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:

Bhushan Power and Steel Limited–Waste Heat Recovery based Captive Power Project.
Version: 02
Date: 05/03/2008

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. The maximum pressure for which the WHRB is designed is 101 kg/cm^2.

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. 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 Atmospheric Fluidised Bed Combustion (AFBC) 1 and WHRB 1 & 2 and the Phase II of 60 MW comprises the AFBC 2 and WHRB 3 & 4. 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. During the year 2006-07, BPSL's 100 MW captive power plant generated about 654,455 MWh of power out which about 233,016.8 MWh net power was generated by the waste heat recovery (WHR) system and the balance power was generated by the coal, coal washery rejects, coal char based AFBC system.

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 646.8 million in addition to which there will be continuous inflow of funds considering CDM revenues. 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 quenched, cleaned and released into the atmosphere and the heat content would have been wasted. The project comprises of four boilers of 51 tons per hour (TPH) capacity and with the outlet steam parameters of 88 kg/cm^2 (maximum pressure of 101 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

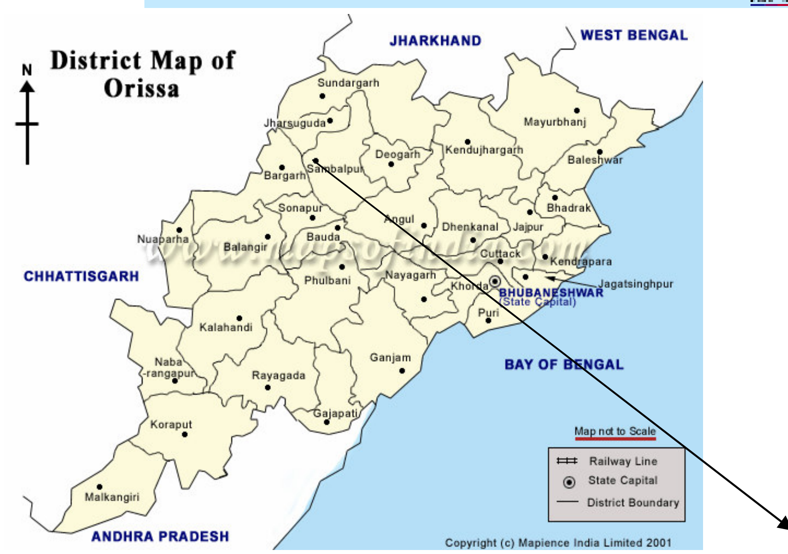
A.4.1.3. City/Town/Community etc:

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

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 Sectoral Scope 1: Energy Industries (renewable/non renewable sources) and Sectoral Scope 4: Manufacturing Industries as per "List of Sectoral Scopes", Version 11. The methodology used for this project activity is "Approved Consolidated Baseline and Monitoring Methodology ACM0012":
Version: 02
Date: 02 November 2007

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

BPSL's 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 kg/cm^2 pressure (designed for maximum pressure of 101 kg/cm^2) 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 WHRBs, 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 into 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. The equipment technical details are provided in Table A-1

Table A-1: 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

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

The project would result in a CO_2 emission reduction of **333,722** tons annually during the 10 -year crediting period (2008 – 2018) which relates to the increased electrical energy generation from the project of about **233,016.8** MWh annually. The emission reductions are provided in Table A-2.

Table A-2: Emission reductions

Years	**Annual estimation of emission reductions in tonnes of CO_2 e**
2008-09	333,722
2009-10	333,722
2010-11	333,722
2011-12	333,722
2012-13	333,722
2013-14	333,722
2014-15	333,722
2015-16	333,722
2016-17	333,722
2017-18	333,722
Total estimated reductions (tons of CO_2 e)	**3,337,220**
Total number of crediting years	**10 years**
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**333,722**

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 GHG emission reductions for waste gas or waste heat or waste pressure based energy system".

Reference: Approved consolidated baseline and monitoring methodology ACM00012.

Version : 02,

Sectoral Scope : 01 and 04

Date : 02 November 2007

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

The applicability criteria of the methodology ACM0012 (version 02, dated 2 November 2007) and how it applies to the project activity is detailed in Table B-1 below:

Table B-1: Justification of how the project meets the applicability criteria of ACM0012

Applicability condition in ACM0012	Description of how the project activity meets the applicability condition
The consolidated methodology is for project activities that utilize waste gas and/or waste heat (hence forth referred to as waste gas/heat) as an energy source for: • Cogeneration; or • Generation of electricity; or • Direct use as process heat source; or • For generation of heat in element process (e.g. steam, hot water, hot oil, hot air); The consolidated methodology is also applicable to project activities that use waste pressure to generate electricity	The project activity utilises waste gas/ heat as an energy source for generation of electricity and therefore meets this applicability criteria
If project activity is use of waste pressure to generate electricity, electricity generated using waste gas pressure should be measurable	Not relevant to the project activity as the project does not involve use of waste pressure
Energy generated in the project activity may be used within the industrial facility or exported outside the industrial facility;	The energy generated in the project activity is used in the industrial facility and if in surplus the same is exported to the grid (i.e. outside the industrial facility). Thus this applicability condition is satisfied by the project activity
The electricity generated in the project activity may be exported to the grid;	The energy generated in the project activity is used in the industrial facility and if in surplus the same may be exported to the grid. Thus this applicability condition is satisfied by the project

Applicability condition in ACM0012	Description of how the project activity meets the applicability condition
	activity
Energy in the project activity can be generated by the owner of the industrial facility producing the waste gas/heat or by a third party (e.g. ESCO) within the industrial facility.	Energy in the project activity is generated by the owner of the industrial facility (BPSL) producing the waste gas/heat. Thus this applicability condition is satisfied by the project activity
Regulations do not constrain the industrial facility generating waste gas from using the fossil fuels being used prior to the implementation of the project activity.	No regulations constrain BPSL from using fossil fuels for the purpose of generating electricity
The methodology covers both new and existing facilities. For existing facilities, the methodology applies to existing capacity. If capacity expansion is planned, the added capacity must be treated as a new facility	BPSL's project activity i.e. WHRB was implemented in a new facility and hence satisfies the applicability condition
The waste gas/pressure utilized in the project activity was flared or released into the atmosphere in the absence of the project activity at existing facility. This shall be proven by either one of the 5 methods as listed under ACM0012	It may be noted BPSL's project activity i.e. WHRB based captive power plant was implemented in July 2005 around the same time when the sponge iron facility was implemented. The facility (sponge iron kiln at BPSL) had started commercial production (July 2005) before the project was submitted for validation, however it may be noted that at BPSL there was no other use of waste gas during this period other than power generation which indicates that the waste gas/ heat would have only been released into the atmosphere in the absence of the project activity[1]. Further the following justifies the fact that the waste gas would only have been released into the atmosphere in the absence of the project activity. During early 2004 (at the time when the project activity was being implemented) it may be noted that in the State of Orissa, there were 64 number sponge iron kilns under operation of which only 6 units were identified to have waste heat recovery based captive power plants[2] and this represented only about 9.375% of the plants in the State. Rest (90.625%) of the sponge iron kilns did not use waste gas for power generation. This indicates that at the time BPSL considered the WHR project, the prevailing practice in the State of Orissa was to release the waste gas / heat into the atmosphere.

[1] Reference: The documentary evidences pertaining to this would be provided to the DOE

[2] Reference: CDM project registered at UNFCCC with Reference No: 0367

Applicability condition in ACM0012	Description of how the project activity meets the applicability condition
	The above justifies/ establishes the fact that the waste gas/ heat would have been released into the atmosphere in the absence of the project activity.
The credits are claimed by the generator of energy using waste gas/heat/pressure.	BPSL is the generator of energy using waste gas/ heat and therefore would be claiming the credits.
For those facilities and recipients, included in the project boundary, which prior to implementation of the project activity (current situation) generated energy on-site (sources of energy in the baseline), the credits can be claimed for minimum of the following time periods: o The remaining lifetime of equipments currently being used; and o Credit period.	This is not relevant to the project activity as it is implemented in a new facility
Waste gas/pressure that is released under abnormal operation (emergencies, shut down) of the plant shall not be accounted for.	BPSL will not account for these releases of waste gas under abnormal conditions
Cogeneration of energy is from combined heat and power and not combined cycle mode of electricity generation.	This is not relevant to the BPSL's project activity.

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 could have generated additional power, equivalent to that of the WHRB system in the absence of the project activity. As apparent from the above table, the project activity satisfies all the applicability conditions as specified in the methodology ACM0012 (version 02, dated 2 November 2007), and hence the methodology is applicable for the project activity.

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

As per the methodology ACM0012 – version 02, 'the geographical extent of the project boundary shall include the following:

1. *The industrial facility where the waste gas/ heat/ pressure is generated (generation of waste energy)*
2. *The facility where process heat in element process/ steam/ electricity are generated (generator of process heat/ steam/ electricity). Equipment providing auxiliary heat to the waste heat recovery process shall be included within the project boundary*
3. *The facility/s where the process heat in element process/ steam/ electricity is used (the recipient plant (s) and/ or grid where the electricity is exported, if applicable*

In the project activity the project boundary comprises the following which is in line with ACM0012 (ver2):

- *The industrial facility where the waste gas/ heat/ pressure is generated (generation of waste energy):* The industrial facility where the waste gas/ heat is generated is BPSL's sponge iron plant/ DRI kiln. The source of waste heat is the After Burning Chambers (ABCs) where the waste gas from the DRI kiln of BPSL facility is combusted. The DRI Kiln and the ABC are included in the project boundary
- *The facility where process heat in element process/ steam/ electricity are generated (generator of process heat/ steam/ electricity).Equipment providing auxiliary heat to the waste heat recovery process shall be included within the project boundary:*The project activity generates steam through WHRBs and power through the turbogenerators as defined in Section A.2 of the PDD. Hence the project boundary includes the Waste heat recovery boilers, related accessories for steam distribution, Steam Turbine Generators (STGs), captive power plant and the power evacuation system. Though there is no equipment that provides auxiliary heat to the waste heat recovery process, it may be noted that supplemental electricity may be required in case of WHRB start up and maintenance in case of exigencies. Grid power or power from coal, coal char and coal washery rejects based AFBC system may be used for this purpose and therefore included within the project boundary.
- *The facility/s where the process heat in element process/ steam/ electricity is used (the recipient plant (s) and/ or grid where the electricity is exported, if applicable:* The electricity generated by the project activity is used in the same facility that generates electricity i.e. BPSL is the generator and recipient of electricity that is generated by the project activity. However the captive power plant would export power to the Orissa state grid which is a within the Eastern regional electricity grid if the power is in surplus of the captive requirements. Therefore the project boundary includes the BPSL's facility as well as the Eastern regional grid to which the power may be exported

Fig B.1 represents the project boundary of the project activity under consideration.

