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

CONTENTS

SECTION A. General description of project activity

A.1 Title of the project activity:

Bhushan Power and Steel Limited–Waste Heat Recovery based Captive Power Project.
Version: 01
Date: 15/05/2007

A.2. Description of the project activity:

Bhushan Power and Steel Limited (BPSL) have set up an Integrated Steel Plant at Thelkoloi, Post Lapanga, Rengali Tehsil, Sambalpur District, Orissa for manufacturing Iron and Steel. The plant produces about 0.6 Million tonnes of Value Added special steels annually.

The complex consists of a Coal Washery, Sponge Iron units, Fluidized Bed and Waste Heat Recovery Boilers, Steam turbine, Induction Furnace, Electric Arc Furnace, Ladle Furnace, Vacuum Degassing unit, Mini Blast Furnace, Continuous Caster, Rolling Mill, Wire Drawing Mill, Ferro Alloys plant, etc.

The BPSL Sponge Iron unit consists of four rotary kilns of 500 tons per day (TPD) each. The generation of flue gas from the kiln is at the flow rate of 120,000 Nm3/hr at 950^0C. The rotary kiln is directly connected to the 4 waste heat recovery boilers (WHRBs) which forms the project activity with a steam generation capacity of 51 tons per hour (TPH) each. The total waste flue gas generated is ducted to the WHRBs to generate steam at 88 Kg/Cm^2 and 520^0C.

Flue gas with high heat content is generated in the Rotary kiln in the Sponge iron plant during Sponge iron conversion from iron ore. The entire gas coming out from After Burning Chamber (ABC) of the Direct Reduced Iron (DRI) plant at about 1000^0C is passed through the WHRB. The volume of the gas generated is proportionate to the production of the DRI kiln. The boiler absorbs the sensible heat of gas and cooled gas at about 150^0C is passed through Electrostatic Precipitators (ESP) and subsequently vented to the atmosphere.

BPSL has implemented the project activity ('waste heat recovery based captive power project') in two phases. BPSL first set up a 40 MW plant in Phase – I and subsequently a 60 MW plant in Phase-II. The phase I of 40 MW capacity comprises the WHRB 1 & 2 and AFBC 1. Phase II of 60 MW comprises the WHRB 3 & 4 and AFBC 2. The contribution of the WHRBs towards total power generation has been estimated at 45 MW.

The Phase-I plant has been in operation since July 2005 and the Phase-II plant has been in operation since May 2006. The DRI kiln gases have adequate heat to produce steam up to 204 TPH. The total power required for the complex is about 654,455 MWh, out which about 241,307 MWh is generated by the waste heat recovery (WHR) power plant and the balance power requirement is met by the coal, coal washery rejects, coal char based Atmospheric Fluidised Bed Combustion (AFBC) boiler. In exigency cases, power from the grid is also imported. The electricity generated by the WHR power plant displaces electricity that would otherwise be generated by the coal, coal washery rejects, coal char based captive power plant. The purpose of the project activity is to generate power through WHRB in order to meet the partial in-house requirements of BPSL. If there is surplus power available after meeting the captive requirements of the steel plant, the same would be exported to the Orissa State Grid.

■ **Project's contribution to sustainable development**

The project activity has contributed to 'Sustainable Development of India' because the project activity is generating power using waste heat gases from the process. By generating clean power, BPSL has replaced power generation from a coal, coal washery rejects, coal char based CPP. Therefore, the project activity enables reduction in CO_2 emissions and saves the conventional fuel.

The project imparts a direct positive impact by improvement of quality of life of local people by providing inflow of funds, additional employment, technological and managerial capacity building etc. The following paragraphs illustrate briefly how the project activity contributes to the four pillars (indicators) of sustainable development of India:

Social aspects

The location of the project in rural setting contributes towards poverty alleviation by generating both direct and indirect employment.

Economic aspects

The project's initial investment is to the tune of INR 2600 million in addition to which there will be continuous inflow of funds considering CDM revenues. In the absence of the project such an inflow of funds to the region was not envisaged. The project will also earn additional revenue for the local and central government.

Environmental aspects

Majority of the power generation in the country is from the fossil fuels like coal, oil and gas. However, the project activity generates the electricity from the waste flue gas and thereby reduces the GHG emissions. The project activity utilizes the enthalpy of the hot flue gas, which will protect the environment from thermal pollution.

Technological aspects

The project activity is based on the WHR technology, a clean technology for power generation from waste hot flue gas, which would otherwise be vented to the atmosphere. The project comprises of four boilers of 51 tons per hour (TPH) capacity and with the outlet steam parameters of 88 kg/cm^2 and 520º C.

A.3. Project participants:

Name of Party involved (host indicates a host Party)	Private and/or public entity (ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
India	Bhushan Power & Steel Limited (BPSL)	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.:

Orissa

A.4.1.3. City/Town/Community etc:

Thelkoloi Village, Post Lapanga, Rengali Tehsil, Sambalpur District, Orissa

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 in and around Khata No. 210/169, Plot No. 3230 of Thelkoli village, Post Lapanga,Rengali Tehsil, Sambalpur District, Orissa. It is located at a latitude of 21-45'-42" N and longitude of 84-01'-20" E. The project site is situated at 38 kms from Sambalpur town in Orissa state. Infrastructural requirements including water, motorable road, electricity etc. are available at site.

Orissa State

Sambalpur District

Plant Site

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

The project activity is generating electricity from the waste hot gas generated from the sponge iron plant. It comes under category 1: Energy Industries (renewable/non renewable sources) as per "List of Sectoral Scopes", Version 04. The methodology used for this project activity is "Approved Consolidated Baseline Methodology ACM0004":
Version: 02
Date : 03 March 2006

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

BPSL integrated complex consists of a captive power plant with two AFBC and four WHRB units. The WHRB are single drum water tube boilers of 51 TPH capacity each operating at 88 ata pressure and at a temperature of 520^{0}C. The Power generated from the generator at 11 kV will be connected to the Sponge Iron plant after the auxiliary power consumption of WHR power plant. The technology to be used for this project activity is based on Rankine cycle.

The BPSL Sponge Iron unit consists of four rotary kilns of 500 TPD each. The generation of flue gas from the kiln is at the flow rate of 120,000 Nm3/hr at 950^{0}C. The rotary kiln is directly connected to the 4 WHRB, with steam generation capacity of 51 TPH each. The total waste flue gas generated is ducted to the WHRB to generate steam at 88 Kg/Cm^2 and 520^{0}C.

