful implementation of ESP, about 25% less than the permissible limit. The plant incorporates an oversized electrostatic precipitator to reduce waste gas particulate emissions to levels well below current regulations. As per the Environmental Standards for Sponge Iron Plants by, under the stack emission standard the permissible limit of particulate matter is $100 mg/Nm^3$ for coal based.
- Substantial reduction in thermal pollution. In absence of the project activity there would have been considerable amount of cooling requirement to be operated with Sponge Iron kiln. CPP primarily utilizes the heat content of the waste flue gas and thereby takes care of thermal pollution. The flue gas of temperature 950 - 950^oC from DRI kiln enters the boiler system and finally vented off with a reduced temperature of 150^oC after effective heat transfer. With reduction of temperature the corrosiveness of flue gas also reduces, thus protecting ESP from early wear and tear and increasing its lifetime. Work environment pollution due to thermal radiation is not significant.
- Negligible magnitude of the impacts during construction phase, taking into consideration the project life cycle. The impacts on air, water and land environment exist for a temporary period of time till the end of construction phase. Therefore, it does not affect the environment considerably.
- Reduced adverse impacts related to air emission at coal mines, transportation of coal that would have been required to meet the capacity requirement of thermal power stations.
- It has also successfully conserved the non-renewable natural resource such as coal, oil.

Water Pollution mitigation:

- Waste water generation from the plant is mainly from the following areas; cooling tower blow-down, DM regeneration, and Boiler blow-down and these effluents could easily be recycled in the system. No effluent generated in the project boundary is disposed in the public sewerage and water system etc.

- Zero discharge facility - storage of outlet waste water to the storage pond located within the facility.
- Reuse of storage pond water for sponge iron process use during dry season.

Noise Pollution mitigation:

- Reduced noise pollution through implementation of noise protection shield (canopy covered) for DG set operation.

Solid Waste Management:

- Slurry waste generation has been avoided by avoiding installation of Venturi Scrubber. Ash collected from the bottom of the hopper of ESPs is transported by dense phased pneumatic conveying system to Ash Silo equipped with bag filters to ensure clean air. The ash thus collected is then utilized for manufacturing process of bricks within the facility.

Green Belt Development:

- Green Belt is another way of attenuating fugitive emission, noise pollution and thermal pollution. It also enhances aesthetic beauty of the surroundings. The efficiency of green belt in pollution abetment depends mainly on the width of green belt, height of trees, and distance from source of pollutants.
- About 35 Acres of green belt development within the vicinity of the facility for overall improvement of the surrounding.

Land:

The project activity is implemented in government notified industrial region and has not effect on forest cover, local flora & fauna. No human displacement/ re settlement is happened due to the project activity.

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 environmental impacts of the project can not be categorized as significant as per guidelines issued by regulatory authorities in host party.

According to the Host party regulations - Environment Impact Assessment Notification S.O.60(E), dated 27/01/1994 Schedule I, under The Environmental (Protection) Rules 1986, Iron & Steel industry with new establishment investment capital less than or equal to INR 1000 million does not require an Environmental Impact Assessment to be carried out for the project activity. The project activity has obtained the Environmental Clearance from the designated State Authority. The industrial facility has obtained consent to operate and consent to establish for establishment and continuation of operation of the project activity.

This project activity in turn has positive environmental impacts. The Waste Heat Recovery Based Captive Power Plant with ESP installed is a cleaner and more energy efficient air pollution control measure as compared to the Gas Conditioning Tower. The project activity is not polluting and the impacts associated with the project activity are insignificant.

SECTION E. Stakeholders' comments

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

BSFAL organized a Stakeholder's consultation meeting to take the views and suggestion from the concerned stakeholders on the initiatives for Climate Change mitigation through implementation of this Clean Development Mechanism (CDM) project on 12th February, 2007 at the BSFAL factory premises at Bad Tamkela, Village, District – Sundargarh, Orissa, India

Along with personal invitation, public notices were placed in local newspapers to invite people for the consultation meeting with the agenda of inviting public comments on the CDM project activity of BSFAL.

Bhaskar Steel & Ferro Alloys Ltd. identified the major stakeholders involved with the project activity at various stages, in order to get their views and concerns on the implementation of the project activity. The concerned persons mentioned below depicted their view on the project activity.