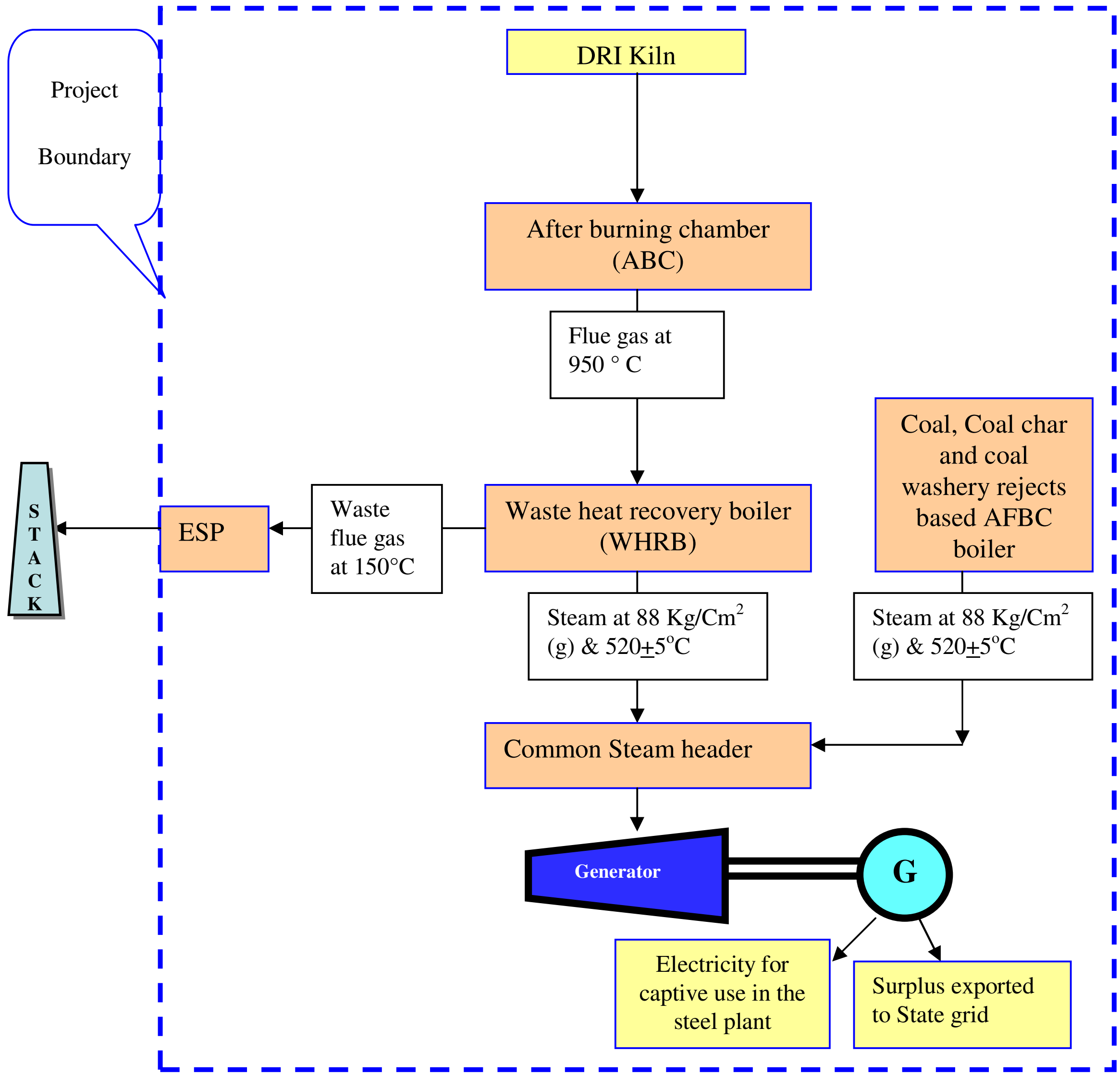


Fig B.1 Project boundary

The sources and gases included in the project boundary for the project activity are as provided in Table B-2

Table B-2: Sources and Gases included in the project boundary:

	Source	Gas	Included	Justification/Explanation
Baseline	Electricity Generation, grid or captive source	CO_2	Included	The baseline would be the coal, coal char and coal washery rejects based captive power plant which would form the main emission source. Electricity generation from grid would not be the baseline and therefore this emission source would be excluded
		CH_4	Excluded	Excluded for simplification. This is conservative
		N_2O	Excluded	Excluded for simplification. This is conservative
	Fossil fuel consumption in boiler for thermal energy	CO_2	Excluded	Excluded as this is not relevant to the project activity
		CH_4	Excluded	Not applicable
		N_2O	Excluded	Not applicable
	Fossil fuel consumption in cogeneration plant	CO_2	Excluded	Excluded as this is not relevant to the project activity.
		CH_4	Excluded	Not applicable
		N_2O	Excluded	Not applicable
	Baseline emissions from generation of steam used in the flaring process, if any	CO_2	Excluded	Excluded as this is not relevant to the project activity.
		CH_4	Excluded	Not applicable
		N_2O	Excluded	Not applicable
Project Activity	Supplemental fossil fuel consumption at the project plant	CO_2	Excluded	Excluded as there is no fossil fuel consumption for auxiliary firing in the project activity
		CH_4	Excluded	Not applicable
		N_2O	Excluded	Not applicable
	Supplemental electricity consumption	CO_2	Included	As a conservative step, though grid power may be used at BPSL for supplemental electricity requirements in case of WHRB start up/ maintenance in case of exigencies, it is assumed that power from coal, coal char and coal washery rejects based AFBC system would be used for start-up/ maintenance of WHRB and in case of exigencies and therefore included as main emission source
		CH_4	Excluded	Excluded for simplification

		N_2O	Excluded	Excluded for simplification.
Project Activity	Project emissions from cleaning of gas	CO_2	Excluded	Waste gas cleaning is not required and therefore these emissions related to energy requirement for cleaning process is not included.
		CH_4	Excluded	Not applicable
		N_2O	Excluded	Not applicable

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

As per the approved methodology, ACM0012 (ver 2), the baseline scenario is identified as the most plausible baseline scenario among all realistic and credible alternative(s). The realistic and credible alternatives are determined for:

- Waste gas/ heat/ pressure use in the absence of the project activity; and
- Power generation in the absence of the project activity; and
- Steam/ heat generation in the absence of the project activity

The above involves identification of baseline scenario / alternative that is most likely to occur in the absence of the project activity. As the project activity at BPSL involves use of waste heat in the flue gas for generating power, the alternatives considered would be only for **waste gas/ heat use** in the absence of the project activity and **power generation** in the absence of the project activity. Baseline steam / heat generation options are not relevant to the project activity and hence not discussed further.

As per ACM0012 (ver 2), the project participant shall exclude baseline options that:

- do not comply with legal and regulatory requirements; or
- depend on fuels (used for generation of heat and/ or power), that are not available at the project site

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

The baseline candidates would be considered for the following facilities:

- For the industrial facility where the waste gas/heat/pressure is generated; and
- For the facility where the energy is produced; and
- For the facility where the energy is consumed

It should be noted that in case of BPSL's project activity, the facility where waste gas is generated, energy is produced and energy is consumed are the same i.e. BPSL's sponge iron kiln produces waste gas, their own captive power plant based on WHR produces energy and their own facility consumes the energy produced. Further only if the energy generated is in surplus the same would be exported to the grid. The baseline candidates are selected based on the above consideration.

A) For Use of Waste Gas, the following alternatives are provided in ACM0012 (ver 2):

Scenario	Description
W1	Waste gas is directly vented to atmosphere without incineration
W2	Waste gas is released to the atmosphere after incineration or ***waste heat is released to the atmosphere*** (waste pressure energy is not utilized);
W3	Waste gas/heat is sold as an energy source;
W4	Waste gas/heat/pressure is used for meeting energy demand.

It needs to be noted that the project activity was implemented in a new facility (sponge iron kiln/ DRI kiln) and therefore there was no prior release of waste heat/ gas in the baseline scenario.

However in the absence of the project involving waste gas/ heat recovery, the waste gas could not have been directly vented into the atmosphere and neither does this waste gas require incineration. 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 quenched, cleaned and released into the atmosphere and the heat content would have been wasted. Therefore the option W2 i.e. 'Waste heat is released to the atmosphere' would be more relevant baseline scenario for the project activity.

In the absence of the project activity, the waste gas/heat would neither have been used for meeting energy demand at BPSL's facility i.e. in the current process of sponge iron making nor would the waste gas/heat have been sold as an energy source. Therefore the most likely alternative of use of waste gas/ heat in the baseline scenario would be 'waste heat is released into the atmosphere' as defined in W2.

B) For Power generation, the following alternatives are provided in ACM0012 (ver 2):

Scenario	Description
P1	Proposed project activity not undertaken as a CDM project activity
P2	On-site or off-site existing/new fossil fuel fired cogeneration plant;
P3	On-site or off-site existing/new renewable energy based cogeneration plant
P4	On-site or off-site existing/new fossil fuel based existing captive or identified plant
P5	On-site or off-site existing/new renewable energy based existing captive or identified plant;
P6	Sourced Grid-connected power plants
P7	Captive Electricity generation from waste gas (if project activity is captive generation with waste gas, this scenario represents captive generation with lower efficiency than the project activity)
P8	Cogeneration from waste gas (if project activity is cogeneration with waste gas, this scenario represents cogeneration with lower efficiency than the project activity).

Alternative P1: Proposed project activity not undertaken as a CDM project activity:

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 P2: On-site or off-site existing/new fossil fuel fired cogeneration plant

BPSL does not have any existing/new fossil fuel based cogeneration plant and also does not require steam in the processes involved in the sponge iron kiln. Further as the project activity is not a cogeneration plant, this baseline alternative is not a realistic alternative to the project, though it is in compliance with the legal and regulatory requirements.

Alternative P3: On-site or off-site existing/new renewable energy based cogeneration plant
BPSL does not have any existing/ new renewable energy based cogeneration plant and also does not require steam in the processes involved in the sponge iron kiln. Further as the project activity is not a cogeneration plant, this baseline alternative is not a realistic alternative to the project, though it is in compliance with the legal and regulatory requirements

Alternative P4: On-site or off-site existing/new fossil fuel based existing captive or identified plant

BPSL could implement a new fossil fuel based captive power plant in the absence of the project activity. Considering the fuel options for captive power generation, under this alternative P4, there could be 3 possible options:
Option 4a: Coal, coal washery rejects, coal char based captive power generation
Option 4b: Diesel based captive power generation
Option 4c: Gas based captive power generation

The above alternative is in compliance with legal and regulatory requirements and could be possible baseline alternative. This alternative is considered for further evaluation.

Alternative P5: On-site or off-site existing/new renewable energy based existing captive or identified plant;

There is no existing renewable energy based captive power plant at the sponge iron facility of BPSL. Renewable energy is generated from sources such as biomass, hydro, wind etc. This alternative is in compliance with the legal and regulatory requirements, and could be a possible baseline alternative. This alternative is considered for further evaluation.

Alternative P6: Sourced Grid-connected power plants

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. This alternative is considered for further evaluation.

Alternative P7: Captive Electricity generation from waste gas (if project activity is captive generation with waste gas, this scenario represents captive generation with lower efficiency than the project activity)

The project activity involves electricity generation from waste gas. This alternative scenario on the captive electricity generation from Waste Heat Recovery (WHR) project with lower efficiency than the proposed project activity could be a possible baseline alternative. This baseline alternative is considered for further evaluation.

Alternative P8: Cogeneration from waste gas (if project activity is cogeneration with waste gas, this scenario represents cogeneration with lower efficiency than the project activity):

BPSL's project activity does not involve cogeneration with waste gas and therefore this alternative is not considered as a baseline scenario.

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

The following baseline alternatives have been identified based on Step 1 which may be considered for evaluation under Step 2:

For waste gas use scenario:

- W2: Waste gas is released to the atmosphere after incineration or ***waste heat is released to the atmosphere*** (waste pressure energy is not utilized);

For power generation scenario:

- P4: On-site or off-site existing/new fossil fuel based existing captive or identified plant
- P5: On-site or off-site existing/new renewable energy based existing captive or identified plant**;**
- P6: Sourced Grid-connected power plants
- P7: Captive Electricity generation from waste gas (if project activity is captive generation with waste gas, this scenario represents captive generation with lower efficiency than the project activity)

Under this step 2, the fuel that may have been used in the baseline as a choice of energy source is evaluated taking into account the national and sectoral policies as applicable. As per this step 2, it is required to demonstrate the following:

- Demonstrate that the identified baseline fuel is available in abundance in the host country and there is no supply constraint.
- Detailed justification shall be provided for the selected baseline fuel. As a conservative approach, the available fuel with the lowest carbon emission factor (e.g., natural gas) shall be used.
- In case of partial supply constraints (seasonal supply), the project participants shall consider the available alternative fuel that result in lowest baseline emissions during the period of partial supply.

