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: 1
Date: 26th March, 2007

A.2. Description of the project activity:

i. Background

Bhaskar Steel & Ferro Alloys Ltd. (BSFAL) is one of the upcoming sponge iron manufacturing company in eastern India with an annual production capacity of 1, 12,000 Tons of Sponge Iron and 88,473 Tons Steel Billets respectively. The industrial facility is operating a single Direct Reduction Iron (DRI) kiln of 350 TPD capacities.

The deployment of 8 MW waste heat recovery based power generation system would help to meet up the industrial power requirement The implementation of the power generating facility is in furtherance of aim of utilizing sensible heat of waste gas generated at DRI Kiln of steel manufacturing process through effective waste heat recovery module. Implementation of the project activity results in reducing import of grid power and associated emission that would occurred in absence of the project activity.

ii. Objective of the project activity:

The main objective of the project activity is an effort to achieve higher productivity and increased energy efficiency by capturing and efficient utilization of the thermal energy of the waste heat of flue gases from the DRI (Direct Reduction Iron) kiln, which would have been released to the atmosphere and also to address the major concern on conservation of natural resources and reduction in Green House Gas emission, due to application of cleaner technology.

iii. Salient Feature of the project activity:

The project activity is 8 MW waste heat recovery based captive power plant. It includes recovery of the sensible heat energy of the flue gases generated from the DRI kilns from sponge iron manufacturing process. The flue gas available at high temperatures of around 900-950^{o}C from the sponge iron kiln constitutes a significant amount of heat energy. With the Waste Heat Recovery Boiler (WHRB), an established and efficient technology, BSFAL has achieved about 55 percent recovery of waste heat from flue gas of sponge iron kiln. The sensible heat from the flue gases is transferred to the WHRB to produce super heated steam. Steam thus produced is fed to a common steam header, from where it is finally fed to the turbo-generator set to generate power.

The 12 MW captive power plant 8 MW waste heat recovery boiler and 4 MW coal and char based fluidized bed combustion (AFBC) boiler. The steams from these sources are fed to a common steam header and then are directed to the turbine generator. The power generation that arises from the waste heat recovery boiler is considered for emission reductions.

In the absence of waste heat recovery based steam generation system for captive power generation, the same heat energy would have been lost in the atmosphere through stack emission of the flue gases of sponge iron kiln, thus the waste heat recovery based power plant generates power from waste heat energy displaces equivalent quantity of grid based power . The main sustainable benefit to the project arises from replacement or displacement of an equivalent amount of grid electricity which would have been generated in the absence of the present project activity. The total emission reductions for the entire crediting period of 10 years have been calculated to be 517560 tCO_2 equivalent.

iv. Project's Contribution towards Sustainable Development

Bhaskar Steel and Ferro Alloys Limited (BSFAL) have always built in sustainable environment friendly actions as an integral part of its corporate strategy. With this mission and commitment BSFAL has selected an eco-friendly and modern technology to affect a paradigm shift in environment management while also being committed to its employees as well as to the development of the community with the policy and action that reflects its vision of corporate social responsibility.

Environmental Benefit:

The waste heat recovery based captive power plant was installed by BSFAL as a clean technology to utilize the sensible waste heat from the flue gases of the Sponge Iron manufacturing process. These waste gases (containing high quantity of SPM and with a temperature of more than 900^oC) would otherwise have been emitted to atmosphere leading to air and thermal pollution. Combusted gases after maximum heat transfer in the boilers lead to exhaust stacks through Electrostatic Precipitators (ESP) which reduce Suspended Particulate Matter (SPM) load of the flue gas to a large extent. Particulate Matter is collected in the hoppers of the ESP. The waste heat recovery based power plant brings down the temperature levels of the flue gas to 150°C. ESP operates at its best efficiency at lower waste gas temperatures and SPM levels are brought down to ≤75 mg/ Nm^3 thereby reducing adverse effects on the atmosphere. Without the implementation of WHRB, the common practice in the sector is to clean the flue gas through Venturi Scrubbers which generate a large quantity of waste water. However the current project activity eliminates the scope of waste water generation and ensures conservation of water. Hence, the project activity contributes to a better quality environment to the employees and the surrounding community. Apart from this, the project activity also contributes in reduction in the emissions of Green House Gases by the replacement of conventional Carbon intensive fossil fuel based power through the power generated utilising sensible heat from DRI kiln off gas, which would have discharged otherwise. This activity also addresses the issue of conservation of natural resources in the form of fossil fuel.

Socio-economic Benefit:

The project activity has resulted in enhanced employment opportunities for proper operation and maintenance of the utilities. With the implementation of the project activity there has been an increase in the business opportunities for contractors, suppliers, and erectors at different phases of its implementation. This has improved the local economic structure and hence social status of the involved people. More than 200 local people are engaged including management staff, skilled, and unskilled labour, for plant operation and maintenance. The local employees are from the nearby villages namely, Tumkela, Gumlei and Bonai. About 80 percent of the total employees have been deployed from the local community. Apart from that, some local people are also associated as suppliers of raw materials, transportation etc. BSFAL is also in the process of making fly ash bricks through local contractors and these will be used in captive construction. It enhances the livelihood and income of the local people. The project is located in a rural area, its construction, installation and operation helps in the economic and sustainable development scenario, bringing new sources of employment in the region and associated business opportunities for the local people. The equipment and parts used are manufactured indigenously; the project also leads to an extension of the national and local value chain.

Technological Well Being:

Power generation using waste heat is a cleaner technology for power generation. The success of the project activity will catalyze more Waste Heat Recovery (WHR) based power projects in the region.

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

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party (ies):

India.

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

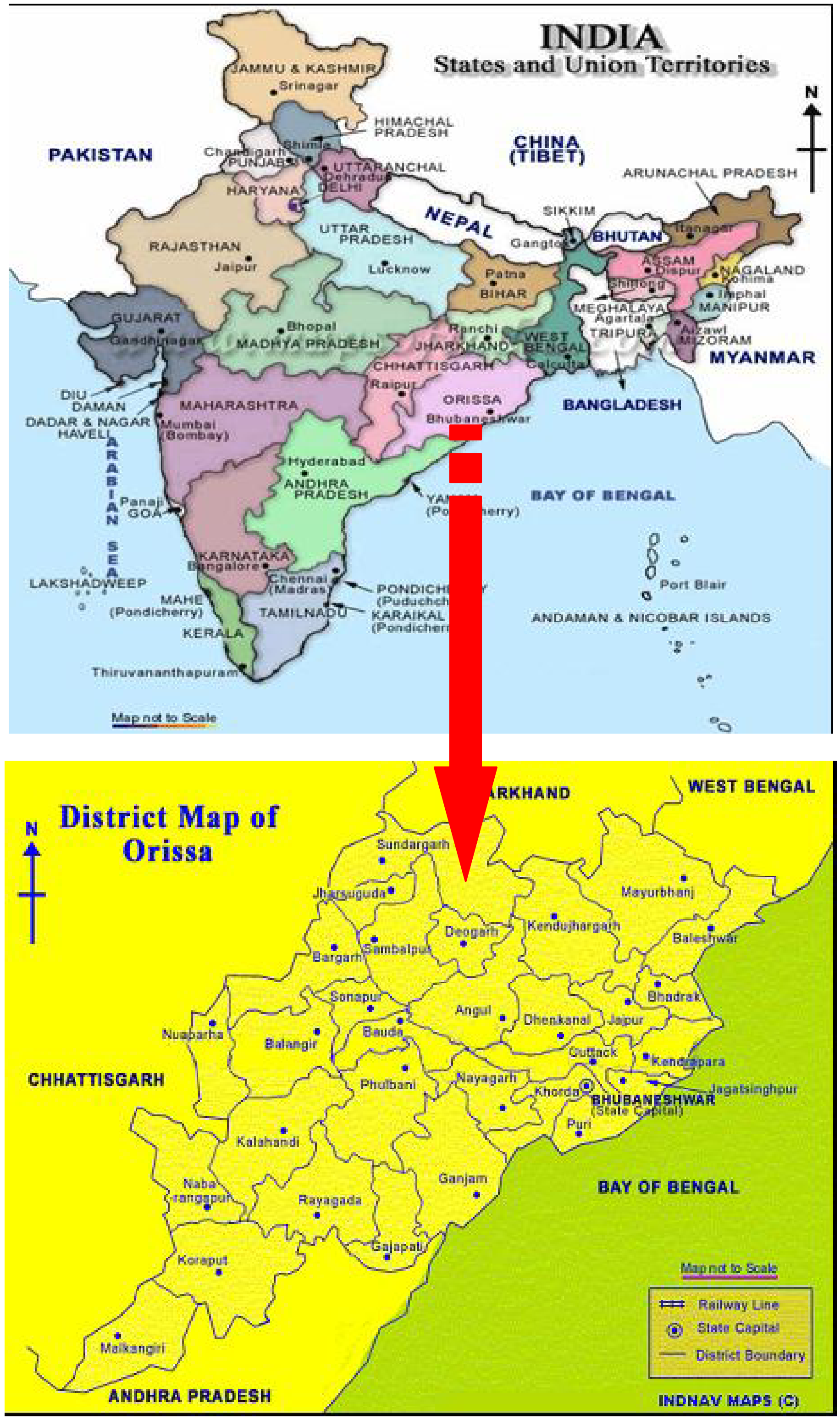
State: Orissa.

A.4.1.3. City/Town/Community etc:

Village: Bad Tamkela; P.O. – Rajamunda; Subdivision – Bonai; District- Sundargarh.

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

The project has been implemented at the facility of Bhaskar Steel & Alloys Ltd. at village – Bad Tamkela, P.O. – Rajamunda, Subdivision – Bonai, District- Sundargarh, State - Orissa, India. The project site is 66 Km away from the nearest city Rourkela and situated between longitude of 84”30’- 85”0’E and 21”30’- 22”0’N.