1. MLA of Bonai
2. Sub-collector, Bonai
3. Tahsildar, Bonai
4. Project Manager, District Industrial Centre, Rourkela
5. Chairman of Orissa Sponge Iron Manufacturing Association (OSIMA), Rourkela
6. President, Rourkela Chamber of Commerce
7. Convenor, Rourkela Chapter Friends of Tribal Society
8. Regional Head, Vanvasi Kalyan Ashram, Sundergarh
9. Equipment Supplier and Consultant
10. MIS Power Tech, Kolkata
11. Chairman, Bhaskar Steel & Ferro Alloys Ltd
12. General Manager (Works), BSFAL
13. CDM Consultant, Verve Consulting, Bhubaneswar

The consultation was performed in an open and transparent manner. Participants were allowed reasonable time to review the project and were actively encouraged to express their comments about the project.

The project proponent prior to the deployment/incorporation of the project activity have contacted with few of the stake holders for obtaining their consent and statutory clearance for setting up the project activity.

E.2. Summary of the comments received:

The overall response to the Project, from local stakeholders, was encouraging and positive. In all, no adverse reaction/comments/clarifications have been received during the hearing. The participants of the meetings have not raised any significant concerns related to potential impacts of the Project.The salient details are as follows:

Queries	Reply
How the project activity will improve the social condition of the people living over here.	The project has resulted in : • The employment opportunity contributing to improvement in the local socio-economic condition. More than 200 manpower resources from the surrounding villages, Tumkela, Gumlei and Bonai have been engaged in the middle management level and unskilled labour for plant operation. As a HR strategy, BSFAL prefers to engage about 80 percent of their employee locally. • Have supported and developed social infrastructure like schools, roads, hospitals, etc. • BSFAL has also undertaken initiatives for Green Belt development with plantation activities within the plant premise and by-pass road being developed for the convenience in transport and avoid the traffic through the nearby village. This can reduce fugitive emission, noise pollution and thermal pollution. It also enhances aesthetic beauty of the surroundings. • The financial benefits from Clean Development Mechanism project would encourage BSFAL to implement clean technology in the manufacturing process and new industrial initiatives in the region.
Is the project is non-polluting?	• The project activity contributes in emission reduction of Green House Gases by replacement of conventional Carbon intensive fossil fuel based power. As a matter of concern for the state, conservation of natural resources in the form of fossil fuel. • Slurry waste generation is avoided by installation of Venturi Scrubber. Fly-ash collected from the bottom of the hopper of ESP is transported by dense phased pneumatic conveying system to Ash Silo equipped with bag filters to ensure clean air. The fly-ash thus collected will be utilized for brick manufacturing within the facility. • Zero Effluent Discharge – the process water is being recycled within the facility. • Zero discharge facility - discharged waste water is stored in a pond and treated, located within the facility. • The treated water is used in the sponge iron process during dry season.
Possibility of damage to the local environment & on the health of local people	There is no detrimental effect on local people health due to the project activity as the project is non-polluting activity and also reducing emission.

The Stakeholder's meeting concluded with encouragement for such Clean Development Mechanism (CDM) initiatives projects with waste heat recovery based captive power project. No such negative comment was received during the Stakeholder's Consultation Meeting and the meeting has been concluded as the waste heat recovery based captive power project of Bhaskar Steel & Ferro Alloys Ltd. not only have any negative impacts towards the local environmental and socio-economic structure but also facilitates green house gas emission reduction phenomena, as a global initiative. The stakeholders have not raised any significant concerns related to potential impacts of the Project. This project as a whole gives positive impression towards the issues of Sustainable Development.

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

The relevant comments and important clauses mentioned in the project documents/clearances were considered while preparation of CDM project design document. The project activity has received positive comments from both the government and non-government parties. As no adverse comments were received, no need to make any adjustments in the document.
The project activity has complied with all the applicable conditions detailed in the consents and agreements. Further the PDD will be posted on Validator's / UNFCCC web-site for public viewing and comments.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Bhaskar Steel & Ferro Alloys Limited
Street/P.O.Box:	--
Building:	4th Floor, Commercial Block, Shree Complex, Uditnagar,
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E-Mail:	bhaskar_steel@rediffmail.com
URL:	--
Represented by:	Mr. Pankaj Agarwal
Title:	Chairman
Salutation:	Mr.
Last Name:	Agarwal
Middle Name:	--
First Name:	Pankaj
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Direct tel:	+91-661-2508395
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There has been no public funding against the project activity. The total funding of the project activity has come from the project owner and loan from financial institution. Moreover there has been no Official development assistance used for the project activity.