Evaluation of P4 alternative:

In the power generation scenario, for alternative P4 there are 3 options considering the available fossil fuels in the country (India) as discussed in Step 1. These are further discussed based on fuel for baseline choice as per the requirement under Step 2:

Option 4a: Coal, coal washery rejects, coal char based captive power generation

Coal is available in abundance in the host country (India) and is one of the main fossil fuels used for power generation[3]. As per World Coal Institute, the following are some key facts on coal availability and use in the host country (India):

- Coal is the dominant commercial fuel, meeting half of commercial primary energy demand and a third of total energy needs.
- The power sector will be the main driver of India's coal consumption - currently around 69% of India's electricity is generated from coal
- Coal reserves in India are plentiful and India has 10% of the world's coal, at over 92 billion tonnes, third only to the USA and China in total reserves. At current rates of production, India has enough coal for the next 217 years
- Almost all of India's 565 mines are operated by Coal India and its subsidiaries, which account for about 86% of the country's coal production. Current policy allows private mines only if they are 'captive' operations, i.e. they feed a power plant or factory. Most of the coal production in India comes from opencast mining, contributing over 83% of the total production

Use of coal for power generation is in compliance with the legal and regulatory requirements. As apparent from Section A.2, BPSL has implemented coal, coal washery rejects and coal char based AFBC at their facility to also cater to the captive power requirements along with WHRB (the project activity). For BPSL, the coal washery reject is sourced from the coal washeries and BPSL also has sanction for captive coal mines from Ministry of Coal, Government of India[4]. This justifies the abundant availability of this fossil fuel i.e. coal as well as coal washery rejects for power generation at BPSL facility itself.

It needs to be noted that as described in Section A.2, BPSL has implemented both the WHRB and AFBC (based on coal, coal washery rejects and coal char) systems in their facility and therefore in the absence of the proposed CDM project activity, BPSL could generate electricity by expanding the capacity of its existing coal, coal washery rejects, coal char based AFBC boilers equivalent to the capacity of the four waste heat recovery boilers i.e. the project activity.

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 of AFBC boilers, the expansion being equivalent to the capacity of the WHRB system (the project activity). BPSL already had planned 2 AFBC boilers having steam generation capacities of 75 TPH and 150 TPH respectively and to put up a AFBC boiler with an additional steam generation capacity of 4 X 51 TPH (i.e. 204 TPH equivalent to the WHRB system), would have required relatively lesser investment when compared to putting up a WHRB of equivalent capacity[5]. The cost of setting up a WHRB is much more than the cost of setting up an equivalent capacity AFBC system.

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[3] Reference: http://www.worldcoal.org/pages/content/index.asp?PageID=402

[4] Reference: Coal mine sanction letters pertaining to Allocation of Jamkhani Coal block and Allocation of Bijahan block by the Ministry of Coal, Government of India, provided to the DOE

[5] Reference: Documents provided to the DOE

Further, 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. Further it is to be noted that BPSL has received sanction for captive coal mines[6] which further strengthens the fact that sufficient coal is available for captive power generation and moreover it would be more economically attractive to procure coal from their captive coal mines rather than purchase coal. This justifies the fact that for BPSL, it would be most economically attractive for setting up a coal, coal char and coal washery rejects based CPP.

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

Option 4b: 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 Option 4b is in compliance with all applicable legal and regulatory requirements and may be a part of the baseline.

Option 4c: 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. The documentary evidence pertaining to non-availability of gas supply to Orissa is apparent from the following information available from the Ministry of Petroleum and Natural Gas (MoPNG), Govt of India, available at the site http://petroleum.nic.in/ng.htm.

Therefore, this Option 4c may be excluded from baseline scenario.

Evaluation of P5 alternative:
Renewable energy would be primarily from biomass, hydro or wind. Considering the non – availability of renewable energy sources at the vicinity of project site and also considering that the extent of power required by BPSL's facility is quite large to be met by these renewable energy sources, this alternative is not considered for further evaluation.

STEP 3: Step 2 and/or step 3 of the latest approved version of the "Tool for the demonstration and assessment of additionality" shall be used to identify the most plausible baseline scenarios by eliminating nonfeasible options (e.g. alternatives where barriers are prohibitive or which are clearly economically unattractive).

The step 2 and/ or step 3 of the latest approved version of additionality tool is further detailed in Section B.5 as required..

[6] Reference: Coal mine sanction letters pertaining to Allocation of Jamkhani Coal block and Allocation of Bijahan block by the Ministry of Coal, Government of India, provided to the DOE

It may be noted that Alternative P7 involving captive electricity generation from waste gas but with lower efficiency than the project activity could have been a valid baseline scenario but for the following reasons. At the time of implementation of the project activity, there were very few sponge iron plants in the state of Orissa that had WHR for captive power generation and the penetration of such systems in the state is very low[7]. Most of the sponge iron plants import power from the grid or use fossil fuels for power generation. Given this common practice scenario, the option P7 cannot be a valid/ plausible baseline scenario for the project activity and hence this is not considered for further evaluation. Hence based on prevailing practice in the region this alternative P7 is not considered for further evaluation as it could not have been the baseline alternative to the project activity.

Based on the above, the plausible alternatives that are considered for evaluation under this Step 3 are as follows:

- P4, i.e. Option 4 (a) *Coal, coal washery rejects, coal char based captive power generation* and Option 4 (b) *Diesel based captive power generation*
- P6: Sourced Grid-connected power plants

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 P4 - 4a & 4b and P6 are the most likely alternatives for the baseline scenario.

All identified alternatives P4 (4a and 4b) as well as P6 are compared on capital investment required and cost of power generation in the table below –

Parameter	Grid Based Power (Option P6)	Coal, based Power plant (Option P-4a)	Diesel based power plant (Option P-4b)
Capital Cost	Nil	INR 40 Million/MW	INR 35 Million/MW
Cost of Power	INR 4.00 per kWh	INR 1.56/kWh[8] as per CEA data INR 1.48 / kWh for BPSL's coal, coal char and coal washery rejects based CPP	INR 5.96[9]/kWh

The Central Electricity Authority (CEA) report namely 'Report of the Expert Committee on Fuels for Power generation, Executive Summary' provides the cost of generation by various fuels at 80% plant load factor (PLF) based on different distances of procurement of fuels. For coal based captive power plant, if domestic coal is procured within 200km from the project site, the cost of generation at 80% PLF would be 1.56 INR/kWh. As per the same report, the cost of generation using diesel, procured from

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[7] Reference: CDM project registered at UNFCCC with Reference No: 0367

[8] Reference: Report of the Expert Committee on fuels for Power Generation, Executive Summary – By Government of India, Central Electricity Authority, Planning Wing, dated February 2004 provided to the DOE.

[9] Reference: Report of the Expert Committee on fuels for Power Generation, Executive Summary – By Government of India, Central Electricity Authority, Planning Wing, dated February 2004

within 200km from project site would be 5.96 INR/ kWh. The cost of importing power from the grid (Orissa state electricity grid) would be 4.0 INR/kWh.

As apparent from the Table B-3, 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. The cost of power generation from diesel is the highest among the options considered. However, in comparison with the grid power cost (4 INR/kWh), 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 to 1.48 INR/kWh[10]. As apparent from the above discussions, Option P-4b (diesel based power) and Option P6 (grid power) being economically un-attractive when compared to Option 4a (coal and coal washery rejects based power), are not considered as baseline alternatives

Considering the various factors available, the most likely baseline scenario would be Alternative-4a, i.e. a coal, coal washery rejects, coal char based CPP to cater to the equivalent power as that of the WHRB system considering the economic attractiveness of a coal, coal char and coal washery rejects based CPP as detailed above.

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

As apparent from the above discussions, there is only one most likely / plausible baseline scenario Alternative-4a, i.e. a coal, coal washery rejects, coal char based CPP to cater to the equivalent power as that of the WHRB system after considering the economic attractiveness of a coal, coal char and coal washery rejects based CPP as compared to the diesel based captive power plant and grid based power (as required under Step 3 above). Therefore since there is only one credible / plausible alternative that remains at this stage of assessment, the Alternative P4 (a) is identified as the baseline scenario for the project activity.

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 project proponent, BPSL had initiated the project in February 2003 as apparent from the work order for the waste heat recovery boilers[11]. Prior to the project start, BPSL was aware of the technological hurdles/ challenges pertaining to the high technical configuration WHRB system (with high pressure and temperature parameters that were first of its kind in the region i.e. State of Orissa) and was also aware that CDM revenues are available for waste heat recovery based power projects[12]

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10 Reference: Cost of power generation from coal, coal washery rejects and coal char as worked out by BPSL

11 Reference: Work order for Waste Heat Recovery Boilers provided to the DOE

12 Reference: Documentary evidences provided to the DOE

The methodology requires the project proponent to determine the additionality based on 'Tool for the demonstration and assessment of additionality – ver 04' as per EB- 36 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 0012 (ver 2) have been discussed in section B4 above. The alternatives to the project activity have been evaluated based on Steps 1 to 4 as required by the ACM0012 (ver 2) methodology. Based on fuel choice and availability; taking into account national and/or sectoral policies; as well as by eliminating nonfeasible options (e.g. alternatives where barriers are prohibitive or which are clearly economically unattractive), it was determined that a coal, coal washery rejects, coal char based AFBC boiler would have been 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.

As per the 'Tool for demonstration and assessment of additionality' – Version 04, the project proponent has opted for Step-3 i.e. barrier analysis

Step 3: Barrier analysis

In this step it needs to be determined whether the project activity faces barriers that:

- Prevented the implementation of this type of proposed project activity
- Do not prevent the implementation of at least on of the alternatives

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

In this sub-step it is required to establish that there are realistic and credible barriers that would prevent the implementation of the proposed project activity from being carried out if the project activity was not registered as a CDM activity.

These realistic and credible barriers include the following:

Investment Barrier

BPSL have installed two AFBC boilers for generation of steam at 75 TPH and 150 TPH capacities which is generating power to the quantum of 60 MW. About 40 MW of power is being generated by the four WHRBs of 51 TPH capacity each.

As an alternative, BPSL had the option of generating power only through AFBC boilers 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.

The cost of setting up an AFBC boiler of 225 TPH capacity would be INR 511.4 Million when compared to the cost of setting up four WHRB boilers of 51 TPH capacity each which is INR 646.8 Million. The higher capital cost of WHRB when compared to AFBC is considering that four WHR boilers are required for utilisation of waste gases from four kilns individually which further increases the project cost. This is not a case for coal based power project because one large AFBC boiler could be utilised for the same.

However BPSL went ahead with the WHRB option with an intention to reduce the GHG emissions in to the atmosphere and also considering the probability of availing carbon revenue through CDM.

Technological Barriers

The following technological barriers were evidenced in the project activity:

(A) Training related

As per additionality tool definition it is required to prove that '*Skilled and/or properly trained labour to operate and maintain the technology is not available, which leads to an unacceptably high risk of equipment disrepair and malfunctioning or other underperformance*';

When BPSL decided to go ahead with the WHRB boiler for steam generation at high pressure and temperature configuration which was the first of its kind in the State of Orissa, the management had envisaged operational difficulties and risks due to its technical configuration[13]. Therefore BPSL ensured that their personnel obtain relevant training

For ensuring continuous power generation, consistent supply of gas at requisite heat value to the WHRB is required. This would require 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. BPSL has provided training to its manpower to operate the waste heat recovery boilers through their technology supplier Thermax Ltd[14].

(B) Risk of technological failure:

As per additionality tool '*the process/technology failure risk in the local circumstances is significantly greater than for other technologies that provide services or outputs comparable to those of the proposed CDM project activity, as demonstrated by relevant scientific literature or technology manufacturer information'*.

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[13] Reference: Document provided to DOE

[14] Reference: Training records pertaining to training of BPSL personnel by Thermax Ltd has been given to the DOE

The project activity i.e. the power generation from waste heat recovery systems has the following technical hurdles/ challenges when compared to other technologies such as AFBC which can provide the same output/ service:

(i) Waste gas quality from DRI kiln:

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. The operational barriers can probably be handled/ managed by providing appropriate training to personnel who would operate the WHR boilers (discussed above).

Whereas all these technical barriers do not appear or arise for the baseline alternative i.e. the AFBC boiler as it can operate smoothly through coal injection which is controlled by the operators.

(ii) Temperature control related

Steam temperature control in WHRB is one of the critical functions in the operation of waste heat recovery boiler used with sponge iron kiln.