The generated steam is then fed introduced in to the Single flow with downward exhaust condensing Turbo Generator for power generation. After transferring the heat, the waste flue gas is passed through the Electro Static Precipitator (ESP) and vented to atmosphere.

Figures 1 and 2 represent the schematic diagram of 40 MW and 60 MW power plants at BPSL.

Equipment Technical Details

Sr. No	Parameter	Details
A.	**Turbine –I**	
1.	Make	Siemens
2.	Type	Single flow with downward exhaust condensing
3.	Rating	40 MW
4.	Inlet steam pressure	84 ata
5.	Inlet steam temperature	510 $\pm$ 5 ^{0}C
6.	Turbine Speed	7059 rpm
B.	**Turbine-II**	
7.	Make	BHEL
8.	Type	Single flow with downward exhaust condensing
9.	Rating	60 MW
10.	Inlet steam pressure	84 ata
11.	Inlet steam temperature	510 $\pm$ 5 ^{0}C
12.	Turbine Speed	3000 rpm
B.	**Boiler**	
13.	Type	Waste Heat Recovery
14.	Net Steaming Capacity at MCR	51 TPH
15.	Super heater outlet pressure	88 ata
16.	Super heater outlet temperature	520$\pm$5 ^{0}C
17.	Gas temperature	950 ^{0}C