INDIA
States and Union Territories
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JAMMU & KASHMIR
Srinagar
HIMACHAL PRADESH
Shimla
PAKISTAN
CHINA (TIBET)
PUNJAB
UTTARANCHAL
Dehradun
HARYANA
DELHI
ARUNACHAL PRADESH
Itanagar
NEPAL
SIKKIM
Gangtok
BHUTAN
RAJASTHAN
Jaipur
UTTAR PRADESH
Lucknow
ASSAM
Dispur
NAGALAND
Kohima
Patna
BIHAR
Shillong
Imphal
MANIPUR
MEGHALAYA
Agartala
TRIPURA
Aizawl
MIZORAM
GUJARAT
Gandhinagar
Bhopal
MADHYA PRADESH
Ranchi
JHARKHAND
WEST BENGAL
Calcutta
MYANMAR
CHHATTISGARH
Raipur
ORISSA
BANGLADESH
DIU
DAMAN
DADAR & NAGAR HAVELI
MAHARASHTRA
Mumbai (Bombay)
Hyderabad
ANDHRA PRADESH
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Panaji
GOA
BAY OF BENGAL
KARNATAKA
Bangalore
Chennai (Madras)
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Phulbani
Nayagarh
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BHUBANESHWAR
(State Capital)
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Railway Line
State Capital
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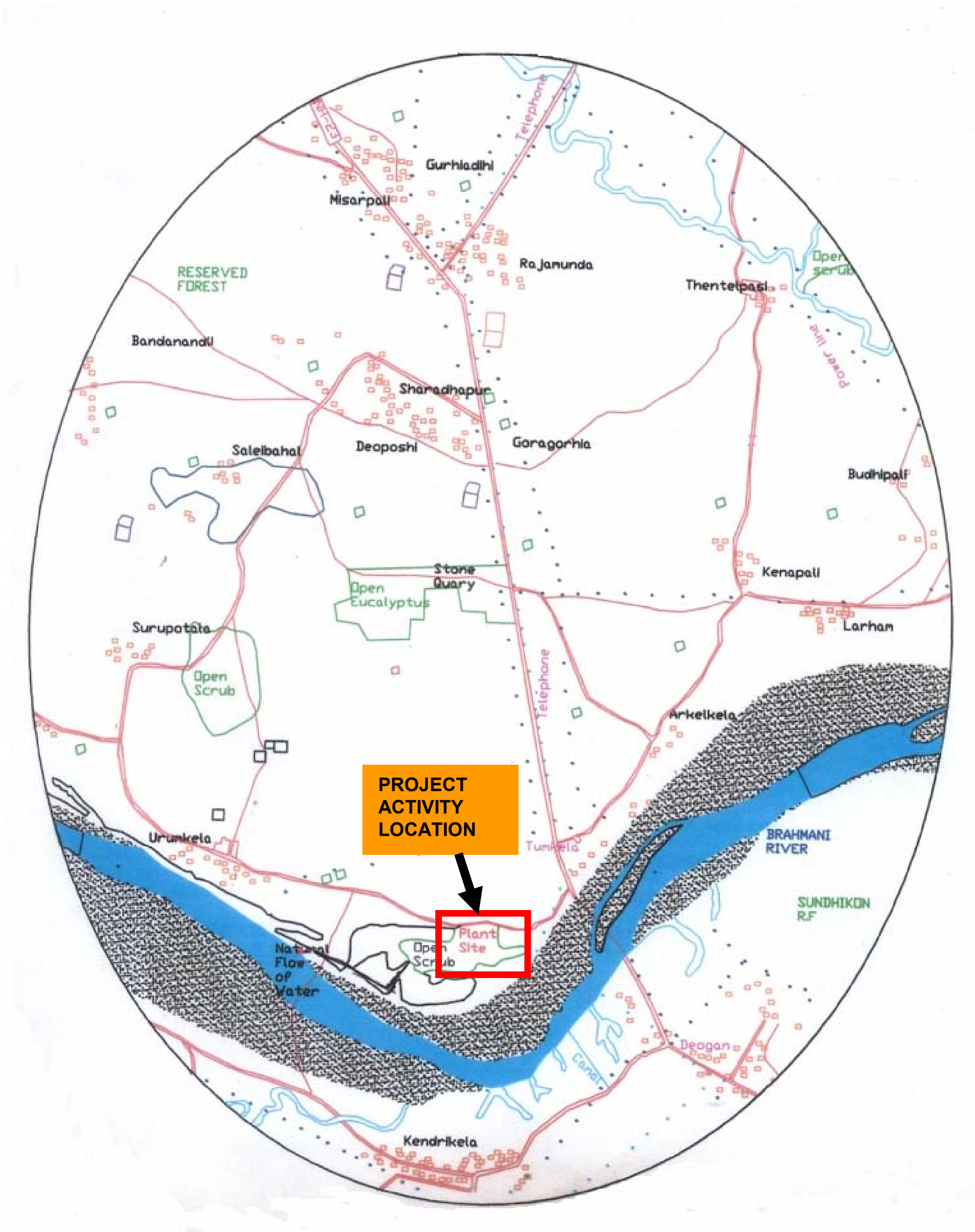
Gurhiadihi
Misarpali
Rajamunda
RESERVED FOREST
Thentelpasi
Open scrub
Bandanandi
Sharadhapur
Saleibahal
Deoposhi
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Budhipali
Stone Quary
Open Eucalyptus
Kenapali
Surupotala
Larham
Open Scrub
Telephone
Arkelkela
PROJECT ACTIVITY LOCATION
Urumkela
Tumkela
BRAHMANI RIVER
SUNDHIKON R.F
Plant Site
Open Scrub
Natural Flow of Water
Deogan
Canal
Kendrikela

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[1], the project activity can be categorized under Sectoral Scope - (1) Energy industries (renewable - / non-renewable sources).

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

The project activity at the facility of BSFAL involves an 8 MW captive power plant which utilizes the waste heat of the off gas produced from DRI kiln, as fuel. The Waste Heat Recovery (WHR) based captive power plant at BSFAL utilizes the sensible heat content of waste flue gas of sponge iron kiln to generate electricity for its captive requirement.

The sponge iron kiln is a rotary type DRI kiln of capacity 350 TPD operating on 320 days/annum (at 100% capacity utilization). It has an annual production of around 11,200 tonnes and runs on coal as fuel. Typical flue gas availability from the sponge iron kiln is 90,000 Nm^3/hr.

The exhausted flue gas of the sponge iron kiln is received at the After-Burning Chamber (ABC) inlet at a temperature of around 950 ^oC. The waste gases are burnt in ABC to remove traces of carbon monoxide. After secondary combustion the hot flue gases leave the ABC at temperatures ranging from 900 ^oC to 950 ^oC which is finally introduced to the WHRB through a hot gas duct.

The WHR based power plant primarily consists of waste heat recovery boiler (WHRB), Turbo generator sets (TG) and other auxiliaries.

i. Waste Heat Recovery Boiler

Waste heat from the Sponge Iron Kiln is utilized in a WHRB to produce steam in order to generate 8 MW of power. The salient technical particulars of the heat recovery boiler are given in Table No. 1.

Table 1: 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 combusted gas from ABC 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 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.

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

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. SPM is collected in the hoppers of the ESP. 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. The salient technical particulars of the ESP are given in Table No. 2.

Table 2: Technical specification of Electro Static Precipitator

Description	**Technical Particulars**
Design gas volume (in Nm^3/hr)	146045
Temperature (in ^oC)	170
Dust Type	Sponge Iron Dust
Maximum inlet dust loading (in gm/ Nm^3)	21
Outlet emission from ESP (in mg/ Nm^3)	≤ 75
Moisture in gas (in % v/v)	12
Collection area (in M^2)	3021
Number of gas passages	17
Velocity through ESP (in M/sec)	0.86
Treatment time (in Sec)	11.3
Number of fields in series	3
Migration Velocity (in cm/sec)	7.57
Design Pressure (in mm WC)	± 300
Dust density for power (in kg/M^3)	1100
Dust density for discharge (in kg/M^3)	800

ii. 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 provided in Table No. 3.

Table 3: 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.

iii. DCS Control System:

The control system of the captive power plant is built around a central DCS based control system and the electricity generation data are monitored with the DCS 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 for firing in WHRB. Therefore, due to unavailability of flue gas (as fuel) power plant remains shutdown during this period. Hence, the total days of operation of the power plant are 320 days per annum. The unit is presently generating around 57000 MWh of power per annum. Around 51624 MWh of power is available after auxiliary consumption.

The total electrical energy produced meets the 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:

Year	Annual Estimation of emission reductions in tonnes of CO2 e
Aug. 2007 – Dec. 2007	21565
2008	51756
2009	51756
2010	51756
2011	51756
2012	51756
2013	51756
2014	51756
2015	51756
2016	51756
Jan. 2017 – July 2017	30191
Total estimated reductions (tonnes of CO_2 e)	**517560**
Total number of crediting years	**10**
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	51756

A.4.5. Public funding of the project activity:

No public funding from parties included in Annex-I is available to the project activity.

SECTION B. Application of a baseline and monitoring methodology

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

Title: Consolidated baseline methodology for waste gas and/or heat and/or pressure for power generation
Reference: Approved consolidated baseline methodology ACM0004 / Version 02;
Sectoral Scope: 01 03 March 2006[2]

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

As stated in the "Consolidated baseline methodology for waste gas and/or heat and/or pressure for power generation – ACM0004 / Version 02"- "*This methodology applies to project activities that generate electricity from waste heat or the combustion of waste gases in industrial facilities*". - The project activity under consideration recovers the sensible heat content of waste gases emitted from the DRI kiln in WHRB and utilizes the same to produce steam which is further used to generate captive electricity.

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

"***The methodology applies to electricity generation project activities:***"
1. "that displace electricity generation with fossil fuels in the electricity grid or displace captive electricity generation from fossil fuels"-As per the Baseline Scenario analysis, conducted in Section B.4 of this PDD, the project activity displaces grid based electricity generation. Therefore the project activity meets the applicability criteria for Methodology ACM0004.

2. "Where no fuel switch is done in the process where the waste heat or the waste gas is produced after the implementation of the project activity"- The project activity involves utilization of the heat content of waste gases of the sponge iron kiln, for power generation. There is no fuel switch involved in the sponge iron kiln operation.