Unlike AFBC, steam temperature of WHRB depends on the steam flow and the temperature of flue gas generated from sponge iron kiln which passes through WHRB boiler. Some times the flow of flue gas from sponge iron kiln could rise abruptly and rush through WHRB which could result in sudden rise of steam temperature in WHRB. To control steam temperature, the temperature of flue gas from sponge iron kiln must be controlled. This could be controlled by spraying water on flue gas in the After Burning Chamber (ABC) which in turn could pose many problems in WHRB's operation.

The water sprayed on flue gas could vaporize and form cakes along with dust particles of the flue gas. These cakes can get carried over and get deposited on evaporators and economizer coils of WHRB. Over a period of time these cakes could get accumulated and form heavy masses. These heavy masses could fall on the other tubes of the boiler causing severe damage to it. Some times it could fall on the wet scrapper and damage its chain link. Hence the WHRB requires extra care and precautions to minimize the above operational problems related to temperature control.

On the contrary, controlling of steam temperature in AFBC boiler is simpler as it is controlled by fuel injected to the boiler which is entirely dependent on the operator. Therefore, this barrier is more relevant to the project activity and does not affect the baseline i.e. the AFBC boiler.

(iii) Boiler operational problems

At the time when BPSL decided to go ahead with the WHRB boiler for steam generation at a relatively high pressure and temperature configuration which was the first of its kind in the State of Orissa, the management had envisaged operational difficulties and risks due to its technical configuration[15]

Considering its high pressure and temperature configuration, BPSL's project activity did face some operational problems post commissioning. To sort out the problems associated with operating WHRB at a high pressure (88ata) and high temperature (520^0C), 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 took place due to repeated problems encountered in the screen tube circuit[16].

Thermax Limited, a global solution provider in energy and environmental engineering, have designed the WHRBs in the project activity with the high pressure (88kg/cm2) and temperature (520 deg C) configuration. The operating parameters of the boilers were the first of the kind to be used with a 500 TPD kiln and hence Thermax could not identify an immediate solution to the various technological problems.

The screen tube failure during Phase 1 (WHRB 1 & 2) occurred for several months and during each time, a short term action was taken but that was not sufficient to prevent the recurrence of the problem as boiler tube leakage problems were encountered in the Phase 2 (WHRB 3&4) as well. After several deliberations between BPSL and Thermax Ltd, modifications were proposed in the WHRBs considering repeated screen tube failures. As apparent from the above discussion the problems were unique to the project activity considering its high technical configuration.

As evident from the above discussions, boiler operational problems occurred in the WHRB whereas an AFBC boiler does not face such operational problems. This has apparently also increased the operation and maintenance cost of a WHRB which is much higher than that of AFBC boiler.

(iv) Other equipments:

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.

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[15] Reference: Document provided to DOE

[16] Reference: Screen tube failure records provided to the DOE

(v) Low capacity utilisation of WHRB:

It is to be noted that despite the WHRBs having a capacity of 51 TPH each, the capacity utilisation[17] as evidenced during the year 2006-07 was only about 58.9% as compared to the AFBC boilers whose capacity utilisation was about 80.5%. This reduced capacity utilisation of WHRBs can be attributed to various problems associated with the availability of flue gases from the kilns and other related operational difficulties as detailed above. The same problems cannot be encountered with the AFBC and therefore there would be assured supply of steam from AFBC as against the WHRB system. Had an equivalent capacity AFBC boiler been installed in place of the 4 WHRB boilers, correspondingly the power generation from the captive power plant would have been much higher. Further, as surplus power from the captive power plant is sold to the state grid, the revenues from the sale of power would also have been higher.

This further justifies the fact that BPSL could have opted to implement equivalent capacity AFBC boilers in place of WHRBs considering better capacity utilisation of AFBC as compared to WHRB.

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

(C) The particular technology used in the proposed project activity is not available in the relevant region.

The project activity (waste heat recovery boilers) was first in the State of Orissa for generating steam with the high pressure and temperature configuration of 88 kg/cm^2 (101 kg/cm^2 maximum pressure) and 520 deg C respectively for recovering waste heat from 500 TPD sponge iron kiln flue gases[18].

Barriers due to prevailing practice

BPSL was the 1st company[19] in the state to initiate the work on its integrated steel plant and signed a 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. 101 kg/cm^2 maximum pressure)[20]

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

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[17] Reference: Synopsis report of 100 MW captive power plant for the year 2006-07 at BPSL provided to the DOE

[18] Reference: Letter from Directorate of Factories and Boilers, Orissa, Bhubhaneshwar that BPSL was the first in the State of Orissa to put up a high pressure and temperature configuration WHRB with maximum pressure of 101 kg/cm^2 provided to DOE

[19] Reference: Pioneer special MOU-Orissa (mines and Minerals)

[20] Reference: Letter from Directorate of Factories and Boilers, Orissa, Bhubhaneshwar that BPSL was the first in the State of Orissa to put up a high pressure and temperature configuration WHRB with maximum pressure of 101 kg/cm^2 provided to DOE

Energy Trading Ltd (RETL) during 01.08.2005 to 30.9.2006[21] 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). As per the PPA with RETL, the Open Access for transmission of power shall be as per the relevant provisions of the Central Electricity Regulatory Commission (CERC) Regulation dated 30 January 2004 regarding 'Open Access in Inter-state Transmission'. It is also to be noted that in its Order dated 27.04.2004, the Orissa Electricity Regulatory Commission (OERC) had granted permission to BPSL for sale of surplus power outside the state of Orissa.

Subsequently since August 2005 and as per PPA with RETL, BPSL had been selling power to RETL which in turn supplies power outside Orissa against committed offtake arrangements from beneficiaries. BPSL and GRIDCO had also signed a 'Short term open access commercial agreement' in July 2006 as per which the short term transactions would guided by Open Access Regulations, 2004 with its amendments issued from time to time.

BPSL later on agreed to sell power to RETL during the period Jan 07 - March 07 as per the Term Sheet for 15 MW RTC power dated 26 November 2006[22]. RETL had submitted the application for grant of open access to the concerned Regional Load Despatch Center (RLDC) however, the Orissa State Load Despatch Center (SLDC) / Orissa Power Transmission Corporation Limited (OPTCL) did not grant consent for short-term open access[23]. Subsequently BPSL replied to the Regional Power Committee[24], to grant consent for Open access for inter-state trading of surplus power which was not considered.

During December 2006, GRIDCO also through its communication to BPSL expressed its willingness to purchase power from BPSL at a provisional rate of 2.02 INR/ kWh or at a rate determined by Orissa Electricity Regulatory Commission (OERC) from 2007 onwards. Since the power export to RETL on short-term open access was not accepted by OPTCL, BPSL had to sign an agreement with GRIDCO for purchase surplus power from their CPP at the rate of 2.02 INR/ kWH.

This reduced tariff of 2.02 INR/kWH as against the higher tariffs offered by RETL, has resulted in huge financial losses and if surplus power from the project activity is exported to the GRIDCO in the future, there would be further losses incurred by BPSL. Thus BPSL had to face institutional barriers due to the above mentioned reasons, which they incurred financial losses.

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) as detailed above in the investment barrier section. An equivalent capacity AFBC boiler would have been much cheaper

[21] Reference: PPA with RETL provided to DOE

[22] Reference: Agreement with RETL provided to DOE

[23] Communication by Power Grid Corporation of India Ltd to RETL on 26 Dec 2006 provided to DOE

[24] Communication from BPSL to the Regional Power Committee on 28 December 2006 provided to DOE

than the four WHRBs.

(2) The AFBC technology is common and is a prevailing practice 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).

- Operation of AFBC boiler being common practice in the region and in the country, it does not require specialized training as compared to WHRB boilers with the high pressure and temperature configuration as that of the project activity
- The process/technology failure risk in the local circumstances is significantly greater for WHRB than for AFBC which provides similar outputs considering the following:
    a. WHRB's depend on the operation of the DRI kiln and cannot operate in isolation where as AFBC boiler operation is smoothly controlled by operators
    b. Controlling steam temperature in the WHRB is operationally more difficult when compared to that of the AFBC boiler
    c. Boiler operational problems occurred in the WHRB (as apparent in the project activity) where as AFBC boiler does not face such operational problems. The operation and maintenance cost of a WHRB is much higher than that of AFBC boiler.
    d. The capacity utilization of WHRB is significantly less when compared to that of AFBC boiler due to operational problems which reduces the power generation and therefore revenues from sale of power. AFBC of equivalent capacity would have generated more power and generated more revenues from sale of power.
    e. Technological risks / uncertainties of the WHRB in the project activity, is primarily on account of high technical configuration (high pressure and temperature) which is first of its kind in the region, where as such risks are not associated with the AFBC boilers

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 similar industrial units. Captive power generation includes waste heat recovery based power generation as well.

During the time of project implementation, 64 sponge iron units were operating in Orissa out of which 58 plants[25] import electricity from the state grid and only 6 units were identified to have the waste heat recovery based captive power plant in their facility. Amongst these six units, three plants (Tata Sponge Iron Limited (TSIL) – 7.5 MW, OCL – 8 MW, Orissa Sponge Iron Limited (OSIL) – 10 MW) have implemented the waste heat recovery projects taking into account potential benefits available under CDM and hence not included in the common practice analysis. Thus it can be interpreted that during the time of implementation the project activity was observed in only 3 other units i.e. 4.6 % of total plants in Orissa. Moreover the temperature and pressure configuration of the project activity is the highest amongst the existing waste heat recovery based captive power plants in similar industrial units in Orissa.

The letter from the Directorate of Factories and Boilers, confirms the fact that the identified project activity is the first of its kind in the State of Orissa, with regard to the high pressure and temperature configuration. Thus in light of the above discussion it can be concluded that the waste heat recovery based captive power plant is not a common practice in the region and moreover adaptation of such a high pressure and temperature configuration in the identified captive power plant has made the project even more exceptional in the region.

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

It is apparent from the above discussion that out of 64 sponge iron plants in the Orissa state (at the time of project activity implementation) only six of them have captive power plant based on waste heat recovery of which 3 of the projects have already been registered at UNFCCC as CDM projects and are availing the carbon benefits. It is evident that similar options occurring in the region are considering inflow of CDM revenues due to the risks/ challenges faced by them. Further BPSL's project is relatively unique as it is relatively a higher technical configuration when compared to other WHR projects in sponge iron plants in the region, which obviously faces greater risks and uncertainties and therefore CDM revenues are essential to mitigate these technical hurdles.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

A) Baseline Emissions

As per ACM0012 (ver 2), baseline emissions for the year y shall be determined as follows:

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

Where

BE_y are the total baseline emissions during the year y in tons of CO2

[25] Reference: CDM project registered at the UNFCCC with Reference No 0367 http://cdm.unfccc.int/UserManagement/FileStorage/1XPWFZQB692QDF7NEK8WYUPYRG3MMN

$BE_{EN,\,y}$ are baseline emissions from energy generated by the project activity during the year y in tons of CO2

$BE_{flst,\,y}$ are baseline emissions from generation of steam if any, using fossil fuel, that would have been used for flaring the waste gas in absence of the project activity (tCO2e per year), calculated as per equation 1c of ACM0012. This is relevant for those project activities where in the baseline steam is used to flare the waste gas. As BPSL's project activity was implemented in a new facility, there is no plant specific historic data available to estimate the steam required per unit of waste gas flared and therefore as per ACM0012 (ver 2), the baseline emissions from this source is ignored. Hence $BE_{flst,y}$ is not considered relevant to the project activity.

The calculation of baseline emissions ($BE_{EN,\,y}$) depends on the identified baseline scenario. For the project activity the baseline emissions are determined as per *Scenario 1 of ACM0012 (ver 2)* has been used.

Baseline emissions for Scenario 1:

Scenario 1 represents the situation where the electricity is obtained from a specific existing power plant or from the grid and heat from a fossil fuel based element process (e.g. steam boiler, hot water generator, hot air generator, hot oil generator).