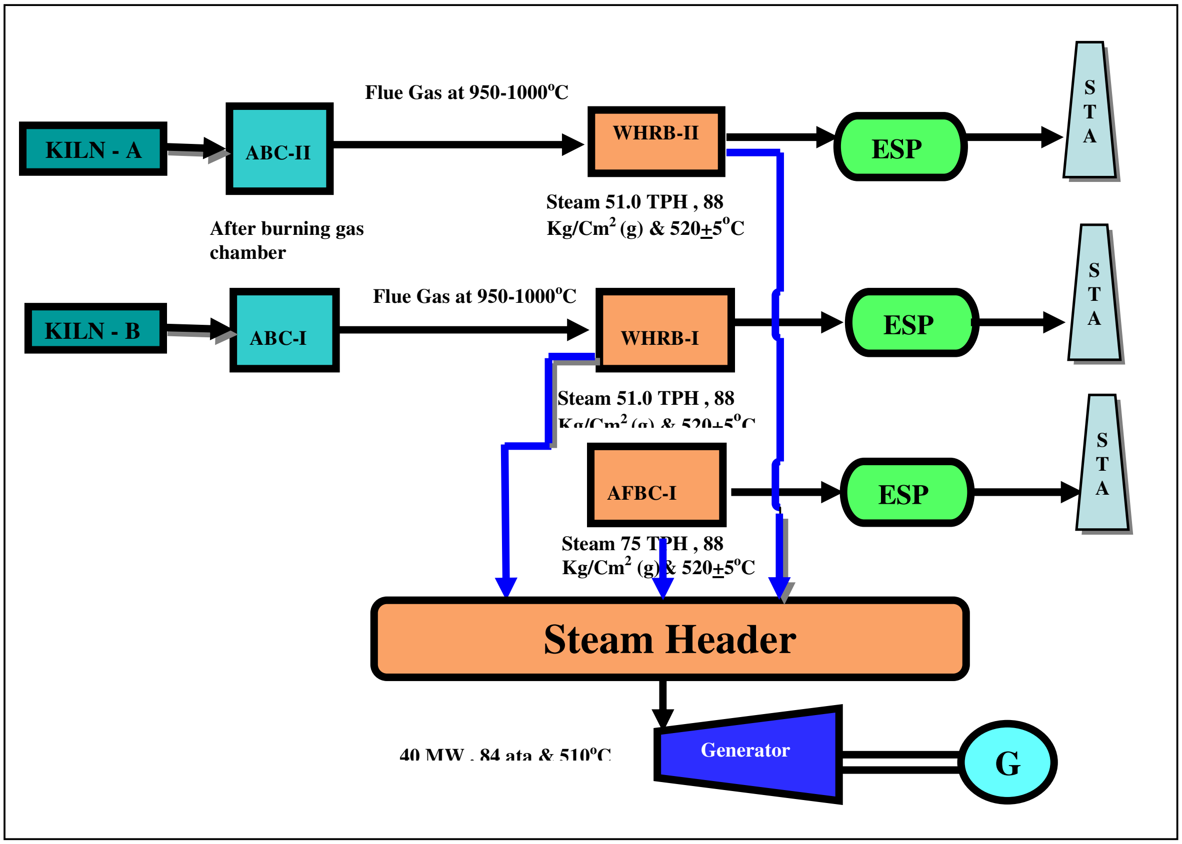

Fig 1: Schematic Diagram of 40 MW power plant at BPSL

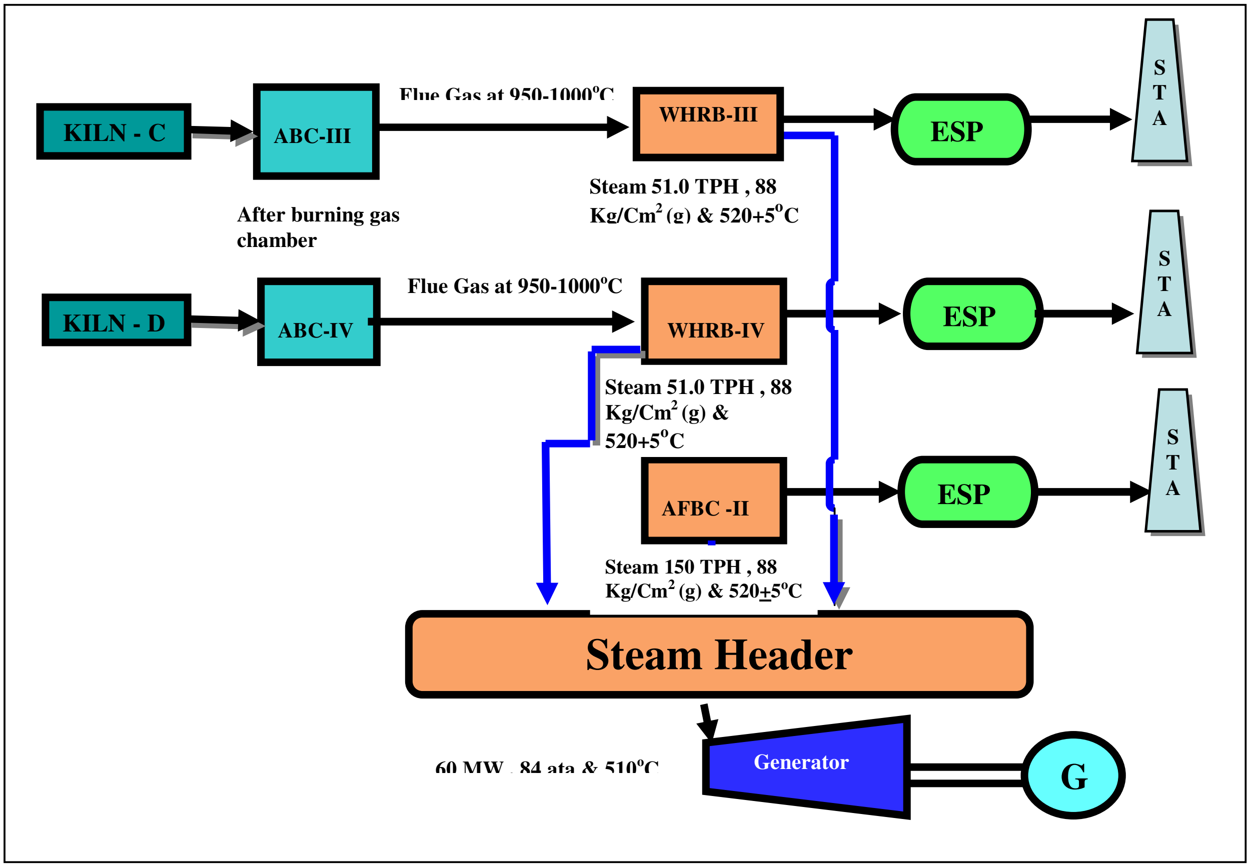

Fig 2: Schematic Diagram of 60 MW power plant at BPSL

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

The project would result in a CO_2 emission reduction of 294,827 tons during the 10 -year crediting period from 2007 - 2017 which relates to the increased electrical energy generation from the project of about 2,41,307 MWh.

Years	**Annual estimation of emission reductions in tonnes of CO_2 e**
Year 1	294,827
Year 2	294,827
Year 3	294,827
Year 4	294,827
Year 5	294,827
Year 6	294,827
Year 7	294,827
Year 8	294,827
Year 9	294,827
Year 10	294,827
Total CER's	2,948,270
Crediting Period	10 years
Annual average over the crediting period of estimated reductions ((tonnes of CO_2 e)	294,827

A.4.5. Public funding of the project activity:

The project has not received any public funding.

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

Date : 03 March 2006

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

The methodology ACM0004 is applicable to project activities that generate electricity from waste heat or the combustion of waste gas in industrial facilities.

The methodology applies to electricity generation project activities:

- That displace electricity generation with fossil fuels in the electricity grid or displace captive electricity generation from fossil fuels;
- Where no fuel switch is done in the process where the waste heat or the waste gas is produced after the implementation of the project activity

The methodology covers both new and existing facilities. For existing facilities, the methodology applies to existing capacity, as well as to planned increases in capacity during the crediting period.

The project activity utilizes the waste gas emanating from the DRI kilns to produce electricity. The generated electricity will be displacing the electricity generation by another coal, coal washery rejects, coal char based AFBC boiler which has capacity to generate additional power. In the project activity, no fuel switch is being done in the process where the waste heat is produced.

Thus the project activity satisfies all the applicability conditions as specified in the methodology ACM0004, and hence the methodology is applicable for the project activity.

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

	Source	Gas	Included	Justification/Explanation
Baseline	Grid Electricity Generation	CO_2	Yes	Main emission source
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
	Captive Electricity generation	CO_2	Yes	Main emission source
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
Project Activity	On site fossil fuel consumption due to the project activity	CO_2	No	Maybe an important emission source
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Combustion of waste gas for electricity generation	CO_2	Yes	It is assumed that this gas would have been burned in the baseline scenario.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.

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

As per the approved methodology, ACM0004, all the alternative baseline scenarios involved in the context of project activity should include all possible options that provide or produce electricity for captive consumption only. The project activity shall exclude baseline options that:

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

The alternative baseline scenarios are listed and explained below:

Alternative 1: Proposed project activity without CDM benefits
Alternative 2: Import of electricity from local grid
Alternative 3: Existing or new captive power generation on site using
a. coal,coal washery rejects, coal char
b. diesel
c. natural gas
Alternative 4: A mix of alternative 2 & 3 e.g. mix of coal ,coal washery rejects ,coal char based captive power plant (AFBC) and grid power import
Alternative 5: Other uses of waste heat and waste gas
Alternative 6: Continuation of the current situation which is the coal,coal washery rejects, coal char based captive power generation as considered in alternative 3a.

The possible **alternative baseline scenarios** are as follows:

Alternative 1: Proposed project activity without CDM benefits

BPSL have set up a waste heat recovery based electricity generation at its facility for meeting the captive power requirement of the integrated steel plant and if this is in surplus, the same would be exported to the state grid. This alternative is in compliance with all applicable legal and regulatory requirements. In order to implement this project activity BPSL had to face number of technological barriers, which makes this alternative, less attractive for the project activity with out CDM benefits. Hence this option can be eliminated for consideration as a baseline scenario.

Alternative 2: Import of electricity from Eastern regional grid

In the absence of CDM project activity, BPSL has the option of importing electricity from the Eastern regional grid, which will further lead to GHG emissions from fossil fuel based thermal power plants that form the grid. This alternative is in compliance with all applicable legal and regulatory requirements and may be a part of the baseline.

Alternative 3a: Coal, coal washery rejects, coal char based captive power generation

In the absence of the proposed CDM project activity, BPSL could generate electricity by implementing a coal, coal washery rejects, coal char based CPP to meet their demand i.e. by expanding the capacity of its existing coal,coal washery rejects,coal char based AFBC boilers.

Considering that BPSL has already implemented coal, coal washery rejects, coal char based AFBC boilers 1 & 2 catering to the captive requirements of the integrated steel plant, there is a possibility that they could expand the existing capacity, the expansion being equivalent to the capacity of the WHRB system (the project activity). Coal char and coal washery wastes (from their existing coal washery) would be used in the AFBC boilers as fuel. Therefore, power generation equivalent to that generated by the WHRB system could have been achieved by the coal/ coal char/ coal washery reject based CPP with a marginal increase in cost of AFBC boiler. This is also considering the abundant availability of fuel from their existing and nearby coal washeries resulting in lesser capital cost and cost of generation per unit.