Annex 3

BASELINE INFORMATION

Estimation of emission Factor for an Electricity System.
The grid emission factor is estimated using "Tool to calculate the emission factor for an electricity system". The methodological tool determines the CO2 emission factor for the displacement of electricity generated by power plants in an electricity system, by calculating the "operating margin" (OM) and "build margin" (BM) as well as the "combined margin" (CM). The operating margin refers to a cohort of power plants that reflect the existing power plants whose electricity generation would be affected by the proposed CDM project activity. The build margin refers to a cohort of power units that reflect the type of power units whose construction would be affected by the proposed CDM project activity.
This tool may be referred to in order to estimate the OM, BM and/or CM for the purpose of calculating baseline emissions for a project activity substitutes electricity from the grid, i.e. where a project activity results in savings of electricity that would have been provided by the grid (e.g. demand-side energy efficiency projects).
The emission factor is to be calculated through adaptation of the following steps:
STEP 1. Identify the relevant electric power system.
STEP 2. Select an operating margin (OM) method.
STEP 3. Calculate the operating margin emission factor according to the selected method.
STEP 4. Identify the cohort of power units to be included in the build margin (BM).
STEP 5. Calculate the build margin emission factor.
STEP 6. Calculate the combined margin (CM) emissions factor.

STEP 1. Identify the relevant electric power system.
In accordance to the Tool to calculate the emission factor for an electricity system": *For the purpose of determining the electricity emission factors, a project electricity system is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity and that can be dispatched without significant transmission constraints. If the DNA of the host country has published a delineation of the project electricity system and connected electricity systems, these delineations should be used*.
In order to facilitate adoption of authentic baseline emissions data and also to ensure uniformity in the calculations of CO2 emission reductions Central Electricity Authority (CEA), in cooperation with host country has delineated the project electricity system. The Indian electricity system is divided into five regional grids, viz. Northern, Eastern, Western, Southern, and North-Eastern. Each grid covers several states. As the regional grids are interconnected, there is inter-state and inter-regional exchange. A small power exchange also takes place with neighbouring countries like Bhutan and Nepal. Central Electricity Authority has divided the entire electrical network into five regions.

Region				
Northern	Western	Southern	Eastern	North-Eastern
Chandigarh	Chhattisgarh	Andhra Pradesh	Bihar	Arunachal Pradesh
Delhi	Gujarat	Karnataka	Jharkhand	Assam
Haryana	Daman & Diu	Kerala	Orissa	Manipur
Himachal Pradesh	Dadar & Nagar Haveli	Tamil Nadu	West Bengal	Meghalaya
Jammu &	Madhya Pradesh	Pondicherry	Sikkim	Mizoram

Kashmir				
Punjab	Maharashtra	Lakshadweep	Andaman-Nicobar	Nagaland
Rajasthan	Goa			Tripura
Uttar Pradesh				
Uttaranchal				

STEP 2. Select an operating margin (OM) method.
In accordance to the Tool to calculate the emission factor for an electricity system" the Operating margin for the selected project electricity system can be estimated through adaptation of one of the following methods.
(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch data analysis OM, or
(d) Average OM.
Any of the four methods can be used, however, the simple OM method (option a) can only be used if low-cost/must-run resources constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term averages for hydroelectricity production.

Share of Must-Run (Hydro/Nuclear) (% of Net Generation)[21]

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
North	25.9%	25.7%	26.1%	28.1%	26.8%	28.1%
East	10.8%	13.4%	7.5%	10.3%	10.5%	7.2%
South	28.1%	25.5%	18.3%	16.2%	21.6%	27.0%
West	8.2%	8.5%	8.2%	9.1%	8.8%	12.0%
North-East	42.2%	41.7%	45.8%	41.9%	55.5%	52.7%
India	19.2%	18.9%	16.3%	17.1%	18.0%	20.1%

As the low-cost/must-run resources constitute less than 50% of the net generation therefore the simple operating margin can be used for estimating the operating margin emission factor. The simple operating margin emission factor will be calculated using ex-post option i.e. the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year y is usually only available later than six months after the end of year y, alternatively the emission factor of the previous year (y-1) may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year proceeding the previous year (y-2) may be used. The same data vintage (y, y-1 or y-2) should be used throughout all crediting periods.
For the Ex post estimation data for (y-1) is used.