Furthermore, "***The methodology covers both new and existing facilities***"**-** The new project activity has been undertaken in the existing sponge iron plant of BSFAL and the waste gases used in the project activity are emitted from the sponge iron kiln currently operating in the facility site.

As stated above, the project activity under consideration meets all the applicability conditions of the baseline methodology – ACM0004 ver. 02. This justifies the appropriateness of the choice and applicability of the methodology in view of the project activity.

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

The project boundary covers the point of waste gas supply to the point of power generated for use of the BSFAL's plant. Thus, boundary covers Dust Settling Chamber, After Burning Chamber, Waste Heat Recovery Boiler, and Turbine Generator and all other power generating equipment, Steam Condenser, captive consumption units, the transport of the waste gases to boiler, the electricity generated for BSFAL's plant.

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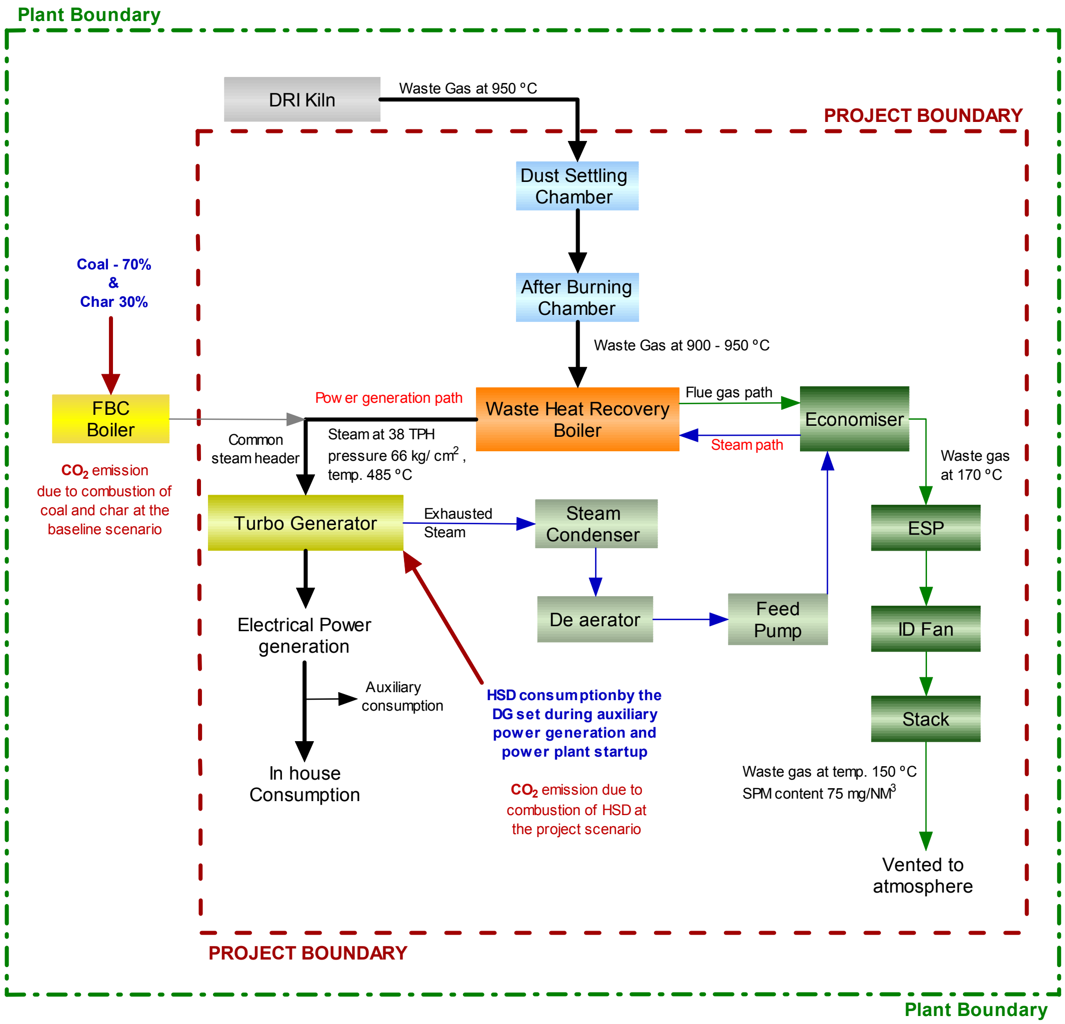
[2] http://cdm.unfccc.int/EB/023/eb23_repan8.pdf

The project boundary comprises of all the anthropogenic emission by source of green house gases under the control of the project participants that are significantly and reasonably attributable to the project activity. The project activity encompasses the waste heat recovery based captive power generation system from which no excess electricity is exported outside the industrial facility. The waste heat recovery based captive power generation system meets a partial base load electrical demand of 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 waste heat recovery based captive power generation.. As such the impact of waste heat recovery based captive power generation system on the project emission is taken under consideration., emission related to the on-site auxiliary HSD consumption for power plant start up, is also considered in the project related emission estimation for a conservative approach.

Figure 1: **Project Boundary of BSFAL Project Activity**



An overview of all emission sources included in or excluded is depicted in the following table:

	Source	Gas	Included/ Excluded	Justification / Explanation
Baseline	Grid electricity Generation	CO_2	Included	Main source of emission.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
Project activity	On-site fossil fuel consumption due to the project activity	CO_2	Included	Below 1% of the emission reduction.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
	Combustion of waste gas for electricity generation	CO_2	Excluded	Excluded for simplification.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.

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

The project activity of BSFAL involves setting up of 8 MW Waste Heat Recovery based CPP to meet the partial in-house power requirement. The approved methodology ACM0004 ver02 is applied in the context of the project activity as follows:

Identification of Alternative Baseline scenarios

The methodology *ACM0004 ver02* as applied to the project activity involves the identification of all possible alternative baseline scenarios that provide or produce electricity for in-house consumption and/or sale to grid and/or other consumers, excluding options that:

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

An assessment of all these alternatives is required to be carried out with respect to the prohibitive barriers associated with their implementation and their economic attractiveness in order to arrive at the baseline scenario i.e. the most likely future scenario in absence of the project activity.

The possible alternative baseline scenarios are as follows:

Possible alternative baseline scenarios	Explanation towards inclusion/exclusion
Alternative 1: Proposed project activity not undertaken as CDM project activity	The alternative of deployment of waste heat recovery based power generation is in compliance with all applicable legal and regulatory requirements but without consideration of CDM benefit the project could not be implemented due to its financial unattractiveness. Hence this is not considered as a baseline option.
Alternative 2: Import of electricity from the Eastern Regional grid	Bhaskar steel would purchase required power from the Eastern Regional grid as the grid power is easily available at the plant site. The lower capital investment for obtaining grid based power facilitates the choice of the alternative as a baseline

	option. The fact of uncertainty and risk involved in obtaining the desired quantum of power further strengthen the choice. This alternative can be considered as a plausible baseline scenario.
Alternative 3: New coal based captive power plant	Orissa is one of the three states (others are Chattisgarh and Jharkhand) which have most of the coal deposits in India. The alternative has advantages like high PLF, well established technology, easily available raw material in and around the industrial facility above all a lower cost per unit of power generation. The analysis of the capital investment for such project reveals financial unattractiveness. This would however result in an equivalent amount of CO_2 emissions corresponding to the power generation in the captive power plant of the grid facility. Hence this alternative can not considered as a baseline option.
Alternative 4: New diesel based captive power plant	Although with a facility like quick start up and comparatively lower capital investment exist yet high cost of fuel oil demotivates industry from choosing any of such option. The high cost of per unit of power in comparison to coal based captive or grid based power revels the unattractiveness for such adaptation. The option also will result in GHG emissions to the existing scenario. Hence the alternative cannot be considered as a baseline scenario.
Alternative 5: Gas based new captive power plant installation	The unavailability of the natural gas in this part of the country rules out the possibility of such alternative in the present scenario. Although with the transnational gas pipe line or formation of gas grid in the country may bring in the possibility of such option in this part of the country yet any of such option is fully dependent on the strategic policy of the country. Hence the alternative cannot be considered as a baseline scenario.

According to the baseline methodology "*among all these alternatives the one that does not face any prohibitive barrier and is the most economically attractive should be considered as the baseline scenario*".

Parameter	**Grid power**	**Coal based CPP**	**Diesel based power generation**
Capital cost		Rs. 42.5 – 45 million / MW	Rs.7.5 – 12.0 million / MW
Cost of power	Energy charge: Rs 3.00 / kWh Demand charge : > Rs 200 / kVA[3]	Rs 1.78 – 1.92 / kWh	Rs 11 – 11.39 / kWh