This above alternative is in compliance with all applicable legal and regulatory requirements and may be a part of the baseline.

Alternative 3b: Diesel based captive power generation

In the absence of the proposed CDM Project activity, BPSL could generate power by implementing a diesel-based power plant to meet their power demand. This will lead to emission of GHG gases, by the diesel based captive power generation. This alternative is in compliance with all applicable legal and regulatory requirements and may be a part of the baseline.

Alternative 3c: Gas based captive power generation

BPSL could generate its own power using natural gas based captive power plant. Although this alternative is in compliance with all regulatory and legal requirements, it is not a realistic alternative due to non availability of natural gas distribution network in Orissa. Therefore, alternative 3c may be excluded from baseline scenario.

Alternative 4: Mix of options (2) and (3) – Grid power plus captive power based on coal, coal washery rejects, coal char, diesel or gas

BPSL had the option of satisfying its captive power requirements using grid power as well as generating captive power from other fuels such as coal, coal washery rejects, coal char diesel or gas. This alternative is in compliance with the existing legal and regulatory requirements.

However considering that BPSL already have a captive power plant based on coal, coal washery rejects, coal char it makes economic sense to go for the same rather than a combination of the two (grid and CPP). Therefore the options 2, 3a and 3b are most likely when compared to option 4. Therefore this option is ruled out for further consideration.

Alternative -5 Other uses of waste heat and waste gas

Since there is practically no other use of waste gases (emanating from the kiln) in the steel plant, in absence of the proposed project the waste gas thus generated would have been flared into the atmosphere leading to air pollution which would be the continuation of prevailing practice. Hence this alternative is excluded from consideration.

Evaluation of alternatives for baseline selection:

Among the five alternatives discussed above that could be a part of baseline scenario, to select the appropriate baseline scenario, the alternatives have been discussed below:

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. Thus from the above identified alternatives, it can be found that alternatives 2, 3a & 3b are the most likely alternatives for the baseline scenario.

All identified alternatives are compared on capital investment required and cost of power generation in the table below –

Parameter	Grid Based Power	Coal, based Power plant	Diesel based power plant
Capital Cost	Nil	INR 45 Million/MW	INR 40 Million/MW
Cost of Power	INR 4.00 per kWh	INR 1.56/kWh.	INR 5.96/kWh

Source: Central Electricity Authority

It may be noted that there is no initial cost for importing power from the grid as compared to the cost of setting up a coal and diesel based power plant. However, the cost of power generation per unit is relatively cheaper for a coal based CPP (about 1.56 INR/ kWH) and even cheaper for a coal, coal washery rejects, coal char based power plant as the availability of coal, coal washery rejects, coal char from the existing coal washeries of BPSL further reduces the cost of generation. Considering the various factors available, the most likely baseline scenario would be Alternative-3a, i.e. a coal, coal washery rejects, coal char based CPP to cater to their additional power requirement with a fractional capital cost and lesser cost of generation.

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, paragraph 43, a CDM project activity is additional if anthropogenic emissions of green house gases by sources are reduced below those that would have occurred in absence of registered CDM project activity. The methodology requires the project proponent to determine the additionality based on 'Tool for the demonstration and assessment of additionality – ver 03' as per EB-29 meeting.

Additionality of project activity as described is discussed hereunder.

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

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

All the plausible and credible alternatives to the project as per the requirement of ACM 0004 have been discussed in section B4.The alternatives to the project activity have been evaluated based on their economic attractiveness and hence a coal, coal washery rejects, coal char based AFBC boiler is considered as the alternative source of power in absence of the project activity.

Sub-step 1b

Consistency with mandatory applicable laws and regulations

The alternatives discussed in section B4 are all in compliance with applicable legal and regulatory requirements. Moreover, there is no foreseeable regulatory change that would make the above alternatives non- compliant.

The project proponent has opted for Step-3 i.e. barrier analysis

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

Investment Barrier

BPSL has already installed two AFBC boilers of 75 TPH & 150 TPH capacity which is generating power to the quantum of 60 MW for their captive consumption. In order to satisfy the additional power requirement of 40 MW which is now being generated by the four WHRBs, BPSL could have augmented the capacity of the existing AFBC boilers or implemented another AFBC boiler of lesser capacity which would have been possible with a marginal increase in the project cost when compared to the project cost of establishing the four WHRBs and the accompanying auxiliaries and steam piping arrangements. However BPSL went ahead with the WHRB option with an intention to reduce the GHG emission in to the atmosphere and also considering the probability of availing carbon revenue through CDM.

Comparing with similar projects, it can be noted that BPSL is the first in the region to implement a WHRB boiler with high pressure and temperature configuration of 88 ata and 520 deg C respectively which requires greater investment when compared to other WHRB configuration (<67 ata pressure) already implemented in the sector.

Technological Barriers

The operation of the DRI Kiln and the WHRB are interrelated without any isolation mechanism i.e. the kiln cannot run without the WHRB in operation and the entire gases generated from the kiln is routed through the WHRB. Any instability in the quality of raw material of the DRI kiln, would affect the flue gases generated. Usually the hot waste gases coming out of the kiln contain high level of SOx and NOx and hence the temperature needs to be maintained at a certain level (above acid dew point) so as to prevent formation of corrosive acids due to condensation of these gases. Corrosive acids may lead to acute damage in the boiler due to boiler tube failure and subsequently in the down stream equipments like ESP, ID Fan, dampers and the exhaust stack and hence in such a situation boilers would have to be shut down for maintenance and the DRI kiln also would have to be stopped. The cooling and heating cycle of the kiln takes minimum of about 5-6 days which further involves substantial expenditure. Also, off grade sponge iron generation takes place in the kiln while cooling and restarting it. Moreover such irregularities in boiler operation also hamper smooth functioning of electric furnaces. Thus all these technical difficulties lead to colossal operational barriers which need to be properly addressed to ensure smooth functioning of the unit. Whereas all these technical barriers do not appear or arise for other alternatives discussed above in section B.4.