$BE_{EN,y} = BE_{Elec,y} + BE_{Ther,y}$

$BE_{Elec,y}$ are baseline emissions from electricity during the year *y* in tons of CO2

$BE_{Ther,y}$ are baseline emissions from thermal energy (due to heat generation by element process) during the year *y* in tons of CO2

As the project activity involves only generation of electricity, the factor $BE_{Elec,y}$ is only considered for estimating baseline emissions. Therefore the following subsection (a) in ACM0012 (ver 2) has been used for the purpose:

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

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

Where:

$BE_{elec,y}$ are baseline emissions due to displacement of electricity during the year *y* in tons of CO2.

$EG_{i,j,y}$ is the quantity of electricity supplied to the recipient *j* by generator, which in the absence of the project activity would have been sourced from *i*th source (*i* can be either grid or identified source) during the year *y* in MWh, and

$EF_{elec,i,j,y}$ is the CO2 emission factor for the electricity source i (i=gr (grid) or i=is (identified source)), displaced due to the project activity, during the year *y* in tons CO2/MWh

f_{wg} Fraction of total electricity generated by the project activity using waste gas. As the steam used for generation of the electricity is produced in dedicated boilers but supplied through common header, this factor is estimated using equation (1d/1e) of ACM0012 (ver 2).

f_{cap} Energy that would have been produced in project year y using waste gas/heat generated in base year expressed as a fraction of total energy produced using waste gas in year y. The ratio is 1 if the waste gas/heat/pressure generated in project year y is same or less then that generated in base year.

Estimation of CO2 emission factor ($EF_{Elec,i,j,y}$) for the captive power plant at BPSL

As BPSL's baseline has been identified as the power generation from coal, coal char and coal washery rejects based captive power plant, the CO2 emission for the same would be estimated/ determined as follows as per ACM0012:

$$EF_{Elec,is,j,y} = \frac{EF_{CO2,is,j}}{\eta_{Plant,j}} x 3.6 * 10^{-3}$$

Where:

$EF_{CO2,is,j}$ is the CO2 emission factor per unit of energy of the fossil fuel *used* in the baseline generation source *i* in (tCO2 / TJ), o*btained from reliable local or national data if available, otherwise, taken from the country specific IPCC default emission factors*

$\eta_{Plant,j}$ is the overall efficiency of the existing plant that would be used by jth recipient in the absence of the project activity.

As per ACM0012, Efficiency of the power plant *($\eta_{Plant,j}$)* shall be one of the following:

- (i) Assume a constant efficiency of the captive plant and determine the efficiency, as a conservative approach, for optimal operation conditions i.e. design fuel, optimal load, optimal oxygen content in flue gases, adequate fuel conditioning (temperature, viscosity, moisture, size/mesh etc), representative or favorable ambient conditions (ambient temperature and humidity); or
- (ii) Highest of the efficiency values provided by two or more manufacturers for power plants with specifications similar to that that would have been required to supply the recipient with electricity that it receives from the project activity; or
- (iii) Assume a captive power generation efficiency of 60% based on the net calorific values as a conservative approach; or
- (iv) Estimated from load v/s efficiency curve(s) established for equipment(s) through measurement and described in Annex I of ACM0012. Follow international standards for estimation of efficiency of power plants.

For determining the efficiency of the captive power plant (based on coal, coal char and coal washery rejects) at BPSL which would have supplied power to the facility in the absence of the project, option (ii) mentioned above has been used. As per this option (ii), the efficiency of the captive power plant at BPSL has been estimated/ derived to be 23.89% considering the following values[26]:

- Boiler efficiency as per manufacturer's specifications which is 84% for the 75 TPH AFBC boiler (based on coal, coal char and coal washery rejects) which is a part of the 40 MW CPP at BPSL. The boiler efficiency is as per the 'Designs specification of the Steam generator' provided in the Operations and Maintenance (O&M) Manual of Thermax Babcock and Wilcox Ltd for BPSL"s project

[26] Reference: The documentary evidences pertaining to the values used in estimating the efficiency of the CPP would be provided to the DOE

- The net calorific value of the blend of the fuel (coal, coal char and coal washery rejects) that is an input to the AFBC boiler is considered as 2500 kCal/kg (as per Analysis report conducted by BPSL)
- Turbine heat rate is 3022.715 Kcal/kWh for the 40 MW Turbogenerator (TG) set at BPSL

It needs to be noted as explained under Section A.2 that there is a 100 MW CPP at BPSL which includes the 40 MW CPP (AFBC1 (75 TPH) and WHRB 1&2) and 60 MW CPP (AFBC2 (150 TPH) and WHRB 3&4). However the values of the boiler efficiency (84%) and the turbine heat rate (3022.715 kcal/kWh) considered above have been selected on a conservative basis.

Considering the above captive power plant efficiency of 23.89%; and considering that the emission factor of coal as per NATCOM report (Indian's Initial National Communication submitted to the UNFCCC[27]) is 26.1 tC/TJ, the CO2 emission factor of the captive power plant is derived as 1.44 tCO2/MWh[28].

Estimation of fraction of total electricity generated by using waste gas in the project activity (f_{wg}):

At BPSL, the steam used for generation of electricity is produced in dedicated boilers i.e. waste heat recovery boilers (WHRB) and coal based AFBC boilers but supplied through a common header. In the project there are 2 phases (as explained in Section A.2) as explained below:

- Phase 1: There are 2 WHRB boilers (51 TPH steam generation capacity each) and 1 AFBC boiler (75 TPH steam generation capacity) supplying steam to a 40 MW TG set through a common header
- Phase 2: There are 2 WHRB boilers (51 TPH steam generation capacity each) and 1 AFBC boiler (150 TPH steam generation capacity) supplying steam to a 60 MW TG set through a common header.

It is hence not possible to determine the electricity generated by using waste gas by means of direct measurement. The ACM0012 (ver 2) methodology provides two situations/ options to calculate the fraction of energy produced. Of the two options, Situation 2 is adopted for the project activity. Situation 2 says that '*An alternative method that could be used when it is not possible to measure the net calorific value of the waste gas/heat, and steam generated with different fuels in dedicated boilers are fed to turbine/s through common steam header takes into account that the relative share of the total generation from waste gas is calculated by considering the total steam produced and the amount of steam generated from each boiler*'

Since the measurement of the net calorific value of the waste gas on continuous basis is not possible at BPSL's facility, it has been decided to choose this *Situation 2*, based on steam generation from boilers.

Therefore this factor (f_{wg}) on fraction of electricity generated using waste gas in the project activity is determined as per equation 1e of ACM0012 (ver 2):

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[27] Reference: http://unfccc.int/resource/docs/natc/indnc1.pdf

[28] Reference: The estimation of CO2 emission factor is provided to DOE

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

Where,

$ST_{whr,y}$,	Energy content of the steam generated in waste heat recovery boiler fed to turbine via common steam header
$ST_{other\ y}$	Energy content of steam generated in other boilers fed to turbine via common steam header. In BPSL's project activity, this refers to the AFBC boiler based on coal, coal char and coal washery rejects

As per ACM0012 (ver 2), the Situation/ Method 2 as detailed above requires that:

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

Estimation of baseline cap (f_{cap}) for the project activity:

As an element of conservativeness, the ACM0012 (ver 2) methodology requires that baseline emissions should be capped irrespective of planned/ unplanned or actual increase in output of plant, change in operational parameters and practices, change in fuels type and quantity resulting into increase in waste gas generation. In case of project activity like BPSL's which is implemented in a new facility, the method 2 shall be used for determining f_{cap}. Under this method 2, following equations should be used to estimate f_{cap}.

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

$$Q_{WG,BL} = Q_{BL,product} \ x \ q_{wg,product}$$

Where;

$Q_{WG,BL}$	Quantity of waste gas generated prior to the start of the project activity
$Q_{WG,y}$	Quantity of waste gas used for energy generation during year y (Nm3)
$Q_{BL\ product}$	Production by process that most logically relates to waste gas generation in baseline.
$q_{wg,\ product}$	Amount of waste gas/heat/pressure the industrial facility generates per unit of product generated by the process that generates waste gas/heat/pressure.

As BPSL's project is implemented in a new facility, there is no historic waste gas generation prior to the start of the project activity and hence the manufacturer's data for the industrial facility shall be used to estimate the amount of waste gas/heat the industrial facility (BPSL) generates per unit of product (sponge iron) generated by the sponge iron kiln. The value arrived at would be used to estimate baseline cap.

B) Project Emissions

As per the methodology-ACM0012 (ver 2), the project emissions include emissions due to combustion of auxiliary fuels used to supplement the waste gas and electricity emission due to consumption of electricity for cleaning the gas before being used for generation of heat/ energy/ electricity.

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

PE_y Project emissions due to the project activity

$PE_{AF,y}$ Project activity emissions from onsite consumption of fóssil fuels by the cogeneration plants in case they are used as supplementary fuels, due to non availability of waste gas to the project activity or due to any other reason.

$PE_{EL,y}$ Project activity emissions from onsite consumption of electricity for gas cleaning equipment

In the project activity, no auxiliary fuel is used to supplement waste gas and hence there would be no emissions from combustion of auxiliary fuels used for supplementing the waste gas. Further the gas is not cleaned before its use in generating electricity and therefore there are no related emissions due to electricity consumption for cleaning of gas. However it needs to be noted that in case of start-up/ maintenance of WHRB, during emergencies etc, power/ electricity generated from the coal, coal char and coal washery rejects based AFBC boiler would be used. Based on the electricity consumed during this start up/ maintenance of WHRB and during emergencies, as per ACM0012 (ver 2), the project emissions from consumption of additional electricity by the project activity is determined as follows:

$PE_{EL,\, y} = EC_{PJ,y} \text{ X } EF_{CO2,EL,y}$

Where,

$PE_{EL,\, y}$ Project emissions from consumption of electricity in tCO2/ yr (considering use of fossil fuel based power for start up/ maintenance purposes i.e. power generated from coal, coal char and coal washery rejects based AFBC)

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

$EF_{CO2,EL,y}$ CO2 emission factor for electricity consumed by the project activity in year y (tCO2/ MWh)

Since electricity used by the project activity is generated on-site using coal, coal char and coal washery rejects based AFBC, the CO2 emission factor for electricity ($EF_{CO2,EL,y}$) may be determined by one of the options as per ACM0012 (ver 2):

- Use of default emission factor of 1.3 tCO2/ MWh
- Calculate the emission factor of the captive power plant at the project site, calculated based on the fuel consumption and electricity generation in year y, as follows.

For the project activity at BPSL, a default emission factor of 1.3 tCO2/MWh is used for the purpose of calculating the project emissions.

C) Leakage

No leakage is applicable under this methodology ACM0012 (ver 2).