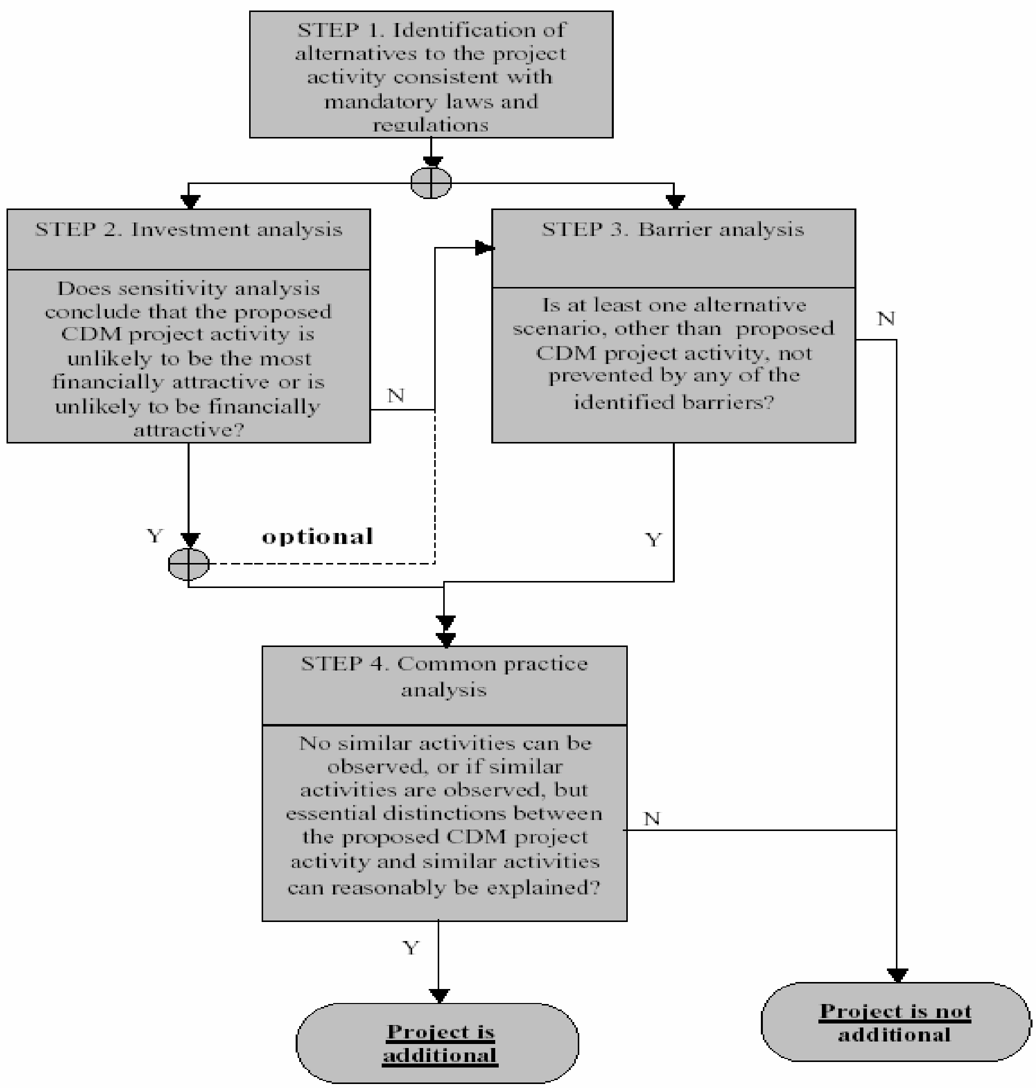
[3] Source : http://www.orierc.org/Orders/Tariff/03-04

Conclusion:
Import of electricity from the grid can be considered as the most suitable baseline scenario in the proposed project activity as this requires minimum investment, having low risk or uncertainty.

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 03)" –, agreed by the CDM Executive Board at its twenty-ninth meeting.
The flowchart presented below provides a step-by-step approach to establishing additionality of the project activity.

Figure 2: Flow chart for establishing additionality



With reference to the above flow-chart, BSFAL demonstrates additionality as follows:

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

Sub-step 1a. Define alternatives to the project activity:

There were five alternatives available to BSFAL that could provide the required electrical energy for in-house consumption; among them two alternatives are realistic and credible alternatives that can be part of the baseline scenario. The two alternatives were analysed to determine the most probable baseline scenario. Among the alternatives that do not face any prohibitive barriers, the most economically attractive alternative was considered as the baseline scenario. The identified alternatives are as follows:

Alternative 1: Proposed project activity not undertaken as CDM project activity.

Alternative 2: Import of electricity from the grid.

Alternative 3: New coal based captive power plant.

Alternative 4: New diesel based captive power plant.
Alternative 5: Gas based new captive power plant installation.

Sub-step 1b. Consistency with mandatory laws and regulations:

All the above mentioned alternatives are in compliance with all applicable legal and regulatory requirements applicable in such manufacturing industries and may be a part of the baseline.
Alternative 2: Import of grid based power was found to be the most feasible baseline scenario and commercially viable too.

The project proponent is required to establish additionality of the project activity by conducting: Step 2: Investment Analysis or, Step 3: Barrier Analysis. BSFAL took into consideration both quantitative - Investment analysis and qualitative - Barrier Analysis assessments to establish the additionality issues for their project activity.

Step 2: Investment Analysis

According to the investment analysis the project proponent is required 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 is done as per the following steps:

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 whether the project is financially additional or not. Revenue of the project is considered by cost savings through avoiding power purchase from grid thus, simple cost analysis cannot be done. Also investment comparison analysis is not applicable in this case as the project proponent did not have any expertise in captive power generation. The benchmark analysis is appropriate for this case as it can show the justification behind the investment decision for the project activity.

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

The project activity has a high capital investment as compared to investment for import of power from grid. The benchmark IRR for investment analysis is taken considering the IRR provided by banks, financial institutions for making decision of fund allotment.

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

In accordance with the benchmark analysis, the project activity will not be considered financially attractive if project IRR is lower than the benchmark IRR. The project IRR is 11.01% and increases to 15.43% with the inclusion of CER revenue. These calculations are based on a projected CER market price of 11 $/tCO2e. The financial calculations done by including all costs associated with the project. The costs include capital investment due to the project activity, interest on loan, salaries and wages, repair and maintenance, administrative expenses, and the costs of grid connectivity. The assumptions pertaining to investment analysis is provided in Annex 5.

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:

Investment barrier

The one of the main barrier to the project activity is the high cost of captive power plant relative to grid connectivity. BSFAL management faced problems in arranging fund from the banks for the project activity. The debt equity ratio for the investment of the project activity is 59:41. The project proponent approached a number of banks like State Bank of India, Oriental Bank of Commerce, Central Bank of India etc for debt sourcing for the project. In due course, three Government undertaking banks agreed to finance the project at competitive lending rates on the sole premise that the project activity had the potential to accrue revenues through CDM project activity, which pushed the IRR above threshold values and made the project financially attractive. All the three banks agreed to partially fund the debt portion required by BSFAL for project. The factors influenced banks to come up with such offer are large amount as loan and project which has low penetration of technology in similar industries than other captive power projects. The management's vision with CDM opportunity became the driving factor for successful implementation of the project activity.

In the absence of the CDM project activity the associated barriers would prevail as the standard WHR project without CDM benefits would not have financial viability and BSFAL would eventually resort to the business-as-usual scenario which is releasing the waste heat from sponge iron kilns into atmosphere. The power plant is not only justified in view of its capability to affect the generation mix but also lead as an example of eco-friendly power from a sponge iron industry. The project meets the requirement of additionality tests as its existence and operation has the effect of reducing GHG emissions below the level that would have occurred in its absence.

Operational Barrier

There were many operational barriers faced by the project activity. There is almost no control over the Quality and Quantity of the flue gases, thus the designing of a proper waste heat recovery system to generate power with the available steam, which is generated out of the available waste heat, is a great technology barrier. This is one of the most important reasons for not having many WHRB plants in India and in the region coming up without CDM benefits. Due to these barriers it was difficult for the project proponent to go ahead with the project.

The project activity had its associated barriers to successful implementation, which are being overcome by BSFAL to bring about additional GHG emission reductions. The barriers are detailed 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 key waste gas parameters and WHRB failure will result in inadequate steam and power generation. Waste gas from the DRI kiln is the only major source of heat energy for the project activity and its insufficiency would completely hinder the 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 BSFAL plant operations would be significantly dependent on the project activity for electricity, disruption in steam and power generation would have a detrimental effect on BSFAL's entire plant operations.

Institutional barrier

The project activity faced institutional barriers during allotment of water linkage, the formal process of water allotment licensing from the Water Resources and Irrigation department involved a time frame of 6 months. Due to such delay the project activity with such facility gets affected on the roll out of operations.

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 to successful implementation. The barriers mentioned above are directly related to Project Activity only and would not prevent the implementation of other alternatives which is mentioned in sub-step 1.a. BSFAL would not have faced any investment or technological barrier in case it continued to procure power from the grid. In this scenario it would not have faced the investment barrier as investment is less in comparison with WHR based captive power plant also as this scenario is common practice in the region and the technology is well known the banks and financial institutes agrees to fund easily. Further other alternatives would not have to face any technological barriers as in the case of generation of waste heat based power. Therefore, it is most likely that in absence of the project activity BSFAL would opt for the business-as-usual scenario, i.e. releasing the waste heat into the atmosphere and generating equivalent electricity from grid.

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:

As per the discussion on the feasible baseline scenarios above in section B.4., the Alternative 2: Import of electricity from the grid is the most common practice due to its economic feasibility in the sponge iron industry in the state of Orissa. At the time of implementation of the project activity in August 2006, there were 73 sponge iron units[4] 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[5] ., OCL India Ltd.[6], and Tata Sponge Iron Ltd.[7]) have implemented Clean Development Mechanism project modalities for their waste heat recovery based captive power project in order to reduce GHG emission and avail the Carbon Credit revenues from sale of the carbon emission reductions. Out of these, 40 units are present in the Sundargargh district, from these only 4 units have Waste Heat Recovery based captive power generation facility. Hence it indicates that the Waste Heat Recovery based Captive Power Plant facility is not an established scenario in Iron and Steel manufacturing sector in Orissa. Thus, the partial power requirement through the WHR process would not have been feasible for establishment without the CDM opportunity.

[4] Source: Orissa Sponge Iron Manufacturers' Association, Bhubaneswar, Orissa

[5] Source: http://cdm.unfccc.int/Projects/registered.html (UNFCCC Ref No.: 0515)

[6] Source: http://cdm.unfccc.int/Projects/registered.html (UNFCCC Ref. No.: 0367)

[7] Source: http://cdm.unfccc.int/Projects/registered.html (UNFCCC Ref. No.: 0274)

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%[8].

With respect to the above discussion to demonstrate the additionality, this project activity is additional as the anthropogenic emissions of GHG gases are reduced significantly, which otherwise would have occurred in the absence of this CDM project.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The monitoring methodology is used in conjunction with the approved baseline methodology ACM0004 Ver02 – "Consolidated baseline methodology for waste gas and/or heat and/or pressure for power generation". The applicability criteria for the approved baseline methodology ACM0004 Ver02 and approved monitoring methodology ACM0004 Ver02 are identical and have been justified in section B.2. Thus the said methodology is applicable 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 for the sake of conservative approach.