For ensuring continuous power generation, consistent supply of gas at requisite heat value to the WHRB is required. This would require proven technology and trained manpower to operate such kind of system. As BPSL had no prior experience in this sector, they had to face many technological barriers during and after commissioning of the plant. BPSL was aware that they would have to get people trained to operate and maintain the system for ensuring consistent and reliable power generation through the waste heat recovery from the DRI kilns without adversely affecting the kiln operation and product quality. However, to sort out the problems associated with operating WHRB at a high pressure (88ata) and 520^0C temperature, BPSL had to shut down the kiln many a times leading to substantial financial losses. The other production units of the plant could also not be run due to non-availability of power. The boiler failure indeed took place due to repeated problems encountered in the screen tube circuit. However the details of various technological barriers faced by BPSL and the subsequent financial loss due to it will be provided to the DOE during the validation.

Any disruption in the operation of the pollution control equipment like ESP or any other down stream auxiliaries will lead to boiler failure and hence the operation of the DRI kiln also will be disrupted due to interconnectivity of the kiln with the boiler without any isolation scheme. Thus it demands exact functioning of all the down stream equipments so as to ensure hassle free operation in all the production facilities.

A fully condensing turbine has been installed so as to maximise the electrical output. Besides this an economiser also has been set to operation with an aim to maintain lowest possible exhaust gas temperature which will enable maximum heat recovery from the waste gases. Thus designing of the economiser demands additional technical sophistication so as to ensure gas temperature is maintained above acid dew point before the gas leaves through the exhaust stack.

The identified project is connected with the state grid. Synchronisation with the grid leads to more disturbances since the state grid is very much susceptible to problems like voltage fluctuation, regular frequency variation etc. Therefore to manage all these adversities, high voltage protection relays have been employed. These relays are again linked to the main distributed control systems (DCS) of the plant for extensive monitoring with an arrangement of rapid connection and disconnection with the grid as and when required.

Despite all the above technical barriers, BPSL has opted for WHRB considering the inflow of CDM revenues

Barriers due to prevailing practice

BPSL was the 1st company[1] in the state to initiate the work on its plant and signed an memorandum of understanding (MOU) with the Orissa Government. Though, BPSL had initiated the work of setting up the integrated complex earlier, they could not do so in time, as they faced many barriers during the implementation of the project. BPSL was amongst the first companies to set up the WHRB at high operating parameters (i.e. 88 ata). Other companies which initiated the work simultaneously with BPSL, commissioned similar plants but with lower operating parameters.

Institutional Barrier

BPSL had initially signed a power purchase agreement (PPA) to export the surplus power to Reliance Energy Trading Ltd. and were exporting power at a variable tariff (peak and off peak) and paying the wheeling charges to the Grid Corporation of Orissa Limited (GRIDCO). However, GRIDCO in its recent order has asked BPSL to export the surplus power only to GRIDCO and not to Reliance at a cheaper and a fixed tariff of INR 2.02/unit. This has in the past resulted in huge financial losses and if surplus power from the project activity is exported to the grid in the future, there would be further losses incurred by BPSL.

Besides the barriers faced by BPSL prior to the implementation of the project, this institutional barrier further strengthens the need of CDM funds.

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):

The above identified barriers do not prevent the implementation of the baseline option i.e. the coal/ coal char/ coal washery reject based captive power plant which is the most likely and economically attractive alternative to the project. This is considering the below:

(1) The capital cost of the coal based CPP is lower when compared to the project activity (WHRB based power with high pressure and temperature configuration).

(2) The AFBC technology is proven and, therefore does not face technology related barriers as compared to a WHRB system of high temperature pressure configuration (as described in the Technological barriers section in Sub-step 3a).

[1] Pioneer special MOU-Orissa (mines and Minerals)

Step 4. Common practice analysis

Based on the information about activities similar to the proposed project activity, BPSL needs to demonstrate a common practice analysis to complement and reinforce the barrier analysis. BPSL is required to identify and discuss the existing common practice through the following sub-steps:

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

A recent study conducted by Joint Plant Committee under the guidance of Ministry of Steel, Government of India pinpoints that out of 147 coal based sponge iron units surveyed the number of units with captive power generation facility is only 16, with maximum concentration in Chattisgarh. Thus it clearly indicates that captive power generation is not a common phenomenon (only 10.88% in the country) in the similar industrial units. Captive power generation includes waste heat recovery based power generation as well.

With respect to the WHR technology options, BPSL has pioneered adopting SL/RN technology of Lurgie, GmbH, West Germany in the region as they are the first of its kind to initiate the work to set up the project. The technology differs with regard to two operations viz. feeding/blowing coal and introduction of air for the process. This technology would ensure flue gas quantity and quality resulting in to stable power generation.

Thus in light of the above discussion it can be concluded that there were significant barriers and technological challenges associated with the project activity which has restricted other similar industrial units from establishing such a project (of similar technological features) where as BPSL has gone ahead with the proposed project activity considering CDM revenues into account.

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

Thus in view of the above discussion it can be concluded that the project activity is not a common practice amongst similar industrial units in the region and hence the project facility has opted for the proposed project only after taking CDM funding into consideration.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

As per the methodology-ACM0004, the project emissions are applicable only if auxiliary fuels are fired for generation start-up, in emergencies, or to provide additional heat gain before entering the WHRB.

a) Project Emissions

The project emissions are given as:

$$PE_Y = \Sigma Q_i \times NCV_i \times EF_i \times 44/12 \times OXID_i$$

Where,

PE_Y: Project emission in year y (t of CO_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 the fuel i (TJ/t or m^3)

EF_i : Carbon emission factor per unit of energy of the fuel i (tC/TJ)
$OXID_{i:}$ Oxidation factor of the fuel i (%)

b) Baseline Emissions

Baseline emissions are given as:

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

Where,

EG_y is the net quantity of electricity supplied to the manufacturing facility by the project during the year y in MWh, and

$EF_{electricity, y}$ is the baseline emission factor for the electricity displaced due to the project activity during the year y (tCO_2/MWh)

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

(Copy this table for each data and parameter)

Data / Parameter:	EF of 40 MW unit (WHRB 1&2, AFBC 1)
Data unit:	TCO_2/MWh
Description:	Captive Power Plant
Source of data used:	-
Value applied:	1.25
Justification of the choice of data or description of measurement methods and procedures actually applied :	Emission factor for coal has been taken from IPCC guideline and as a conservative approach and the boiler efficiency of the CPP has been assumed at 100% where as the average turbine efficiency has been estimated at 28.0 %.
Any comment:	This data has been calculated and the details are given in Annex - 3