STEP 3. Calculate the operating margin emission factor according to the selected method.
The simple operating margin emission factor is calculated as the generation weighted average CO2 emission per unit net generation (tCO2/MWh) of all generating power plants serving the system, not including low cost/ must run power plants/units. The estimation is done based on "Option A" i.e. based on data on fuel consumption and net electricity generation of each power plant/unit.

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[21] CO2 Baseline Database for the Indian Power Sector Version 2.0 June 2007 Government of India Ministry of power Central Electricity Authority.

NAME	2005-06 Net Generation GWh	2005-06 Absolute Emissions t CO_2	2005-06 Specific Emissions t CO_2/MWh
Patratu	706	1,356,368	1.92
Barauni	96	242,342	2.52
Kahalgaon	6,020	6,090,761	1.01
Tenughat	1,311	2,002,824	1.53
Jojobera Imp.	2,126	2,307,939	1.09
Chandrapura	1,775	2,538,987	1.43
Durgapur	1,601	2,243,952	1.40
Bokaro B	2,365	3,751,554	1.59
Mejia	5,262	5,741,686	1.09
Talcher	3,174	3,899,070	1.23
I.B.Valley	2,773	2,844,741	1.03
Talcher Stps	19,703	18,809,830	0.95
Bandel	1,853	2,525,307	1.36
Santaldih	1,046	1,576,619	1.51
Kolaghat	6,508	9,988,356	1.53
Bakreswar	3,947	4,699,567	1.19
D.P.L.	1,958	3,322,327	1.70
Newcossipore	406	813,574	2.00
Titagarh	1,671	2,023,357	1.21
Southern Repl.	902	1,080,120	1.20
Budge Budge	4,000	4,082,263	1.02
Farakka Stps	10,660	10,575,971	0.99

Total import to the Eastern Grid

(Net, in GWh)
Year 2000-2001

From / To	Eastern
Year 2000-2001	
Northern	0.0
Year 2001-2002	
Northern	0.0
Southern	-778.5
Western	0.0
North-Eastern	0.0
Bhutan	1,423.3
Nepal	-90.2
Net imports	554.6
Total Imports	1,423.3
Year 2002-2003	
Northern	-827.0
Southern	23.6
Western	-257.2
North-Eastern	0.0
Bhutan	1,519.6
Nepal	-102.0
Net imports	357.0

Total Imports	1,543.2
Year 2003-2004	
Northern	-116.5
Southern	56.7
Western	0.0
North-Eastern	0.0
Bhutan	1,748.4
Nepal	0.0
Net imports	1,688.6
Total Imports	1,805.1
Year 2004-2005	
Northern	-3,042.6
Southern	-286.2
Western	-120.4
North-Eastern	-2,105.6
Bhutan	1,735.1
Nepal	0.0
Net imports	-3,819.8
Total Imports	1,735.1
Year 2005-2006	
Northern	-4,260.3
Southern	-99.8
Western	-10,142.0
North-Eastern	818.0
Bhutan	1,762.7
Nepal	-137.7
Net imports	-12,059.1
Total Imports	2,580.8

In accordance to the tool for estimation of emission factor for an electricity system the operating margin is calculated on ex post basis based on emission factor of the previous year. The same will be estimated every year and used for the purpose of estimating the baseline emission.
The Operating margin for eastern regional grid (tCO2/MWh) (incl. Imports) is as follows:

	2005-06
East	**1.13**

STEP 4. Identify the cohort of power units to be included in the build margin (BM).
The build margin reflects the average CO2 intensity of newly built power stations that will be (partially) replaced by a CDM project. The build margin is calculated in this database as the average emissions intensity of the 20% most recent capacity additions in the grid based on net generation. Depending on the region, the build margin covers units commissioned in the last five to ten years.

	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06
Gross Generation Total (GWh)						
East	58,936	64,048	66,257	75,374	85,776	93,902
Net Generation Total (GWh)						
East	53,350	58,097	59,841	68,428	77,968	86,014
20% of Net Generation (GWh)						
East	10,670	11,619	11,968	13,686	15,594	17,203
Net Generation in Build Margin (GWh)						
East					15,818	17,567

STEP 5. Calculate the build margin emission factor.
The build margin emission factor is calculated using Option 1 of the tool for estimation of emission factor for an electricity system. In accordance to the option For the first crediting period, the build margin

emission factor ex-ante based is calculated on the most recent information available on units already built for sample group at the time of CDM-PDD submission to the DOE for validation. This option does not require monitoring the emission factor during the crediting period.
The Build margin for eastern regional grid (tCO2/MWh) (incl. Imports) is as follows:

	2005-06
East	0.97

STEP 6. Calculate the combined margin (CM) emissions factor.
The combined margin emissions factor is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

Where:
$EF_{grid,BM,y}$ = Build margin CO2 emission factor in year y (tCO2/MWh)
$EF_{grid,OM,y}$ = Operating margin CO2 emission factor in year y (tCO2/MWh)
w_{OM} = Weighting of operating margin emissions factor (%)
w_{BM} = Weighting of build margin emissions factor (%)

The following default values is used for w_{OM} and w_{BM} , wOM = 0.5 and wBM = 0.5.

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$
$$= 1.13 \times 0.5 + 0.97 \times 0.5$$
$$= 1.04633375$$
$$\approx 1.05\ tCO_2/MWh$$

Annex 4

MONITORING INFORMATION

The Monitoring and Verification (M&V) procedures define a project-specific standard against which the project's performance (i.e. GHG reductions) and conformance with all relevant criteria will be monitored and verified. It includes developing suitable data collection methods and data interpretation techniques for monitoring and verification of GHG emissions with specific focus on technical performance parameters. It also allows scope for review, scrutiny and benchmarking of all this information against reports pertaining to M & V protocols.
Monitoring of the project activity is required for actual emission reduction estimation on the part of the project activity. The project proponent therefore needs to monitor and archive data required for estimation of the baseline and project emission. The baseline emission being solely dependent on the amount of electricity generated by the waste heat recovery based captive power generation system whereas the estimation of the project emission is based on the HSD consumed by the project activity for plant start-up. The DCS system will be used up in monitoring the total power generated from the 12 MW captive power generating facility at the industrial premise. The system will also measure the total auxiliary power consumption of the12 MW unit. The net power generated from the waste heat recovery project will be estimated from the gross power generated from the waste heat recovery system and the associated

auxiliary power consumed. The estimation of the above would be carried out based on the procedures mentioned in the Annex -3 above.

Description of Maintenance Operations for the Project activity:
Systematic maintenance is essential to keep the boiler and its auxiliaries in good condition to obtain reliable operation of the power generating unit. Effective maintenance aims at timely inspection of parts to repair or replace defective components and prevent their failure when the generation unit is in service. The maintenance operation pertaining to the project activity is carried out in two phases
Phase 1: Preventative Maintenance
Phase 2: Periodic maintenance on daily, weekly, monthly and yearly basis.

Phase 1: Preventative Maintenance
Preventative Maintenance program for valves.

- Dismantle the bonnet and cleaning of the trim and valve seat
- Cleaning the valve stem and re lubricating of the operating thread
- Renewing the bonnet joint and assembling the trim on the valve seat.

Preventative maintenance program for spares.

Phase 2: Periodic maintenance
Daily monitoring

Sl.No	Equipment	Check
1	Local level gauges on the boiler Shell	Check illumination, leaking valve glands, leaking ports.
2	Lubricating oil level of pumps.	Dosing pump.
3	BFW pumps	Check of pump, motor body temperature, load current, abnormality of sound.
4	Safety valves	Check for passing of the safety valves.
5	Boiler cladding, air duct or flue gas duct.	Check for hot spots.
6	Turbine	Level of lubricant tank, leak in internal lines, noise, contamination or damage in the lubricant cooler.
7	Generator	Check the bearing lube oil level while generator is operating.

Monthly checks

Sl.No	Equipment	Check
1	BFW pumps	Check for coupling arrangement between motor and pump, check of impeller and operation of NRV at pump discharge.
2	Safety valve operation	Check of operation of valve after increasing of boiler pressure.
3	Feed water tank	Deposits of foreign particles.
4	Turbine	Checking of electrical component, proper operation of lubrication pump, proper operation of lubricant container level indicator, electrical check of all turbine speed measuring sensors

All the above operation will be carried out by staff members of the operation and maintenance team of the power plant with relevant qualification. The operation and maintenance would provide training to the personals in due course. Training has been provided to the power plant O&M staff by the member of Equipment supplier. A detail of the training and personals undergoing the training is provided in the subsequent section below. The qualification of the Operation and maintenance team are as follows:

Maintenance and Calibration of Meters:

The energy meter is maintained in proper condition as prescribed or approved by the Inspector for examination, testing or regulation of the meter used or intended to be used in connection with the supply of energy. Every meter is being examined, tested and regulated for ascertaining the amount of energy supplied before their installation at the project site; this refers to the check related to the zero setting of the meters.