Project Emissions Calculation:

Project Emissions are applicable only if auxiliary fuels are fired for generation startup, in emergencies, or to provide additional heat gain before entering the Waste Heat Recovery Boiler (According to the Approved Consolidated Methodology ACM0004 Version 02).

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

a. GHG emission due to heat energy extraction in the WHRB is zero, as there is no change in chemical composition of waste gases at the inlet and outlet of the boiler.
b. Only GHG emissions due to consumption of fossil fuel during initial power plant start up has been considered on a conservative approach during project emission calculation.
c. No other major on-site emissions for meeting the auxiliary consumption, since the plant runs on the power that is generated by the project activity.

$$PE_y = \sum_i Q_i \times NCV_i \times EF_i \times \frac{44}{12} \times OXID_i$$

where:

PE_y Project emissions in year y (tCO_2)
Q_i Mass or volume unit of fuel *i* consumed (t or m^3)
NCV_i Net calorific value per mass or volume unit of fuel *i* (TJ / t or m^3)
EF_i Carbon emissions factor per unit of energy of the fuel *i* (tC / TJ)
$OXID_i$ Oxidation factor[9] of the fuel *i* (%)

Baseline Emissions Calculation:

Baseline emissions are given as:

[8] Source: http://www.cea.nic.in/planning/ "*Report on Tapping of Surplus Power from Captive Power Plants*"

[9] The oxidation factor of the fuel is used from page 1.29 in the 1996 Revised IPCC Guidelines for default values.

$$BE_{electricity,\,y} = EG_y * EF_{electricity,\,y}$$

Where:
EG_y = Net quantity of electricity supplied to the manufacturing facility by the project activity during the year *y* in MWh,
EF_y = CO_2 baseline emission factor for the electricity displaced due to the project activity during the year *y* (tCO_2 / MWh).
Net electricity supplied is calculated by subtracting electricity consumption due to auxiliary from the total electricity generation.

Emission Factor of the Grid (EF_{Grid})

As the baseline scenario determined is grid power imports (As illustrated in B.4). Baseline emission factor of eastern region (EF*y*) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors according to Baseline Methodology ACM0004, Version 02, Option 02 the baseline emission factor is calculated by Central Electricity Authority (CEA)[10], Ministry of Power, Government of India in accordance of the guidance of the "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002)..

The value for grid emission factor for applicable eastern regional grid has been considered as provided by Central Electricity Authority, Government of India (Baseline Carbon Dioxide Emission Database Version 1.1 – LATEST[11]), the detailed emission factor consideration is provided under Annex 3.

Leakage Emissions Calculation:

The leakage emission is not considered as per the methodology ACM0004 ver 02. Hence, leakage emission is zero.

Emission Reduction Calculation:

The emission reduction due to project activity is calculated according to Approved Consolidated Methodology ACM0004 Version 02, as follows:

$$ER_y = BE_y - PE_y$$

where:
ER_y = *Total* emissions reductions of the project activity during the year *y* (in tons of CO_2),
BE_y = Total baseline emissions due to displacement of electricity during the year *y* (in tons of CO_2),
PE_y = Total project emissions during the year *y* (in tons of CO_2),

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

Data / Parameter	NCV_{HSD}
Data unit:	TJ per tonne.
Description:	The Net Calorific Value of the fuel (HSD) consumed by the project activity for auxiliary power generation and power plant start up will be essential for estimating the project emission there by the emission reduction. The quantity of the HSD consumed by the captive power generation facility is measured by the manual metering at the DG set facility.

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

[11] http://www.cea.nic.in/planning/c%20and%20and%20e/database%20ver1.1.zip

Source of data to be used:	IPCC default data source. Revised 1996 IPCC Guidelines for National Green House Gas Inventories: Workbook, Energy Module I.
Value applied:	0.043 TJ/tonne.
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data is used for estimating the project emissions due to utilisation of additional fossil fuel within the project boundary.
Any comment:	

Data / Parameter:	EF_{HSD}
Data unit:	Kg of green house gas per TJ on a Net calorific value basis.
Description:	The carbon emission factor of the fuel (HSD) consumed by the project activity for auxiliary power generation and power plant start up will be essential for estimating of the project emission there by the emission reduction. The quantity of the HSD consumed, is measured manual metering at the DG set facility.
Source of data to be used:	2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 2: Energy
Value applied:	74100
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data is used for estimating the project emissions due to utilisation of additional fossil fuel for power plant start up within the project boundary.
Any comment:	

Data / Parameter:	$OXID_{HSD}$
Data unit:	
Description:	The efficiency of carbon oxidised. The oxidation factor of the auxiliary fuel, HSD will be required for estimating the project emission there by the emission reduction.
Source of data to be used:	IPCC default data source. Revised 1996 IPCC Guidelines for National Green House Gas Inventories: Workbook, Energy Module I.
Value applied:	Value considered as 0.99
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data is used for estimating the project emissions due to utilisation of additional fossil fuel within the project boundary.

Any comment:	The data will be recorded once a year and according to any change in IPCC value it will be changed.

Data / Parameter:	*EFgrid, y*
Data unit:	tCO_2 / MWh
Description:	CO_2 baseline emission factor for the grid electricity displaced due to the project activity during the year y
Source of data used:	Central Electricity Authority, India "CO_2 Baseline Database for the Indian Power Sector" Version 1.1, 21st December 2006
Value applied:	1.04 t CO_2 / MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	CEA has calculated Combined margin (including inter-regional and cross-border electricity transfers) according to methodology ACM0002 for the year 2004 - 2005.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

Project Emissions Calculation

Project Emissions are applicable only if auxiliary fuels are fired for generation startup or in emergencies.

Project Emissions are given as:

$$PE_y = \sum_i Q_i \times NCV_i \times EF_i \times \frac{44}{12} \times OXID_i$$

Where:

PE_y Project emissions in year y (tCO_2)
Q_i Mass or volume unit of fuel *i* consumed (t or m^3)
NCV_i Net calorific value per mass or volume unit of fuel *i* (TJ/t or m^3)
EF_i Carbon emissions factor per unit of energy of the fuel *i* (tC/TJ)
$OXID_i$ Oxidation factor[12] of the fuel *i* (%)

Project emissions [PE_y (tCO_2e /annum) = (Quantity of the fuel) x (NCV of the fuel) x (Emission Factor of the fuel) x (Oxidation factor of the fuel)] due to the auxiliary HSD consumption for power plant start up.
The estimated project emissions (tCO_2e /annum) per annum = 1.04

Baseline Emissions Calculation

Baseline emissions are given as:

$\boldsymbol{BE_{electricity,\,y} = EG_y * EF_{electricity,\,y}}$

where:

EG_y = Net quantity of electricity supplied to the manufacturing facility by the project during the year *y* in MWh, and
EF_y = CO_2 baseline emission factor for the electricity displaced due to the project activity during the year *y* (tCO_2/MWh).
Grid based electricity supply at the industrial premise has been considered as a baseline for the project activity. Central electricity Authority has established a baseline emission factor for all five regional grid of the country based on ACM0002,ver06.

Emission Factor of the Grid (*EFy*)

Baseline emission factor of the eastern regional grid have been estimated at 1.04 tCO_2 / MWh[13] .

Net quantity of electricity supplied to the manufacturing facility by the project (*EGy*)

Net units of electricity substituted in the grid (EGy) = (Total electricity generated by the project activity – Auxiliary consumption by the project activity)
Net units of electricity substituted in the grid (EGy) = (EG_{GEN} - EG_{AUX})

EG_{GEN} = 55296 MWh
EG_{AUX} = 5530 MWh
EGy = EG_{GEN} - EG_{AUX}
= 55296 – 5530
= 49766 MWh

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[12] The oxidation factor of the fuel is used from page 1.29 in the 1996 Revised IPCC Guidelines for default values.

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

Emission Reduction Calculation

The emission reduction resulting from the project activity is calculated in accordance with Approved Consolidated Methodology ACM0004 Ver02, as the emission reduction ER_y by the project activity during a given year *y* is the difference between the Baseline Emissions through substitution of electricity generation with fossil fuels (BE_y) and Project Emissions (PE_y), as follows:

$$ER_y = BE_y – PE_y$$

Where:

ER_y = *Total* emissions reductions of the project activity during the year *y* (in tons of CO_2),

BE_y = Total baseline emissions due to displacement of electricity during the year *y* (in tons of CO_2),

= 51757 tCO2e

PE_y = Total project emissions during the year *y* (in tons of CO_2),

= 1.04 tCO2e

Therefore, estimated annual emission reduction will be 51757 tCO_2e.

$ER_y = BE_y – PE_y$

= 51757 – 1.04

ER_y = 51756 tCO_2e

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

Year	Net Electricity Generated (in MWh)	Baseline Emission (TCO_2e)	Project Emission (TCO_2e)	Emission Reduction (TCO_2e)
Aug. 2007 – Dec. 2007	20736	21565	1.04	21565
2008	49766	51757	1.04	51756
2009	49766	51757	1.04	51756
2010	49766	51757	1.04	51756
2011	49766	51757	1.04	51756
2012	49766	51757	1.04	51756
2013	49766	51757	1.04	51756
2014	49766	51757	1.04	51756
2015	49766	51757	1.04	51756
2016	49766	51757	1.04	51756
Jan 2017 – July 2017	29030	30192	1.04	30191

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

B.7.1 Data and parameters monitored:

Data / Parameter:	$EG_{GROSS-CPP}$
Data unit:	MWh / yr
Description:	Total electricity generation from the entire captive power generation facility per annum.
Source of data to be used:	Metered and data recorded in log book.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	82944 MWh / yr
Description of measurement methods and procedures to be applied:	Total power generation from the facility will be monitored continuously through digital control system of the power plant.
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 installed, adjusted and calibrated according to manufacturer's manual.
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 kept for a period of two years after the end of the crediting period.