Data / Parameter:	EF of 60 MW (WHRB 3 &4 and AFBC 2)
Data unit:	T CO_2/MWh
Description:	Captive Power Plant
Source of data used:	-
Value applied:	1.19
Justification of the choice of data or description of measurement methods and procedures actually applied :	Emission factor for coal has been taken from IPCC guideline and as a conservative approach the boiler efficiency of the CPP has been assumed at 100% where as the average turbine efficiency has been estimated at 29.0 %.
Any comment:	This data has been calculated and the details are given in Annex - 3

B.6.3 Ex-ante calculation of emission reductions:

a) Project Emissions

Project Emissions are applicable only if auxiliary fuels are fired for generation start-up, in emergencies, or to provide additional heat gain before entering the Waste Heat Recovery Boiler. Since no auxiliary fuel is being fired in the project activity, the project emissions will be zero.

b) Baseline Emissions

Since the baseline scenario has been determined as coal, coal washery rejects, char based captive power generation. The emission factor for displaced electricity is calculated as follows.

$$EF_{Captive,y} = EF_{CO2,i} / Eff_{captive} \times 44/12 \times 3.6 \text{ TJ}/1000 \text{ MWh}$$

where:

$EF_{captive,y}$	Emissions factor for captive power generation (tCO_2/MWh)
$EF_{CO2,i}$	CO_2 emissions factor of fuel used in captive power generation (tC/TJ)
$Eff_{captive}$	Efficiency of the captive power generation (%)
44/12	Carbon to Carbon Dioxide conversion factor
3.6/1000	TJ to MWh conversion factor

To estimate boiler efficiency, project participants may choose between the following two options:

Option A

Use the highest value among the following three values as a conservative approach:

1. Measured efficiency prior to project implementation;
2. Measured efficiency during monitoring;
3. Manufacturer nameplate data for efficiency of the existing boilers.

Option B

Assume a boiler efficiency of 100% based on the net calorific values as a conservative approach.

As a conservative approach BPSL has considered Option B.

The baseline emissions are given as

$$BE_{electricity,y} = EG_y \times EF_{captive,y}$$

$EF_{captive,y}$ the CO2 baseline emission factor for the electricity displaced due to the project activity during the year in tCO2/ MWh which has been calculated at 1.25 tCO2/MWh and 1.19 tCO2/MWh for the 40 MW and 60 MW unit respectively

EG_y i.e. the net quantity of electricity generated by utilizing the waste gases are calculated as under:
Net quantity of electricity supplied to the manufacturing facility by the project (EG_y)

Net units of electricity generated (EGy) = (Total electricity generated-Auxiliary Consumption)

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 are the emissions reductions of the project activity during the year y in tons of CO_2,

BE_y are the baseline emissions due to the displacement of electricity during the year y in tons of CO_2

PE_y are the project emissions during the year y in tons of CO_2
Therefore

$ER_y = BE_y - PE_y$

ER_y = 294,827 - 0 = 294,827 t CO_2 /yr

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

Year	Estimation of project activity emissions (tons)	Estimation of baseline emissions (tons)	Estimation of leakage (tons)	Estimation of overall emission reductions (tons)
Year 1	0	294,827	0	294,827
Year 2	0	294,827	0	294,827
Year 3	0	294,827	0	294,827
Year 4	0	294,827	0	294,827
Year 5	0	294,827	0	294,827
Year 6	0	294,827	0	294,827
Year 7	0	294,827	0	294,827
Year 8	0	294,827	0	294,827
Year 9	0	294,827	0	294,827
Year 10	0	294,827	0	294,827
Total	**0**	**2,948,270**	**0**	**2,948,270**

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

B.7.1 Data and parameters monitored:

(Copy this table for each data and parameter)

Data / Parameter:	EG_{Gen}
Data unit:	MWh/year
Description:	Total electricity generated
Source of data to be used:	Onsite Instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	654,455
Description of measurement methods and procedures to be applied:	Monitoring location: meters at plant and DCS will measure the data. Manager In-charge would be responsible for regular calibration of the meter, which would be carried out annually.
QA/QC procedures to be applied:	This can be cross-checked with the individual consumption of the different load centres. The verifier can check the calibrated equipments. The calibration of all the measuring meters will be done once a year.
Any comment:	This data will be measured

Data / Parameter:	EG_{Aux}
Data unit:	MWH/yr
Description:	Auxiliary Consumption
Source of data to be used:	On Site instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	65,445
Description of measurement methods and procedures to be applied:	Monitoring location: meters at plant. Manager In-charge would be responsible for regular calibration of the meter, which would be carried out annually.
QA/QC procedures to be applied:	This data will be recorded online continuously. Calibration of all the measuring meters will be done once a year.

Any comment:	This data will be measured

Data / Parameter:	EG_{Net}
Data unit:	MWh/yr
Description:	Net electricity generated
Source of data to be used:	Data records of BPSL
Value of data applied for the purpose of calculating expected emission reductions in section B.5	589,009
Description of measurement methods and procedures to be applied:	-
QA/QC procedures to be applied:	-
Any comment:	This parameter is calculated using the formulae $EG_{Gen} - EG_{Aux}$

Data / Parameter:	**S_{WHRB}**
Data unit:	T/day
Description:	Total steam generation from WHRB
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	3209
Description of measurement methods and procedures to be applied:	This data will be monitored daily and recorded in the logbooks. The data will be archived either electronically or in paper and will be available up to two years after crediting period. All instruments will be calibrated annually.
QA/QC procedures to be applied:	All necessary procedures will be followed. This will be used to calculate the effective waste heat generation. All instruments will be calibrated annually
Any comment:	This data will be measured

Data / Parameter:	**S_{AFBC}**
Data unit:	T/day
Description:	Total steam generation from AFBC
Source of data to be used:	Onsite instrumentation

Value of data applied for the purpose of calculating expected emission reductions in section B.5	4583
Description of measurement methods and procedures to be applied:	This data will be monitored daily and recorded in the logbooks. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
QA/QC procedures to be applied:	All necessary procedures will be followed. All instruments will be calibrated annually
Any comment:	This data will be measured

Data / Parameter:	**S_{TG}**
Data unit:	T/day
Description:	Total steam inlet to the turbine
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	7402
Description of measurement methods and procedures to be applied:	This data will be monitored daily and recorded in the logbooks. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
QA/QC procedures to be applied:	All necessary procedures will be followed. All instruments will be calibrated annually
Any comment:	This data will be measured

Data / Parameter:	**S_{loss}**
Data unit:	T/day
Description:	Total steam lost due to venting, blow down etc
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	389.59
Description of measurement methods and procedures to be applied:	This data will be calculated as the difference between total steam generated by both the boilers and the steam at turbine inlet.