The flow meter, temperature and pressure transmitter is being examined, tested and regulated for ascertaining the correctness of value.

A record pertaining to the date of last test, error recorded at the time of test, limit of accuracy after adjustment, date of calibration etc will be maintained by the monitoring team. As such meter are periodically calibrated as per guidance of the testing agency.

Sl.No	Type of Meter	Calibration Schedule
1	Energy meter	Meter will be Calibrated once in a year
2	Temperature transmitter	Meter will be calibrated on yearly basis.
3	Pressure Gauge	Meter will be calibrated on yearly basis.
4	Steam flow meter	Meter will be calibrated on yearly basis.
5	Flow meter for measuring quantity of waste gas	Meter will be calibrated on yearly basis.

Training on O&M of the project activity.

The project proponent does not have experience related to operation and maintenance of the waste heat recovery based power generation. As such training programme has been conducted on site during erection and /or commissioning period. Even after relevant training the operation of the project activity would be supervised by representative (technician) of Turbomach for certain period year along with assistance from customers personal, who will be thus trained. Training has been provided to the operation and maintenance staff. The raining programme was conducted by members of Manufacturer Company.

The training programme involved:

- Explanation on concept of modern thermal station.
- Introduction to the waste heat recovery technology.
- Design and function of water and steam drums, heaters and tubes.
- Design and function economisers, super heater etc.
- Design and function of fans and compressors.
- Design and function of soot blowers
- Design and function of boilers
- Design and function of turbine and auxiliaries

- Design and function of alternator and excitation system
- Design and function of coal handling plant
- Design and function of ash and slag handling plant
- Design and function of treatment of water
- Design and function of fire protection and gas leakage system
- Design and function of turbine/generator control and protection system.
- Interpretation of Thermal System's documents code sign and alarms.
- Operation mode
- Data logging
- Recovery from abnormal operation condition.
- Emergency cases
- Trouble shooting
- Planning of maintenance service.
- Use of maintenance manual
- Design and function of monitoring instruments

Training on monitoring and archiving of data related to the project activity

Training is provided to the staff member of the power plant on the procedure of recording and archiving of data. The training pertaining to the monitoring and archiving of the data is carried out by General Manager power plant along with members of CDM consulting team. The details procedure of emission reduction estimation has also been explained to the monitoring team.

Internal Audit Team (CDM) and its compliance

BSFAL limited has formulated an internal audit procedure pertaining to verification of the monitoring procedure and monitored documentation. The internal audit team would be responsible for determining whether GHG emission reductions project conforms to the planned arrangements of the Monitoring Methodology and Plan including other criteria related to GHG performance parameters. The responsibilities also pertain to calculation/determining of the quantum of emission reduction. The internal audit team also involves a CDM consultant experienced in the field of Technical audit; the respective person would help the organisational internal audit team in carrying out internal audit from time to time. The internal audit team headed jointly by the General Manager (works) Mr.S. K. Safi and member of CDM consulting team. The personals will be responsible for reviewing and providing necessary co-operation for the conduct of the audit and thereby taking corrective actions so as to remove the non-conformities within a specified time frame. Internal audit to be carried out can be segmented under two broad heads

- Reviewing of the monthly report quarterly.
- Reviewing of Emission reduction during a crediting period yearly.

The internal audit team would report on

- Non-conformity of Data monitored
- Effectiveness of the implemented Monitoring methodology and Plan
- Improvement required
- Implementation and effectiveness of any corrective actions in previous recommendation

The project proponent will obtain the auditee's acceptance of non-conformities, along with the proposed corrective actions. The General Manager works (Mr. Safi) and member of the consulting shall follow up and report on the progress of implementation of corrective actions. The nonconformities if any shall be closed within the stipulated time frame and closure shall be approved by the General Manager power plant.

GHG performance parameters

The monitoring protocol requires BSFAL to monitor the following GHG performance parameters for estimating the emission reductions from the waste heat recovery based CPP.

- Gross generation of electricity by CPP
- Auxiliary consumption by CPP
- Net quantity of steam available from either of the system.
- Total steam availability to TG set
- Temperature and pressure of the steam from either unit.
- Net electricity generation from the waste heat recovery.

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