Data / Parameter:	$EG_{AUX-CPP}$
Data unit:	MWh / yr
Description:	The auxiliary electricity consumption by the entire captive power generation facility per annum.
Source of data to be used:	Metered and data recorded in log book.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	8294 MWh / yr
Description of measurement methods and procedures to be applied:	Log book maintained based on DCS data which receive data from energy meters connected to DCS.
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 installed and adjusted and calibrated according to manufacturer's manual.
Any comment:	The data measured 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:	***EG_{GEN}***
Data unit:	MWh / yr
Description:	Total electricity generation from the project activity per annum.
Source of data to be used:	Calculated from the gross electricity generated and steam generated by the individual facility.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	55296 MWh / yr
Description of measurement methods and procedures to be applied:	Calculated based on the enthalpy ratio and the quantum of the steam generated from each of the facility. EG_{GEN} (MWh) = $EG_{GROSS-CPP}$ x $(H_1) / (H_1 + H_2)$ Where, $EG_{GEN-CPP}$ = Total power generated from Captive Power Plant per day in MWh EG_{GEN} (MWh) = Total power generated from WHRB steam
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.
Any comment:	The data calculated 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 kept for a period of two years after the end of the crediting period.

Data / Parameter:	***EG_{AUX}***
Data unit:	MWh / yr
Description:	The auxiliary electricity consumption by the project activity per annum.
Source of data to be used:	Calculated from the total auxiliary power consumed and steam generated by the individual facility.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	5529 MWh / yr
Description of measurement methods and procedures to be applied:	Log book maintained based on estimated data.
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.
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:	***EG_y***
Data unit:	MWh / yr
Description:	The net electricity generation from the project activity per annum.
Source of data to be used:	Calculated as a difference between Gross electricity generated from the waste heat recovery and the auxiliary consumption.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	49766 MWh / yr
Description of measurement methods and procedures to be applied:	The data holds a significant purpose for determining the baseline emissions and the emissions reductions accruing due to the project activity. This is calculated as the difference between the total waste heat power generated for a year from the auxiliary power consumption during that year.
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.
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:	***Q_i***
Data unit:	Litre
Description:	The quantity of the auxiliary fuel (HSD) consumed by the industrial facility due to d power plant start up. This estimation will be required for estimation of the project emission. The quantity of the HSD consumed by the captive power generation facility is measured by the industrial facility and is also reflected from the fuel bill of the vendor agency.
Source of data to be used:	Plant HSD consumption report and the vendor company fuel invoice.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	The total quantity of HSD to be consumed by the industrial facility (DG sets) in a year will be in the range of 384 m^3
Description of measurement methods and procedures to be applied:	The actual usage will be measured using actual stock available onsite and total purchases made during that period (not involved in the usual plant operations) after every year. A log book will be maintained at the DG set facility to record the total amount HSD consumed and running hours of the DG set, respective Shift In-charge – Captive Power Plant will be responsible for the monitoring of HSD consumption data.
QA/QC procedures to be applied:	The amount of HSD consumed can be cross checked from the amount of power generated and used up for the power plant start up. Specific fuel consumption for the generator set is known.
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:	S_{WHRB}
Data unit:	Tonne / hr
Description:	Steam flow rate at outlet of waste heat recovery boiler steam header.
Source of data to be used:	Steam flow meter provided at the waste heat recovery boiler steam header.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	100% and the data will be used for calculating the effective Waste heat recovery steam flow per day.
Description of measurement methods and procedures to be applied:	Log book maintained based on the DCS data which receive data from steam flow meters.
QA/QC procedures to be applied:	QA/QC procedures have been planned. Manager in-charge 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 calculate the net / effective WHR steam. The calibration of industrial meters as per manufacturer specification and Calibration standard.
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:	S_{AFBC}
Data unit:	Tonne / hr
Description:	Steam flow rate at outlet of AFBC boiler steam header.
Source of data to be used:	Steam flow meter provided at the AFBCB steam header.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	100% and the data will be used for calculating the effective Waste heat recovery steam flow per day.
Description of measurement methods and procedures to be applied:	Log book maintained based on the DCS data which receive data from steam flow meters.
QA/QC procedures to be applied:	QA/QC procedures have been planned. Manager in-charge 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 calculate the net / effective WHR steam. The calibration of industrial meters as per manufacturer specification and Calibration standard.
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:	T_1
Data unit:	^0C
Description:	Avg. Temperature of WHRB steam at the WHRB steam header.

Source of data to be used:	Temperature meter provided at the outlet of waste heat recovery boiler.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	100% and the data will be used for calculating the Total Enthalpy from WHRB steam. Average steam temperature of 485^{0}C has been taken into consideration.
Description of measurement methods and procedures to be applied:	Log book maintained on the basis of DCS data which receive data from temperature meter.
QA/QC procedures to be applied:	QA/QC procedures have been planned. Manager in-charge would be responsible for maintenance and calibration of the meters. The level of uncertainty level of data is low. This data would be used for calculation of WHRB steam parameters. The calibration of industrial meters as per manufacturer specification and Calibration standard.
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:	T_2
Data unit:	^{0}C
Description:	Avg. Temperature of AFBC steam at the AFBCB steam header.
Source of data to be used:	Temperature meter provided at the outlet of AFBC boiler.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	100% and the data will be used for calculating the Total Enthalpy from AFBCB steam. Average steam temperature of 485^{0}C has been taken into consideration
Description of measurement methods and procedures to be applied:	Log book maintained on the basis of DCS data which receive data from temperature meter.
QA/QC procedures to be applied:	QA/QC procedures have been planned. Manager in-charge would be responsible for maintenance and calibration of the monitoring equipment. The level of uncertainty level of data is low. This data would be used for calculation of AFBCB steam parameters. The calibration of industrial meters as per manufacturer specification and Calibration standard.
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:	P_1
Data unit:	kg / cm^3
Description:	Steam pressure at the outlet of waste heat recovery boiler.
Source of data to be used:	The pressure gauge provided at the waste heat recovery boiler steam header.
Value of data applied	100% and the data will be used for calculating the Total Enthalpy from WHRB steam.

for the purpose of calculating expected emission reductions in section B.6	Average steam pressure of 65 kg/cm^2 has been taken into consideration.
Description of measurement methods and procedures to be applied:	Log book maintained on the basis of DCS data which receive data from pressure gauge.
QA/QC procedures to be applied:	QA/QC procedures have been planned. Manager in-charge would be responsible for maintenance and calibration of the monitoring equipment. The level of uncertainty level of data is low. This data would be used for calculation of WHRB steam parameters. The calibration of industrial meters as per manufacturer specification and Calibration standard.
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:	***P_2***
Data unit:	kg / cm^3
Description:	Steam pressure at the outlet of AFBC boiler.
Source of data to be used:	The pressure gauge provided at the AFBC boiler steam header.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	100% and the data will be used for calculating the Total Enthalpy from AFBC steam. Average steam pressure of 65 kg/cm^2 has been taken into consideration.
Description of measurement methods and procedures to be applied:	Log book maintained on the basis of DCS data which receive data from pressure gauge.
QA/QC procedures to be applied:	QA/QC procedures have been planned. Manager in-charge would be responsible for maintenance and calibration of the monitoring equipment. The level of uncertainty level of data is low. This data would be used for calculation of AFBCB steam parameters. The calibration of industrial meters as per manufacturer specification and Calibration standard.
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:	***h_1***
Data unit:	kCal/kg
Description:	Enthalpy of the steam at WHR boiler outlet.
Source of data to be used:	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.
Value of data applied for the purpose of calculating expected	The value is dependent on the steam parameter.

emission reductions in section B.6	
Description of measurement methods and procedures to be applied:	The value of enthalpy is determined from the standard steam table.
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.
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:	kCal/kg
Description:	Enthalpy of the steam at AFBC boiler outlet.
Source of data to be used:	Enthalpy is estimated from the AFBC boiler steam parameter.Noted from standard Steam table Mollier Diagram from the avg. temperature (T_2) and pressure (P_2) of the AFBC boiler steam.
Value of data applied for the purpose of calculating expected emission reductions in section B.6	The value is dependent on the steam parameter.
Description of measurement methods and procedures to be applied:	The value of enthalpy is determined from the standard steam table.
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.
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.

B.7.2 Description of the monitoring plan:

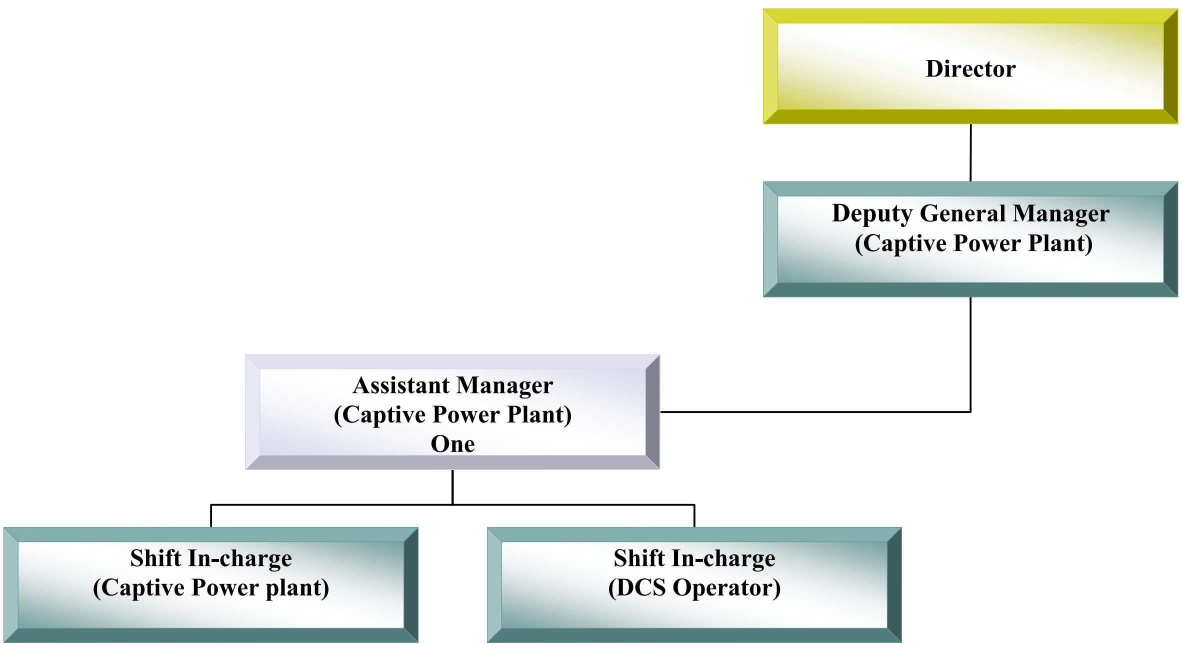
Monitoring Plan

The captive power plant consists of 8 MW of waste recovery and 4 MW of coal and char based fluidised boiler unit of 35 TPH and 18 TPH respectively with a common turbo generator. The pressure and temperature from the waste heat recovery boiler and the FBC are identical. The only variable is the quantum of steam from the two system which determines the quantum of electricity generated from either of the system. The data to be archived include the electricity generated, auxiliary consumption, steam generation, steam characteristics (temperature and pressure required to figure out the enthalpy).The frequency of the monitored data is provided in the Annex 4.