Emission Reduction

The emission reduction ER_y by the project activity during a given year *y* is the difference between the baseline emissions (BE_y) and project emissions (PE_y), as follows:

$$ER_y = BE_y - PE_y$$

Where:

ER_y	are the total emissions reductions of the project activity during the year *y* in tons of CO_2,
$BE_{,y}$	are the baseline emissions for the project activity during the year *y* in tons of CO_2,
PE_y	are the emissions from the project activity during the year *y* in tons of CO_2,

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

(Copy this table for each data and parameter)

Data / Parameter:	η_{BL} ($\eta_{Plant,j}$)
Data unit:	%
Description:	Baseline efficiency of the captive power plant
Source of data used:	Manufacturer's data on boiler efficiency; Calorific value of fuel (coal, coal char and coal washery rejects blend) as per analysis report by BPSL; Turbine heat rate calculated based on enthalpy of steam and inlet flow rate.
Value applied:	23.89
Justification of the choice of data or description of measurement methods and procedures actually applied :	Efficiency of the captive power plant is derived as per (ii) Highest of the efficiency values provided by two or more manufacturers for captive power plants used in the project activity. It needs to be noted as explained under Section A.2 that there is a 100 MW CPP at BPSL which includes the 40 MW CPP (AFBC1 (75 TPH) and WHRB 1& 2) and 60 MW CPP (AFBC2 (150 TPH) and WHRB 3&4). However the values of the boiler efficiency (84% for AFBC1 (75 TPH)) and the turbine heat rate of 3022.715 kCal/ kWh for 40 MW TG set) considered in the efficiency computation have been selected on a conservative basis[29].
Any comment:	The following values have been considered (on a conservative basis) to estimate the efficiency as per the method indicated above: • Net calorific value of coal is 2500 kCal/kg • Boiler efficiency as per manufacturer's details is 84% • Turbine heat rate is 3022.715 Kcal/kWh

Data / Parameter:	$EF_{CO2,is,y}$
Data unit:	tCO2/TJ
Description:	CO2 emission factor per unit of energy of the fossil fuel (coal) used in the

[29] Reference: Documentary evidence would be provided to the DOE

	baseline generation source
Source of data to be used:	The source of data is National source as per India's Initial National Communication (NATCOM) report submitted to UNFCCC available on website of UNFCCC
Value applied	95.7
Justification of the choice of data or description of measurement methods and procedures actually applied :	The value applied is 26.1 tC/TJ, which is the emission coefficient of non-coking coal as per the NATCOM report submitted by India to the UNFCCC. The value 95.7 tCO2/ TJ is derived by considering the emission coefficient of 26.1 tC/TJ (after multiplying the conversion factor of 44/12 to convert from tC/ TJ to tCO2/ TJ)
Any comment:	This value is sourced from National data

Data / Parameter:	$EF_{Elec,i,j,y}$
Data unit:	tCO2/MWh
Description:	CO2 emission factor for the electricity source (coal, coal char and coal washery rejects based AFBC), displaced due to the project activity, during the year *y*
Source of data to be used:	BPSL's calculation sheets worked out as per ACM0012 (ver 2)
Value applied:	1.44
Justification of the choice of data or description of measurement methods and procedures actually applied :	The emission factor is calculated based on the equation 1a-11 of ACM0012 (ver 2) which requires values of: (a) CO2 emission factor per unit of fossil fuel used in the baseline i.e. $EF_{CO2,is,y}$. This value has been obtained from NATCOM report submitted to UNFCCC by India, which is 26.1 tC/TJ or 95.7 tCO2/TJ for coal. (b) Overall efficiency of the existing plant (η_{BL} ($\eta_{Plant,j}$)that would be used in the absence of the project activity. This has been estimated as 23.89%
Any comment:	This value is calculated based on equation 1a-11 of ACM0012 (ver 2)

Data / Parameter:	$Q_{WG,BL}$
Data unit:	Nm3
Description:	Quantity of waste gas generated prior to the start of the project activity.
Source of data used:	Source of data is manufacturer's specification
Value applied:	3,456,000,000
Justification of the choice of data or description of measurement methods and procedures actually applied :	Estimated based on information provided by the technology supplier on the waste gas/heat/ per unit of product and volume or quantity of production. The waste gas/ heat per unit of the product (sponge iron) is derived as 5760 m3/ton sponge iron and the sponge iron production per 500 TPD kiln would be 150,000 tons / year as per manufacturer's specification. Based on the above, the waste gas generated per year from each 500 TPD kiln would be 864,000,000 m3. It needs to be noted that in BPSL there are four 500 TPD kilns and therefore the total waste gas generation prior to the start of the project activity would be 864,000,000 X 4 = 3, 456,000,000 m3.
Any comment:	Method 2 as per ACM0012 (ver 2) is adopted

Data / Parameter:	$Q_{BL,\ Product}$

Data unit:	Tons/ yr
Description:	Plant or departmental. Production process which most logically relates to waste gas generation in baseline.
Source of data used:	BPSL, the project proponent
Value applied:	600,000
Justification of the choice of data or description of measurement methods and procedures actually applied :	The maximum potential sponge iron production output of each 500 TPD kiln as per the rated capacity of the kiln, obtained from the technology specification/ manufacturers specification (i.e. Outokumpu technology by Lurgi Metallurgie GmBH) is 150,000 tons a year. For four numbers 500 TPD kiln the sponge iron production would be 150,000 X 4 = 600,000 tons / year
Any comment:	-

Data / Parameter:	$q_{wg, Product}$
Data unit:	m^3/ Ton
Description:	Specific waste gas production per unit of sponge iron which most logically relates to waste gas generation generated as per manufacturer's data.
Source of data used:	Derived from Manufacturer's specifications
Value applied:	5760
Justification of the choice of data or description of measurement methods and procedures actually applied :	The waste gas/ heat generation per unit of sponge iron is calculated by BPSL from the manufacturer's specifications (i.e. Outokumpu technology by Lurgi Metallurgie GmBH) considering 120,000 m3/ hr waste gas generation for a 500 TPD sponge iron kiln.
Any comment:	Derived from manufacturer's specifications

B.6.3 Ex-ante calculation of emission reductions:

A) Baseline Emissions

The following equations as explained in B.6.1 are used for estimation of baseline emissions.
$BE_{EN,y} = BE_{Elec,y} + BE_{Ther,y}$

As $BE_{Ther,,y}$ is not relevant only $BE_{Elec,y}$ is considered for computing baseline emissions.

Computation of $BE_{Elec,y}$:

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

Since the baseline scenario has been determined as coal, coal washery rejects, coal char based captive power generation, the emission factor for displaced electricity as per ACM0012 (ver 2) is calculated as follows.

Computation of $EF_{Elec,i,j,y}$:

$$EF_{Elec,is,j,y} = \frac{EF_{CO2,is,j}}{\eta_{Plant,j}} x3.6*10^{-3}$$

For determining the efficiency of the captive power plant at BPSL, option (ii*) "Highest of the efficiency values provided by two or more manufacturers for power plants with specifications similar to that that would have been required to supply the recipient with electricity that it receives from the project activity*" has been used which is provided in Table B-4 below:

Table B-4: Determination of CO_2 Baseline Emission Factor for Electricity Displaced $EF_{Elec,i,j,y}$

Description	**Value**	**Unit**
Net calorific value of coal	2500	kCal/kg
	0.010467	TJ/tonne
Energy input to the boiler	2.91	MWh/tonne
Boiler efficiency as per manufacturers' detail (%)	84.0%	
Energy available at the boiler outlet	2.4	MWh/tonne
	2100000	kCal/tonne
Turbine heat rate	3022.715	kCal/kWh
Energy available at the turbine outlet	694.7	kWh/tonne
Efficiency of the captive power plant (η_{plant})	0.2389	
Emission Factor of the baseline plant ($EF_{Elec,i,j,y}$)	1.44	tCO2/MWh

As per this option (ii), the efficiency of the captive power plant at BPSL has been estimated to be 23.89%. Considering the above efficiency of 23.89% and emission factor of coal as per NATCOM report (India's Initial National Communication to UNFCCC) being 26.1 tC/TJ, the CO2 emission factor of the captive power plant is derived as 1.44 tCO2/MWh.

Computation of f_{cap}:

As mentioned under f_{cap} in Section B.6.2, the f_{cap} shall be determined using 'Method 2' of ACM0012 (ver 2) however, it may be noted that as required under the equation for determining f_{cap}, the data on $Q_{WG,y}$ which is the quantity of waste gas used for energy generation during year y is not available at BPSL currently. However, this parameter ($Q_{WG,y}$) is proposed to be measured during the crediting period (BPSL has already initiated the process of installing the metering device) as defined under Section B.7.1 below. Therefore for the purpose of calculating ex-ante emission reductions, f_{cap} is assumed as 1.

Computation of f_{wg} :
f_{wg} i.e. the fraction of electricity generated using waste gas in the project activity is determined as below:

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

Steps to estimate the fraction of electricity generated using waste gas:

Step 1: The quantity of steam generated from the WHRB (QS_{WHRB}) and the AFBC (QS_{AFBC}) are measured. For the purpose of ex-ante calculation of emission reductions, the actual values of steam generated from the WHRB and AFBC during 2006-07 has been used.

Step 2: The quantity of steam lost due to steam venting and blow down (QS_{loss}) is assumed as 5% of the total steam generation from the WHRB and AFBC boilers, for the ex-ante calculation of emission reductions. However during the crediting period, the steam loss due to venting and blow down from the 40 MW and 60 MW CPPs will be calculated as $QS_{loss} = (QS_{WHRB} + QS_{AFBC}) - QS_{TG.}$ The QS_{TG} which is the total steam at the inlet to the turbine would be deducted from the total steam generation from both WHRB and AFBC to compute the steam loss.

Step 3: The net quantity of steam generated from the WHRB ($QS_{WHRB\text{-}Net}$) is estimated as $QS_{WHRB\text{-}Net} = QS_{WHRB} - QS_{loss}$. It is here assumed that the entire quantity of steam loss due to venting and blowdown is from the WHRB system and the net steam generated from WHRB is computed

Step4: The enthalpy of the steam from the WHRB (H_{WHRB}) and AFBC (H_{AFBC}) are derived from the steam tables based on the steam pressure and steam temperature at the WHRB and AFBC respectively which are measured at BPSL. The enthalpies are derived and recorded at BPSL

Step 6: The enthalpy of feed water at the inlet to the WHRB (H_{feed_WHRB}) and AFBC (H_{feed_AFBC}) is determined based on the feedwater temperature at the inlet to the WHRB and AFBC respectively. The enthalpies are derived and recorded at BPSL.

Step 7: The energy content of the steam from WHRB ($ST_{whr,y}$)is estimated as $ST_{whr,y} = QS_{WHRB\text{ - }Net}$ X ($H_{WHRB} - H_{feed\_WHRB}$) and energy content of the steam from AFBC ($ST_{other,y}$)is estimated as $ST_{other,y} = QS_{AFBC}$ X ($H_{AFBC} - H_{feed\_AFBC}$). This is as per requirement of ACM0012 (ver 2) that the *'enthalpy of steam and feed water will be determined at measured temperature and pressure and the enthalpy difference will be multiplied with quantity measured by steam meter'*.

Based on the above steps 1-7, for the project activity at BPSL, f_{wg} is determined separately for Phase 1 (WHRB1&2) and Phase 2 (WHRB 3&4) and is provided in Table B-5(a) and Table B-5(b) respectively:

Table B-5(a) Estimation of fraction of electricity generated using waste gas (fwg) for WHRB 1&2 (in Phase 1)

Description	Value	Units
Total steam generation from Phase 1(WHRB1&2 and AFBC 1)	1,197,165,000	kg/annum
Total steam loss due to venting and other blow down losses (Assumed as 5% of the generation)	59,858,250	kg/annum
Total Steam Generation from WHRB - 1&2	596,902,000	kg/annum
Net steam generated from WHRB - 1&2 (Total steam generation from WHRB1&2 - Total steam loss)	537,043,750	kg/annum
Steam generated from AFBC 1	600,263,000	kg/annum
Enthalpy of steam generated from WHRB 1&2 (based on steam pressure of 88 kg/cm2 and steam temperature of 520 deg C)	813	kcal/kg
Enthalpy of steam generated from AFBC 1 (based on steam pressure of 88 kg/cm2 and steam temperature of 520 deg C)	813	kcal/kg
Enthalpy of feedwater (at 155 deg C) at inlet to WHRBs	155	kcal/kg
Enthalpy of feedwater (at 180 deg C) at inlet to AFBC1	182	Kcal/kg

Steam energy content from WHRB1 & 2 ($ST_{whr1\&2,y}$)	353,374,787,500	kcal/annum
Steam energy content from AFBC 1 ($ST_{other1,y}$)	378,586,992,602	kcal/annum
Fraction of electricity generated using waste gas from WHRB1 & 2 ($f_{wg\text{-}WHRB1\&2}$) = $ST_{whr1\&2,y}$/ ($ST_{whr1\&2,y}$ + $St_{other1,y}$)	0.483	

Table B-5(b)Estimation of fraction of electricity generated using waste gas (fwg) for WHRB 3&4 (in Phase 2)		
Description	**Value**	**Units**
Total steam generation from Phase 2 (WHRB3&4 and AFBC 2)	1,374,146,000	kg/annum
Total steam loss due to venting and other blow down losses (Assumed as 5% of the generation)	68,707,300	kg/annum
Total Steam Generation from WHRB - 3&4	461,904,000	kg/annum
Net steam generated from WHRB - 3&4 (Total steam generation from WHRB3&4 - Total steam loss)	393,196,700	kg/annum
Steam generated from AFBC 2	912,242,000	kg/annum
Enthalpy of steam generated from WHRB 3&4 (based on steam pressure of 88 kg/cm2 and steam temperature of 520 deg C)	813	kcal/kg
Enthalpy of steam generated from AFBC 2 (based on steam pressure of 88 kg/cm2 and steam temperature of 520 deg C)	813	kcal/kg
Enthalpy of feedwater (at 150 deg C) at inlet to WHRBs	155	kcal/kg
Enthalpy of feedwater (at 215 deg C) at inlet to AFBC2	220	Kcal/kg
Steam energy content from WHRB3 & 4 ($ST_{whr3\&4,y}$)	258,723,428,600	kcal/annum
Steam energy content from AFBC 2 ($ST_{other2,y}$)	541,029,242,608	kcal/annum
Fraction of electricity generated using waste gas from WHRB 3 &4 ($f_{wg\text{-}WHRB3\&4}$) = $ST_{whr3\&4,y}$/ ($ST_{whr3\&4,y}$ + $St_{other2,y}$)	0.324	

As apparent from the above Tables, ($f_{wg\text{-}WHRB1\&2}$) and ($f_{wg\text{-}WHRB3\&4}$) are 48.3% and 32.4% respectively indicating the proportion or fraction of electricity generated using waste heat in the Phase 1 and Phase 2 of the project activity respectively.