QA/QC procedures to be applied:	-
Any comment:	This data will be calculated

Data / Parameter:	T_{WHRB}
Data unit:	^{0}C
Description:	Average steam temperature from WHRB
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	520
Description of measurement methods and procedures to be applied:	This data will be monitored daily from the temperature gauge and recorded in the logbooks. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
QA/QC procedures to be applied:	All necessary procedures will be followed. All instruments will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	T_{AFBC}
Data unit:	^{0}C
Description:	Average steam temperature from AFBC boiler
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	520
Description of measurement methods and procedures to be applied:	This data will be monitored daily from the temperature gauge and recorded in the logbooks. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
QA/QC procedures to be applied:	All necessary procedures will be followed. All instruments will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	T_{TG}
Data unit:	^{0}C
Description:	Average steam temperature at the inlet of Turbine
Source of data to be used:	Onsite instrumentation

Value of data applied for the purpose of calculating expected emission reductions in section B.5	510
Description of measurement methods and procedures to be applied:	This data will be monitored daily from the temperature gauge and recorded in the logbooks. The data will be archived either electronically or in paper and will be available upto two years after crediting period.
QA/QC procedures to be applied:	All necessary procedures will be followed. All instruments will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**P_{WHRB}**
Data unit:	Kg/cm^2
Description:	Average steam pressure from WHRB
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	88
Description of measurement methods and procedures to be applied:	This data will be monitored daily from the pressure gauge and recorded in the logbooks. The data will be archived either electronically or in paper and will be available upto two years after crediting period.
QA/QC procedures to be applied:	All necessary procedures will be followed. All instruments will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**P_{AFBC}**
Data unit:	Kg/cm^2
Description:	Average steam pressure from AFBC
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	88
Description of measurement methods and procedures to be applied:	This data will be monitored daily from the pressure gauge and recorded in the logbooks. The data will be archived either electronically or in paper and will be available upto two years after crediting period.
QA/QC procedures to	All necessary procedures will be followed. All instruments will be calibrated

be applied:	annually.
Any comment:	This data will be measured

Data / Parameter:	**P_{TG}**
Data unit:	Kg/cm^2
Description:	Average steam pressure inlet of Turbine
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	84
Description of measurement methods and procedures to be applied:	This data will be monitored daily from the pressure gauge and recorded in the logbooks. The data will be archived either electronically or in paper and will be available upto two years after crediting period.
QA/QC procedures to be applied:	All necessary procedures will be followed. All instruments will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**h_{WHRB}**
Data unit:	kCal/kg
Description:	Enthaply
Source of data to be used:	Steam tables
Value of data applied for the purpose of calculating expected emission reductions in section B.5	812.96
Description of measurement methods and procedures to be applied:	This data will be calculated from steam tables. The data will be archived either electronically or in paper and will be available upto two years after crediting period.
QA/QC procedures to be applied:	-
Any comment:	This data will be calculated from the steam table

Data / Parameter:	**h_{AFBC}**
Data unit:	kCal/kg
Description:	Enthaply
Source of data to be used:	Steam tables
Value of data applied	812.96

for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	This data will be calculated from steam tables. The data will be archived either electronically or in paper and will be available upto two years after crediting period.
QA/QC procedures to be applied:	-
Any comment:	This data will be calculated from the steam table

Data / Parameter:	**h_{TG}**
Data unit:	kCal/kg
Description:	Enthaply
Source of data to be used:	Steam tables
Value of data applied for the purpose of calculating expected emission reductions in section B.5	812.96
Description of measurement methods and procedures to be applied:	This data will be calculated from steam tables. The data will be archived either electronically or in paper and will be available upto two years after crediting period.
QA/QC procedures to be applied:	-
Any comment:	This data will be calculated from the steam table

B.7.2 Description of the monitoring plan:

The Vice President - (VP) is responsible for the operation and maintenance of the power plant. The VP is assisted by a Deputy General Manager (E&I) and Manager- Power Plant. Regular shift engineers monitor the operation of the plant for all the three shifts. The VP reports to the Director and the Director would be overall responsible for the operation and maintenance of the power plant.

The Deputy General Manager (E&I) is responsible for the hourly data recording at generation end. The Daily and monthly reports stating the generation and net power consumed and exported is prepared by the Engineer and verified by the DGM – E&I.

BPSL does calibration of the meters recording the power generated, consumed and exported every year and necessary records are maintained at the site. All auxiliary units at the power plant are monitored and the meters are checked and calibrated each year to ensure the quality of the data.

In order to estimate the net electricity generation from the WHRBs, the following parameters as described in Section B.7.1 need to be monitored:

- Total steam generated from both WHRBs and AFBC boiler;
- Total steam consumed by the turbine;
- Average temperature and pressure of WHR steam and AFBC steam;
- Average temperature and pressure of steam at the inlet of the turbine; and
- Enthalpy of WHR steam and AFBC steam and steam at TG inlet

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)

16/05/2007.
The contact detail of the person responsible is given in Annexure-1.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

27/02/2003

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

25 years

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

Fixed crediting period is chosen

C.2.1. Renewable crediting period

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

>>

C.2.1.2. Length of the first crediting period:

>>

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/11/2007 or subsequent to the date of registration of the project

C.2.2.2. Length:

10 years, 0 months

SECTION D. Environmental impacts

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

Assessment of Environmental Impact due to the project activity was carried out and submitted to the local pollution control board and Ministry of Environment and Forests (MoEF), Government of India (GoI). On reviewing and assessing the report, both the Orissa State Pollution Control Board (OSPCB) and MoEF have accorded clearances to set up the plant.

BPSL has installed an electrostatic precipitator (ESP) to reduce the particulate emissions to less than 150 mg/nm^3. An effluent treatment plant to treat the waste water is also in operation. The water after treatment is used for greenbelt.

BPSL monitors the Air and Water quality regularly and the reports are submitted to the local pollution control boards.

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:

Host party regulations requires BPSL to obtain environmental clearance in the form of “No objection Certificate” from OSPCB. The local pollution control boards after reviewing the project have accorded “consent to establish” and “consent to operate”.