Operational and Management structure:

The Director would be responsible for managing the entire CDM related activities and ensure quality assurance on the final data and facts recorded. The Deputy General Manager – Power Plant would be responsible for supervising the monitoring and archiving of data required for estimating the emission reductions. The Assistant Manager (Captive power plant), will be responsible for generating daily, monthly and annual plant report. The Assistant Managers in turn will be supported by the respective Shift In-charges. Shift In-charge – DCS System and Shift In-charge – Captive Power Plant would continuously monitor the data logging at the ground level.

The Deputy General Manager (Captive Power Plant) will have the authority to revise the monitoring plan in line with the methodology and other futuristic requirements and would be accessing the viability of the data at regular interval. The Deputy manager in turn will report the director on monthly basis on the operational details of the project activity. . BSFAL would engage its existing resources to manage, monitor and ensure quality control on the monitoring and recording of the desired data for the project activity. The proposed team in addition to their current responsibilities would be responsible for the CDM related activities.



The monitoring plan for the CDM project activity has been developed in order to determine the baseline emissions and project emissions over the entire credit period. The gross and the net electricity generated by the is to be determined through a robust monitoring system which comprises mainly of the power meters and steam meters.

As stated above the project activity is a part of the BSFAL's Captive Power Generation System which includes a WHRB, AFBCB and a Turbo-generator.

The instrumentation and control system for the Captive Power unit is designed with adequate instruments to control and monitor the various other operating parameters for safe and efficient operation of the WHRB, AFBCB and the turbo generator unit. BSFAL has employed the state of art monitoring and control equipment that will measure, record, report, monitor and control various key parameters like total power generated in the power system, power used by BSFAL industrial facility, auxiliary consumption, steam flow rate, temperature and pressure of the steam generated for power generation from both the project activity and AFBCB system.

The instrumentation system comprises of manual metering systems, microprocessor-based instruments of reputed make with the best accuracy available. All instruments are calibrated and marked at regular intervals so that the accuracy of measurement can be ensured all the time. The calibration frequency too is a part of the monitoring system.
For detailed monitoring information, please refer Annex 4 of this document.

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 “Verve Consulting Pvt. Ltd.” whose address is

Date of completion of baseline: 23/02/07

Mr. Ashok Kumar Singha
Director, Verve Consulting Pvt Ltd
4387 / 4819 – A, Tankapani Road,
Bhubaneswar – 751018
India

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:

31/05/2005

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:

15/7/2007.

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 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 (< 75mg/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^{o}C from DRI kiln enters the boiler system and finally vented off with a reduced temperature of 150^{o}C 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.

The project activity has obtained the Environmental Clearance from the designated State Authority. The state pollution control board does not recommend for carrying out of environmental impact assessment. The industrial facility thus applied to the pollution control board and the board has offered no objection certificate for 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, as follows:

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

E.2. Summary of the comments received:

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,
City:	Rourkela
State/Region:	Orissa
Postfix/ZIP:	769012
Country:	India
Telephone:	+91-661-2508395, 2500176
FAX:	+91-661-2500176
E-Mail:	bhaskar_steel@rediffmail.com
URL:	--
Represented by:	Mr. Pankaj Agarwal
Title:	Chairman
Salutation:	Mr.
Last Name:	Agarwal
Middle Name:	--
First Name:	Pankaj
Department:	--
Mobile:	+91-9437040323
Direct FAX:	+91-661-2500176
Direct tel:	+91-661-2508395
Personal E-Mail:	

Organization:	Verve Consulting Private Limited – CONSULTING TEAM
Street/P.O. Box:	
Building:	4387/4819 A, Tankapani Road
City:	Bhubaneswar
State/Region:	Orissa
Postfix/ZIP:	751018
Country:	India
Telephone:	+91-674-2432695
FAX:	+91-674-2430651
E-Mail:	verve@verveconsult.com
URL:	www.verveconsult.com
Represented by:	Mr. Ashok Kumar Singha
Title:	Director
Salutation:	Mr.

Last Name:	Singha
Middle Name:	Kumar
First Name:	Ashok
Department:	Climate Change Management Advisory Group
Mobile:	+91-9437067019
Direct FAX:	+91-674-2430651
Direct Tel:	+91-674-2432695
Personal E-Mail:	aksingh@verveconsult.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Till now funding from any Annex I country for the project activity is not available.

Annex 3

BASELINE INFORMATION

Please add a few lines on selection of CEA data and the basis of that, you can take the points from the User Guideline of CEA baseline data.

EMISSION FACTORS					
Weighted Average Emission Rate (tCO_2/MWh) (excl. Imports)					
	2000-01	2001-02	2002-03	2003-04	2004-05
North	0.72	0.73	0.74	0.71	0.71
East	1.09	1.06	1.11	1.10	1.08
South	0.73	0.75	0.82	0.85	0.79
West	0.90	0.92	0.90	0.90	0.92
North-East	0.39	0.38	0.37	0.36	0.30
India	0.82	0.83	0.85	0.85	0.84
Simple Operating Margin (tCO_2/MWh) (excl. Imports)					
	2000-01	2001-02	2002-03	2003-04	2004-05
North	0.98	0.98	1.00	0.99	0.97
East	1.22	1.22	1.20	1.23	1.20
South	1.02	1.00	1.00	1.01	1.00
West	0.98	1.01	0.98	0.99	1.01
North-East	0.67	0.66	0.68	0.62	0.66
India	1.02	1.02	1.02	1.03	1.03
Build Margin (tCO_2/MWh) (excl. Imports)					
	2000-01	2001-02	2002-03	2003-04	2004-05
North					0.53
East					0.90
South					0.72
West					0.78
North-East					0.10
India					0.70
Combined Margin (tCO_2/MWh) (excl. Imports)					
	2000-01	2001-02	2002-03	2003-04	2004-05
North	0.76	0.76	0.77	0.76	0.75
East	1.06	1.06	1.05	1.07	1.05
South	0.87	0.86	0.86	0.86	0.86
West	0.88	0.89	0.88	0.88	0.90
North-East	0.39	0.38	0.39	0.36	0.38
India	0.86	0.86	0.86	0.86	0.86
Weighted Average Emission Rate (tCO_2/MWh) (incl. Imports)					
	2000-01	2001-02	2002-03	2003-04	2004-05
North	0.72	0.73	0.74	0.71	0.72

East	1.09	1.03	1.09	1.08	1.05
South	0.74	0.75	0.82	0.85	0.79
West	0.90	0.92	0.90	0.90	0.92
North-East	0.39	0.38	0.37	0.36	0.46
India	0.82	0.83	0.85	0.85	0.84
Simple Operating Margin (tCO_2/MWh) (incl. Imports)					
	2000-01	2001-02	2002-03	2003-04	2004-05
North	0.98	0.98	1.00	0.99	0.98
East	1.22	1.19	1.17	1.20	1.17
South	1.03	1.00	1.00	1.01	1.00
West	0.98	1.01	0.98	0.99	1.01
North-East	0.67	0.66	0.68	0.62	0.81
India	1.01	1.02	1.01	1.02	1.02
Build Margin (tCO_2/MWh) (not adjusted for imports)					
	2000-01	2001-02	2002-03	2003-04	2004-05
North					0.53
East					0.90
South					0.72
West					0.78
North-East					0.10
India					0.70
Combined Margin in tCO_2/MWh (incl. Imports)					
	2000-01	2001-02	2002-03	2003-04	2004-05
North	0.76	0.76	0.77	0.76	0.75
East	1.06	1.05	1.04	1.05	1.04
South	0.87	0.86	0.86	0.86	0.86
West	0.88	0.89	0.88	0.88	0.89
North-East	0.39	0.38	0.39	0.36	0.45
India	0.86	0.86	0.86	0.86	0.86

Annex 4

MONITORING INFORMATION

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 gross power generated from the waste heat recovery project and the associated auxiliary power consumed is being estimated with the help of the formula below.

WHR based power generation calculation will be done by using following monitoring methodology:

Calculation of Waste Heat Power: The waste heat based power generation is calculated on the basis of Total Energy Content (steam enthalpy per unit x steam flow) of WHR based steam as a percentage of Total Energy Content of Steam fed to the steam turbine from both WHRB and AFBC boiler.

The formula to calculate waste heat power is as follows:

A. Total Energy content of Steam from WHRB in kcal (H_1)

= Enthalpy of steam at WHRB outlet (kcal/kg) x Total steam flow from WHRB (tonnes per day)

= h_1 x S_{WHRB}

The enthalpy of WHRB steam (**h_1**) is calculated based on average temperature (**T_1**) and pressure (**P_1**) of the steam for the day and steam flow (***S_{WHRB}***) from WHRB per day is measured by the steam flow meter installed at the WHRB outlet.