Total quantity of electricity supplied by the captive power plant ($EG_{i,j,y}$)

The total quantity of electricity supplied by the 40 MW and 60 MW CPPs are provided below in Table B-6(a) and B-6(b) respectively:

Table B-6(a) - ($EG_{i,j,y\text{-}40MW}$)- Total electricity supplied by the Phase 1 - 40 MW CPP		
Total electricity generated by the 40 MW CPP	296,272,260	kWh/annum
Auxiliary consumption (10% of total generation)	29,627,226	kWh/annum
Net electricity supplied by 40 MW CPP ($EG_{i,j,y\text{-}40MW}$)	266,645,034	kWh/annum

Table B-6(b) - ($EG_{i,j,y\text{-}60MW}$)- Total electricity supplied by the Phase 2 - 60 MW CPP		
Total electricity generated by the 60 MW CPP	358,183,485	kWh/annum
Auxiliary consumption (10% of total generation)	35,818,349	kWh/annum
Net electricity supplied by 60 MW CPP ($EG_{i,j,y\text{-}60MW}$)	322,365,137	kWh/annum

The total electricity generated by the 40 MW and 60 MW CPP are based on data at BPSL pertaining to 2006-07.

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

Baseline emissions in the absence of the project activity (WHRB 1,2, 3 and 4) is estimated as below in Tables B-7(a) and B-7(b) respectively:

Table B-7(a)-Total baseline emissions from electricity displaced due to WHRB1 & 2 in the project activity		
Baseline emissions from electricity that is displaced by the project activity ($BE_{Elec,y\text{-}40\ MW}$) = f_{cap} X $f_{wg\text{-}WHRB1\&2}$ * $EG_{i,j,y\text{-}40MW}$ X $EF_{Elec,i,j,y}$	185,606.3	tCO2/annum

Table B-7(b) - Total baseline emissions from electricity displaced due to WHRB 3&4 in the project activity		
Baseline emissions from electricity that is displaced by the project activity ($BE_{Elec,y\text{-}60MW}$) = f_{cap} X $f_{wg\text{-}WHRB3\&4}$ * $EG_{i,j,y\text{-}60MW}$ X $EF_{Elec,i,j,y}$	150,362.7	tCO2/annum

$BE_{Elec,y}$ = $BE_{Elec,y\text{-}40\ MW}$ + $BE_{Elec,y\text{-}60MW}$
= 185,606.3 + 150,362.7
= 335,969 tCO2/ annum

$BE_{EN,y}$ = $BE_{Elec,y}$ + $BE_{Ther,y}$
= $BE_{Elec,y}$
= 335,969 tCO2/annum

B) Project Emissions

Project Emissions are applicable to the project activity as power from AFBC boiler may be used for generation start-up/ maintenance of the WHRB, in emergencies etc.

For the project activity (consisting of 4 WHRBs) about 1,728 MWh of power would be required annually for start–up which would be met by the coal based AFBC boiler or the diesel generator sets. This figure of 1,728 MWh is arrived at by considering that for each WHRB about 2 MW of power would be required during startup, the duration of each startup is on an average about 72 hrs and there are about 3 startups per year. For the project activity at BPSL, a default emission factor of 1.3 tCO2/MWh is used for the purpose of calculating the project emissions as per ACM0012 (ver 2). The project emission determination is provided in Table B-8 below:

Table B-8 Determination of Project Emissions (startup power, maintenance of WHRB, exigencies)		
Description	**Value**	**Unit**
Source of power for startup/ maintenance purpose	Coal, coal char and coal washery rejects based AFBC	

Power required by each WHRB & its auxiliaries for start up purpose	2	MW
Average duration of each start up	72	Hrs
Number of startups in a year	3	Nos
Number of WHRBs in the project activity	4	Nos
Power required for startup due to the project activity	1,728	MWh/ annum
Emission factor for the CPP (assumed as per ACM0012-ver 2)	1.30	tons CO2/MWh
Project emissions (PEy)	**2,246.4**	**tons CO2/annum**

(C) Emission reductions:

The emission reduction ERy by the project activity during a given year y is the difference between the baseline emissions (BEy) and project emissions (PEy), as follows:

ERy = BEy - PEy

Therefore

ERy = BEy - PEy

ERy = 335,969.0 – 2246.40 = 333,722 tCO_2/yr

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

Year	**Estimation of project activity emissions (tons of CO2e)**	**Estimation of baseline emissions (tons of CO2e)**	**Estimation of leakage (tons of CO2e)**	**Estimation of overall emission reductions (tons of CO2e)**
2008-09	2,246.4	335,969.0	0	333,722
2009-10	2,246.4	335,969.0	0	333,722
2010-11	2,246.4	335,969.0	0	333,722
2011-12	2,246.4	335,969.0	0	333,722
2012-13	2,246.4	335,969.0	0	333,722
2013-14	2,246.4	335,969.0	0	333,722
2014-15	2,246.4	335,969.0	0	333,722
2015-16	2,246.4	335,969.0	0	333,722
2016-17	2,246.4	335,969.0	0	333,722
2017-18	2,246.4	335,969.0	0	333,722
Total (tons of CO2e)	**22,464**	**3,359,690**	**0**	**3,337,220**

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:	**$Q_{WG,y}$**
Data unit:	Nm^3
Description:	Quantity of waste gas used for energy generation during year y
Source of data to be used:	Generators of gas i.e. BPSL
Value of data applied for the purpose of calculating expected emission reductions in section B.5	3,456,000,000
Description of measurement methods and procedures to be applied:	An online flow meter would be installed at each of the WHRB ducts for continuous measurement of waste gas quantities from all the four WHRBs.
QA/QC procedures to be applied:	Measuring equipment would be calibrated once in a year.
Any comment:	Data will be measured during the crediting period. BPSL has initiated the process of installing the online flow meter to measure the waste gas generation and the same would be available during the crediting period.

Data / Parameter:	**EG_{40_Gen}**
Data unit:	MWh/year
Description:	Total electricity generated from the 40 MW captive power plant at BPSL (from both AFBC1 and WHRB1&2)
Source of data to be used:	Onsite Instrumentation. The instrument used would be the Watt transducer of accuracy +/- 0.5%.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	296,272
Description of measurement methods and procedures to be applied:	Tri vector energy meters of 0.2 class accuracy have been installed to measure the gross energy generated.
QA/QC procedures to be applied:	The data displayed in the energy meter will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the General Manager (O&M) who will in turn report to the Vice President – Power (VP - Power) Power Plant Head on daily basis. This data will be available up to two years after the crediting period All the meters are calibrated annually by the Meter Relay Testing division of the state utility.
Any comment:	This data will be measured

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Data / Parameter:	**EG_{40_Aux}**
Data unit:	MWH/yr
Description:	Auxiliary Consumption by the 40 MW CPP
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	29,627.2
Description of measurement methods and procedures to be applied:	This parameter would be calculated based on total electricity generation and net electricity generation from the 40 MW CPP.
QA/QC procedures to be applied:	The shift engineer will archive the data of auxiliary consumption in the plant log book based on the total electricity generation and net electricity generation. This will be reviewed by the General Manager (O&M) who will in turn report to the Vice President – Power (VP - Power) Power Plant Head on daily basis. This data will be available up to two years after the crediting period.
Any comment:	This parameter is calculated using the formulae EG_{40_Gen} - EG_{40_Net}

Data / Parameter:	**EG_{i,j,y_40MW}**
Data unit:	MWh/yr
Description:	Net electricity generated from the 40 MW CPP
Source of data to be used:	Individual distribution energy meters
Value of data applied for the purpose of calculating expected emission reductions in section B.5	266,645
Description of measurement methods and procedures to be applied:	Trivector energy meters of 0.5 class accuracy have been installed as individual distribution meter to measure the net energy consumption.
QA/QC procedures to be applied:	The data displayed in the individual distribution energy meters will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period All the meters are calibrated annually by the Meter Relay Testing division of the state utility.
Any comment:	This data will be measured.

Data / Parameter:	**EG_{60_Gen}**
Data unit:	MWh/year
Description:	Total electricity generated from the 60 MW captive power plant at BPSL (from both AFBC2 and WHRB3&4)

Source of data to be used:	Onsite Instrumentation. The instrument used would be the Watt transducer of accuracy +/- 0.5%.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	358,183
Description of measurement methods and procedures to be applied:	Tri vector energy meters of 0.2 class accuracy have been installed to measure the gross energy generated.
QA/QC procedures to be applied:	The data displayed in the energy meters will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. All the meters are calibrated annually by the Meter Relay Testing division of the state utility.
Any comment:	This data will be measured

Data / Parameter:	**EG_{60_Aux}**
Data unit:	MWH/yr
Description:	Auxiliary Consumption by the 60 MW CPP
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	35,818.3
Description of measurement methods and procedures to be applied:	This parameter would be calculated based on total electricity generation and net electricity generation from the 60 MW CPP.
QA/QC procedures to be applied:	The shift engineer will archive the data of auxiliary consumption in the plant log book based on the total electricity generation and net electricity generation. This will be reviewed by the General Manager (O&M) who will in turn report to the Vice President – Power (VP - Power) Power Plant Head on daily basis. This data will be available up to two years after the crediting period.
Any comment:	This parameter is calculated using the formulae EG_{60_Gen} - EG_{60_Net} This data will be measured

Data / Parameter:	**EG_{i,j,y_60MW}**
Data unit:	MWh/yr
Description:	Net electricity generated from the 60 MW CPP
Source of data to be	Individual distribution energy meters

used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	322,365
Description of measurement methods and procedures to be applied:	Trivector energy meters of 0.5 class accuracy have been installed as individual distribution meter to measure the net energy consumption.
QA/QC procedures to be applied:	The data displayed in the individual distribution energy meters will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period All the meters are calibrated annually by the Meter Relay Testing division of the state utility.
Any comment:	This parameter is measured

Data / Parameter:	**QS_{WHRB1}**
Data unit:	Tons/day
Description:	Total steam generation from WHRB1
Source of data to be used:	Onsite instrumentation (Flow meter of Emerson make having an accuracy of +/- 0.065%; Tag W-FT 103A, 103B and 103C)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	911
Description of measurement methods and procedures to be applied:	Flow meter of Emerson make having an accuracy of +/-0.065%; Tag W-FT 103A, 103B and 103C has been installed to measure the flow.
QA/QC procedures to be applied:	The data displayed in the flow meter will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The flow meter is calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**QS_{WHRB2}**
Data unit:	Tons/day
Description:	Total steam generation from WHRB2
Source of data to be used:	Onsite instrumentation (Flow meter of Emerson make having an accuracy of +/- 0.065%; Tag W-FT 203A, 203B and 203C)
Value of data applied for the purpose of	898