SECTION E. Stakeholders' comments

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

BPSL published a notice in English (Times of India) and local (Dharitri) news daily, inviting views, comments, objections and suggestions from the stakeholders about the proposed project activity. Subsequent to this the public hearing meeting was conducted on 16th July, 2003 at Tahasil office, Rengali.The stakeholders identified for this project are the State government , State pollution control board , Representatives of the local panchayat etc. After a detail discussion an unanimous decision was given in favour of the proposed project.

The village Panchayat /local elected body of representatives administering the local area have provided their consent / permission to set up the project. The no objection certificate from the local panchayat for setting up this project was obtained, which will be provided to the DOE during validation.

E.2. Summary of the comments received:

As per the public hearing document, all the stakeholders have given their consent to the project subject to provision of local employment opportunities. Since the proposed project has already provided employment to the local people as per the requirement, the members who attended the meeting have appreciated the work of BPSL in setting up the plant. There were no adverse comments on the project. The details of the public hearing would be made available to the DOE.

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

As no comments were received, no action has been taken in this regard.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Bhushan Power & Steel Limited
Street/P.O.Box:	Plot No. 3,
Building:	Industrial Area, Phase-1
City:	Chandigarh
State/Region:	Chandigarh
Postfix/ZIP:	160001
Country:	India
Telephone:	+ 91 172 3911738-39
FAX:	+ 91 172 3911704
E-Mail:	neeraj@bhushanchd.com
URL:	www.bhushanpowersteel.com
Represented by:	
Title:	Vice President
Salutation:	Mr.
Last Name:	Arora
Middle Name:	-
First Name:	Neeraj
Department:	Finance
Mobile:	+ 91 9814104212
Direct FAX:	-
Direct tel:	-
Personal E-Mail:	aroraneeraj421_9@hotmail.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding for this project

Annex 3

BASELINE INFORMATION

The project activity generates electricity by using waste gases emanating out of the DRI kiln in the production facility. Thus it displaces equivalent quantum of power which otherwise would have been generated in a captive coal, coal washery rejects and coal char fired plant. The emission reduction due to the project activity will depend upon the net quantity of electricity supplied by the WHRB and the CO_2 baseline emission factor of the coal,coal washery rejects and coal char based captive power plant.

Emission Reduction Estimation from the Project Activity	
Calculation of baseline emission factor (t CO_2/MWh) – 40 MW baseline plant (WHRB 1& 2; AFBC 1)	
Carbon Emission Factor of the Coal used in the baseline plant (tC/TJ)	26.1
Efficiency of baseline plant	28 %
Emission Factor of the baseline plant (t CO_2/MWh)	1.25
Calculation of baseline emission factor (t CO_2/MWh) – 60 MW baseline plant (WHRB 3&4; AFBC 2)	
Carbon Emission Factor of the Coal used in the baseline plant (tC/TJ)	26.1
Efficiency of baseline plant	29 %
Emission Factor of the baseline plant (t CO_2/MWh)	1.19
Emission Reduction due to the project activity	
Year	Emission Reduction (t CO2)
Year 1	294,827
Year 2	294,827
Year 3	294,827
Year 4	294,827
Year 5	294,827
Year 6	294,827
Year 7	294,827
Year 8	294,827
Year 9	294,827
Year 10	294,827

Annex 4

MONITORING PLAN

A. THE METHODOLOGY REQUIRES MONITORING OF THE FOLLOWINGS

1. Net electricity generation
2. Auxiliary power consumption
3. Steam flow at the outlet of WHRB 1, 2, 3&4, AFBCB 1&2 and inlet to TGI & II
4. Steam Temperature at the outlet of WHRB 1, 2, 3&4, AFBCB 1&2 and inlet to TGI& II
5. Steam pressure at the outlet of WHRB 1, 2, 3&4, AFBCB 1& 2 and inlet to TG I&II

BPSL has installed meters to monitor all the above mentioned parameters. All the meters are annually calibrated to ensure a proper monitoring mechanism.

B. ESTIMATION OF NET POWER GENERATED FROM WHRB

Contribution to Net Electricity Generation from WHRB = (% Contribution of Enthalpy of Steam from WHRB X Net Electricity Generated)

Note :

% Contribution of Enthalpy of Steam from WHRB is ascertained by dividing the total enthalpy of the steam and the steam enthalpy at the WHRB outlet only according to the table given in section B.7.1 of this document "data and parameters monitored".

1. Steam enthalpy ($\mathbf{h_{WHRB}}$ & $\mathbf{h_{AFBC}}$) in kCal/kg is derived by using thermodynamic steam tables, based on the pressure and temperature readings.

2. Flow quantity ($\mathbf{S}_{WHRB}$ & S_{AFBC}) is determined from the recorded steam flow at DCS.

Annex 5

Abbreviations

AFBC	Atmospheric Fluidised Bed Combustion
BPSL	Bhushan Power & Steel Limited
CDM	Clean Development Mechanism
CPP	Captive Power Plant
CER	Certified Emission Reduction
CEA	Central Electricity Authority
Cm	Centimeter
DRI	Direct Reduced Iron
DOE	Designated Operational Entity
ESP	Electrostatic Precipitator
GHG	Green House Gas
GRIDCO	Grid Corporation of Orissa Limited
INR	Indian Rupees
Kg	Kilogram
KWh	Kilowatt Hour
MW	Mega Watt
MWh	Megawatt hour
MOU	Memoranding of Understaning
OSPCB	Orissa State Pollution Control Board
PLF	Plant Load Factor
PPA	Power Purchase Agreement
RPM	Revolutions per minute
TG	Turbine Generator
TPD	Tons per day
TPH	Ton Per Hour
UNFCCC	United Nations Framework Convention of Climate Change
WHRB	Waste Heat Recovery Boiler

Annex 6

LIST OF REFERENCES

Sr. No	References
1.	Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) **www.unfccc.int/cdm**
2.	Website of United Nations Framework Convention on Climate Change, **http://unfccc.int**
3.	UNFCCC decision 17/CP.7: Modalities and procedures for a clean development mechanism as defined in article 12 of the Kyoto Protocol
4.	Detailed project report on WHR power plant of Bhushan Power & Steel Limited
5.	Website of Central Electric Authority (CEA), Ministry of Power, Govt. of India- **www.cea.nic.in**
6.	CEA published document "16th Electric Power Survey of India"
7.	Website of Climate Change Cell, Ministry of Environment & Forest, Govt. of India. **www.envfor.nic.in**