Similarly,

B. Total Energy content of Steam from AFBC boiler in kcal (H_2)

= Enthalpy of steam at AFBC boiler outlet (kcal/kg) x Total steam flow from FBC boiler (tonnes/day)

= h_2 x S_{AFBC}

The enthalpy of AFBC steam (**h_2**) is calculated based on average temperature (**T_2**) and pressure (**P_2**) of the steam for the day and steam flow (***S_{AFBC}***) from AFBC boiler per day is measured by the steam flow meter installed at the outlet of AFBC boiler.

C. Total Power Generated by Waste Heat Recovery Boiler (EG_{GEN}) would be calculated as

EG_{GEN} (MWh) = $EG_{GROSS\text{-}CPP}$ x (H_1) / (H_1 + H_2) …………**eq.1**

Where,

$EG_{GEN\text{-}CPP}$ = Total power generated from Captive Power Plant per day in MWh

EG_{GEN} (MWh) = Total power generated from WHRB steam

Again, Auxiliary Consumption for Waste Heat Recovery Boiler (EG_{AUX}) would be calculated in the same ratio as

EG_{AUX} (MWh) = $EG_{AUX\text{-}CPP}$ x $(H_1) / (H_1 + H_2)$ ……….**eq. 2**

Where,
$EG_{AUX\text{-}CPP}$ = Auxiliary Consumption for the CPP per day in MWh
EG_{AUX} (MWh) = Auxiliary Consumption for Waste Heat Recovery Boiler

Therefore,
Net Generation from Waste Heat Recovery Boiler i.e. project activity (EG_y) would be calculated as

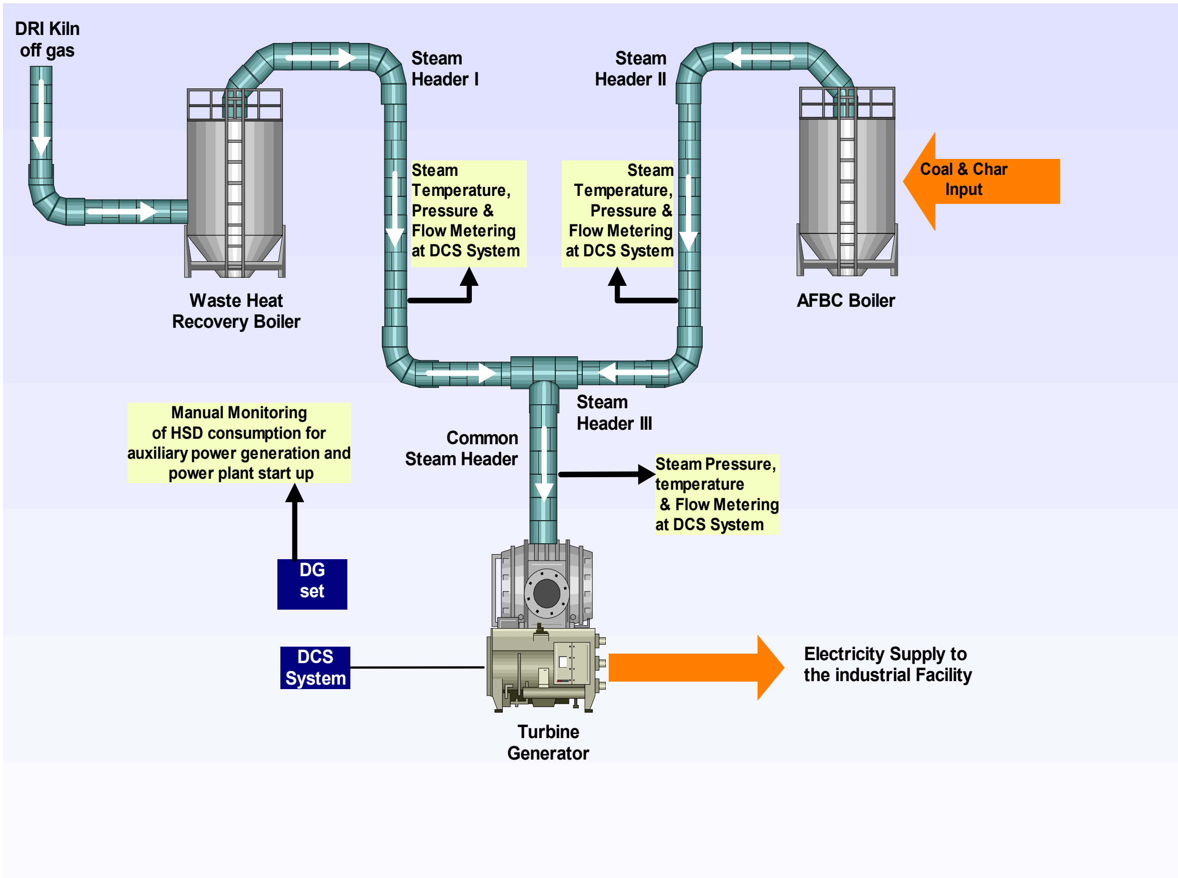
EG_y (MWh) = (EG_{GEN} - EG_{AUX}) ………….**3**

Monitoring frequency and responsibility

Data Variable	**Recording Frequency**	**Responsibility for Monitoring and quality check and assurance**
Total electricity generated by the captive power plant	Continuously	Assistant Manager captive power plant will be responsible for calibration of metre from time to time whereas shift in charge captive power plant and DCS system will be responsible for monitoring and recording of data
Auxiliary power required by the captive power plant	Continuously	Assistant Manager captive power plant will be responsible for calibration of metre from time to time whereas shift in charge captive power plant and DCS system will be responsible for monitoring and recording of data
Total electricity generated by the waste heat recovery system	Continuously	Assistant Manager captive power plant will be responsible for estimation of the quantity.
Auxiliary power required by the waste heat recovery system	Continuously	Assistant Manager captive power plant will be responsible for estimation of the quantity.
Net power generated by the waste heat recovery system	Continuously	Assistant Manager captive power plant will be responsible for estimation of the quantity.
HSD consumption	Annually	Shift in charge captive power plant will be responsible for monitoring and recording of data
Steam flow rate at outlet of waste heat recovery boiler steam header	Daily	Assistant Manager captive power plant will be responsible for calibration of metre from time to time whereas shift in charge captive power plant and DCS system will be responsible for monitoring and recording of data.
Steam flow rate at outlet of AFBC	Daily	Assistant Manager captive power

Data Variable	Recording Frequency	Responsibility for Monitoring and quality check and assurance
boiler steam header		plant will be responsible for calibration of metre from time to time whereas shift in charge captive power plant and DCS system will be responsible for monitoring and recording of data.
Temperature of steam at outlet of waste heat recovery boiler steam header	Continuously	Assistant Manager captive power plant will be responsible for calibration of metre from time to time whereas shift in charge captive power plant and DCS system will be responsible for monitoring and recording of data.
Temperature of steam at outlet of AFBC boiler steam header	Continuously	Assistant Manager captive power plant will be responsible for calibration of metre from time to time whereas shift in charge captive power plant and DCS system will be responsible for monitoring and recording of data.
Pressure of steam at outlet of waste heat recovery boiler steam header	Continuously	Assistant Manager captive power plant will be responsible for calibration of metre from time to time whereas shift in charge captive power plant and DCS system will be responsible for monitoring and recording of data.
Pressure of steam at outlet of AFBC boiler steam header	Continuously	Assistant Manager captive power plant will be responsible for calibration of metre from time to time whereas shift in charge captive power plant and DCS system will be responsible for monitoring and recording of data.
Enthalpy of steam from waste heat recovery boiler	Continuously	Assistant Manager captive power plant will be responsible for estimation of the value from the steam table .
Enthalpy of steam at from AFBC	Continuously	Assistant Manager captive power plant will be responsible for estimation of the value from the steam table.

Schematic representation of the monitoring plan:



Monitoring Team and Responsibility:

1. **Director:** Overall responsibility of compliance with the CDM monitoring plan
2. **Deputy General Manager (Captive Power Plant):** Quality assurance of the data/report generated by Assistant Manager (Captive Power Plant).
3. **Assistant Manager (Captive Power Plant):** Responsibility for completeness of data, reliability of data (calibration of meters), and monthly report generation.
4. **Shift-In-Charge (Captive Power Plant):** Responsibility of daily report generation, log preparation, data recording.
5. **Shift-In-Charge (DCS operator):** Responsibility of daily report generation, log preparation, data recording.

Annex 5

Components	Assumption[14]
Cost of grid based power	**Baseline scenario** Total units required in kWh : 74649600 Cost per unit as per WESCO : Rs. 3.00 Total cost per annum : Rs. 2239.49 Lakhs
Total cost of power from Captive Power Plant (cost of coal based + waste heat recovery + cost of diesel generator)	FBC using coal for power generation : 4 MW Waste Heat Recovery based power generation : 8 MW Diesel generator : 2 MW Average cost of power generation from 12 MW unit (excludes diesel generator) : Rs. 1.87 per kWh Total cost : Rs. 4674.00 Lakhs
Capex (project cost - capital cost of grid power facility)	Difference between the project cost and cost of grid power facility in the premise. Capex : Rs. 4062.20
Insurance Premium	At 1 % of the plant & machinery, building and other fixed assets in project cost.
Depreciation on plant and machinery Depreciation on building and civil construction	General depreciation rate applicable to plant and machinery (not being a ship) under Written Down Value method of Triple shift operation-As per Companies Act, 1956, Schedule XIV. General depreciation rate applicable to factory building under Written Down Value method of Triple shift operation) under Written Down Value method of Triple shift operation-As per Companies Act, 1956, Schedule XIV.
Diesel cost due to uncertain electricity generation	This has been considered for uninterrupted power supply for process requirement. Annual operating hours : 480 hours Generator capacity : 2 MW Specific fuel consumption : 0.34 lt/kWh Cost of HSD per litre : Rs. 34.00 Total cost of fuel per annum : Rs. 98.41 Lakhs
IRR computation period	25 years
Crediting period	Fixed : 10 years
Expected price per CER	11 USD

[14] Detailed Project Report – Bhaskar Steel & Ferro Alloys Limited