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	Flow meter of Emerson make having an accuracy of +/-0.065%; Tag W-FT 203A, 203B and 203C has been installed to measure the flow.
QA/QC procedures to be applied:	The data displayed in the flow meter will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period A detailed calibration system is already in place at BPSL. The flow meter is calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**QS_{WHRB3}**
Data unit:	Tons/day
Description:	Total steam generation from WHRB3
Source of data to be used:	Onsite instrumentation (Flow meter of Emerson make having an accuracy of +/-0.065%; Tag W-FT 403A, 403B and 403C)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	740
Description of measurement methods and procedures to be applied:	Flow meter of Emerson make having an accuracy of +/-0.065%; Tag W-FT 403A, 403B and 403C has beem installed to measure the flow.
QA/QC procedures to be applied:	The data displayed in the flow meter will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period A detailed calibration system is already in place at BPSL. The flow meter is calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**QS_{WHRB4}**
Data unit:	Tons/day
Description:	Total steam generation from WHRB4
Source of data to be used:	Onsite instrumentation (Flow meter of Emerson make having an accuracy of +/-0.065%; Tag W-FT 503A, 503B and 503C)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	659
Description of	Flow meter of Emerson make having an accuracy of +/-0.065%; Tag W-FT

measurement methods and procedures to be applied:	503A, 503B and 503C has been installed to measure the flow
QA/QC procedures to be applied:	The data displayed in the flow meter will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The flow meter is calibrated annually.
Any comment:	This data will be measured
Data / Parameter:	**QS_{AFBC1}**
Data unit:	Tons/day
Description:	Total steam generation from AFBC1
Source of data to be used:	Onsite instrumentation (Flow meter of Emerson make with accuracy of +/- 0.1%; Tag: B-FT 302A, 302B and 302C)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1819
Description of measurement methods and procedures to be applied:	Flow meter of Emerson make with accuracy of +/- 0.1%; Tag: B-FT 302A, 302B and 302C has been installed to measure the flow.
QA/QC procedures to be applied:	The data displayed in the flow meter will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The flow meter is calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**QS_{AFBC2}**
Data unit:	Tons/day
Description:	Total steam generation from AFBC2
Source of data to be used:	Onsite instrumentation (Flow meter of Emerson make with accuracy of +/- 0.065%; Tag: B-FT 602A, 602B and 602C)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	2764
Description of measurement methods and procedures to be applied:	Flow meter of Emerson make with accuracy of +/- 0.065%; Tag: B-FT 602A, 602B and 602C has been installed to measure the flow.
QA/QC procedures to	The data displayed in the flow meter will be recorded in the DCS. The shift

be applied:	engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period A detailed calibration system is already in place at BPSL. The flow meter is calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**QS_{TG1}**
Data unit:	Tons/day
Description:	Total steam inlet to the turbine (TG-I)
Source of data to be used:	Onsite instrumentation (Flow meter (FT 101) of ABB make with accuracy of -/ +0.065%)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	3446
Description of measurement methods and procedures to be applied:	Flow meter (FT 101) of ABB make with accuracy of -/ +0.065% has been installed to measure the flow
QA/QC procedures to be applied:	The data displayed in the flow meter will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The flow meter is calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**QS_{TG2}**
Data unit:	Tons/day
Description:	Total steam inlet to the turbine (TG-II)
Source of data to be used:	Onsite instrumentation (Flow meter (FT 1501) of Rosemount make with accuracy of -/ +0.065%)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	3955
Description of measurement methods and procedures to be applied:	Flow meter (FT 1501) of Rosemount make with accuracy of -/ +0.065% has been installed to measure the flow
QA/QC procedures to be applied:	The data displayed in the flow meter will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period.

	A detailed calibration system is already in place at BPSL. The flow meter is calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**QS_{loss1}**
Data unit:	Tons/day
Description:	Total steam lost due to venting, blow down etc at 40 MW CPP
Source of data to be used:	The data is calculated
Value of data applied for the purpose of calculating expected emission reductions in section B.5	181.38
Description of measurement methods and procedures to be applied:	This data will be calculated as the difference between total steam generated by the WHRB 1&2 and AFBC1 boilers and the steam at turbine TG-I inlet.
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period.
Any comment:	This data will be calculated

Data / Parameter:	**QS_{loss2}**
Data unit:	Tons/day
Description:	Total steam lost due to venting, blow down etc at 60 MW CPP
Source of data to be used:	The data is calculated
Value of data applied for the purpose of calculating expected emission reductions in section B.5	208.20
Description of measurement methods and procedures to be applied:	This data will be calculated as the difference between total steam generated by the WHRB 3&4 and AFBC2 boilers and the steam at turbine TG-II inlet.
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period
Any comment:	This data will be calculated

Data / Parameter:	**T_{WHRB1}**

Data unit:	^{0}C
Description:	Average steam temperature from WHRB1
Source of data to be used:	Onsite instrumentation (temperature gauge of ABB make with accuracy of +/-0.20%; Tag nos: W-TT-115A, 115B, 115C)
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:	Temperature gauge of ABB make with accuracy of +/-0.20%; Tag nos: W-TT-115A, 115B, 115C has been installed.
QA/QC procedures to be applied:	The data displayed in the temperature gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Temperature gauge will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**T_{WHRB2}**
Data unit:	^{0}C
Description:	Average steam temperature from WHRB2
Source of data to be used:	Onsite instrumentation (temperature gauge of ABB make with accuracy of +/-0.20%; Tag nos: W-TT-215A, 215B, 215C)
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:	Temperature gauge of ABB make with accuracy of +/-0.20%; Tag nos: W-TT-215A, 215B, 215C has been installed to measure the temperature.
QA/QC procedures to be applied:	The data displayed in the temperature gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Temperature gauge will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**T_{WHRB3}**
Data unit:	^{0}C

Description:	Average steam temperature from WHRB3
Source of data to be used:	Onsite instrumentation (temperature gauge of Emerson make with accuracy of +/-0.20%; Tag nos: W-TT-415A, 415B, 415C)
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:	Temperature gauge of Emerson make with accuracy of +/-0.20%; Tag nos: W-TT-415A, 415B, 415C has been installed to measure the temperature.
QA/QC procedures to be applied:	The data displayed in the temperature gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Temperature gauge will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	$\mathbf{T_{WHRB4}}$
Data unit:	^{0}C
Description:	Average steam temperature from WHRB4
Source of data to be used:	Onsite instrumentation (temperature gauge of Emerson make with accuracy of +/-0.20%; Tag nos: W-TT-515A, 515B, 515C)
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:	The temperature gauge of Emerson make with accuracy of +/-0.20%; Tag nos: W-TT-515A, 515B, 515C has been installed to measure the temperature.
QA/QC procedures to be applied:	The data displayed in the temperature gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Temperature gauge will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	$\mathbf{T_{AFBC1}}$
Data unit:	^{0}C

Description:	Average steam temperature from AFBC1 boiler
Source of data to be used:	Onsite instrumentation (Temperature gauge of Rosemount make with accuracy of +/-0.2%; Tag nos: TT-321A, 321B, 321C)
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:	Temperature gauge of Rosemount make with accuracy of +/-0.2%; Tag nos: TT-321A, 321B, 321C has been installed to measure the temperature.
QA/QC procedures to be applied:	The data displayed in the temperature gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Temperature gauge will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	$\mathbf{T_{AFBC2}}$
Data unit:	^{0}C
Description:	Average steam temperature from AFBC2 boiler
Source of data to be used:	Onsite instrumentation (Temperature gauge of Rosemount make with accuracy of +/-0.2%; Tag nos: TT-621A, 621B, 621C)
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:	Temperature gauge of Rosemount make with accuracy of +/-0.2%; Tag nos: TT-621A, 621B, 621C has been installed to measure the temperature.
QA/QC procedures to be applied:	The data displayed in the temperature gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Temperature gauge will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	$\mathbf{T_{feed\_WHRB1}}$
Data unit:	^{0}C

Description:	Temperature of feed water at inlet to WHRB1
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	155
Description of measurement methods and procedures to be applied:	Temperature gauge has been installed to measure the temperature.
QA/QC procedures to be applied:	The data displayed in the temperature gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Temperature gauge will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	$\mathbf{T_{feed\_WHRB2}}$
Data unit:	^{0}C
Description:	Temperature of feedwater at inlet to WHRB2
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	155
Description of measurement methods and procedures to be applied:	Temperature gauge has been installed to measure the temperature.
QA/QC procedures to be applied:	The data displayed in the temperature gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Temperature gauge will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	$\mathbf{T_{feed\_WHRB3}}$
Data unit:	^{0}C

Description:	Temperature of feedwater at inlet to WHRB3
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	155
Description of measurement methods and procedures to be applied:	Temperature gauge has been installed to measure the temperature.
QA/QC procedures to be applied:	The data displayed in the temperature gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Temperature gauge will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	$\mathbf{T_{feed\_WHRB4}}$
Data unit:	^0C
Description:	Temperature of feedwater at inlet to WHRB4
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	155
Description of measurement methods and procedures to be applied:	Temperature gauge has been installed to measure the temperature.
QA/QC procedures to be applied:	The data displayed in the temperature gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Temperature gauge will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	$\mathbf{T_{feed\_AFBC1}}$
Data unit:	^0C

Description:	Temperature of feedwater at inlet to AFBC 1
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	180.
Description of measurement methods and procedures to be applied:	Temperature gauge has been installed to measure the temperature.
QA/QC procedures to be applied:	The data displayed in the temperature gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Temperature gauge will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	T_{feed_AFBC2}
Data unit:	^0C
Description:	Temperature of feedwater at inlet to AFBC 2
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	215
Description of measurement methods and procedures to be applied:	Temperature gauge has been installed to measure the temperature.
QA/QC procedures to be applied:	The data displayed in the temperature gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Temperature gauge will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	T_{TG1}
Data unit:	^0C

Description:	Average steam temperature at the inlet of Turbine (TG-I) of 40 MW CPP
Source of data to be used:	Onsite instrumentation (temperature gauge; T/C direct to DCS module, Tag No: TE-102)
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:	Temperature gauge; T/C direct to DCS module, Tag No: TE-102 has been installed to measure the temperature.
QA/QC procedures to be applied:	The data displayed in the temperature gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Temperature gauge will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	$\mathbf{T_{TG2}}$
Data unit:	^{0}C
Description:	Average steam temperature at the inlet of Turbine (TG2) of 60 MW CPP
Source of data to be used:	Onsite instrumentation (temperature gauge; T/C direct to DCS module, Tag No: TE-202)
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:	Temperature gauge; T/C direct to DCS module, Tag No: TE-202 has been installed to measure the temperature.
QA/QC procedures to be applied:	The data displayed in the temperature gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Temperature gauge will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	$\mathbf{P_{WHRB1}}$
Data unit:	Kg/cm^2

Description:	Average steam pressure from WHRB1
Source of data to be used:	Onsite instrumentation (Pressure gauge of Emerson make with accuracy of +/- 0.1%; Tag No: W-PT 106A, 106B, 106C)
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:	Pressure gauge of Emerson make with accuracy of +/- 0.1%; Tag No: W-PT 106A, 106B, 106C has been installed to measure the pressure
QA/QC procedures to be applied:	The data displayed in the pressure gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Pressure gauge is calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	P_{WHRB2}
Data unit:	Kg/cm^2
Description:	Average steam pressure from WHRB2
Source of data to be used:	Onsite instrumentation (Pressure gauge of Emerson make with accuracy of +/- 0.1%; Tag No: W-PT 206A, 206B, 206C)
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:	Pressure gauge of Emerson make with accuracy of +/- 0.1%; Tag No: W-PT 206A, 206B, 206C has been installed to measure the pressure.
QA/QC procedures to be applied:	The data displayed in the pressure gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Pressure gauge is calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	P_{WHRB3}
Data unit:	Kg/cm^2

Description:	Average steam pressure from WHRB3
Source of data to be used:	Onsite instrumentation (Pressure gauge of Emerson make with accuracy of +/- 0.065%; Tag No: W-PT 406A, 406B, 406C)
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:	Pressure gauge of Emerson make with accuracy of +/- 0.065%; Tag No: W-PT 406A, 406B, 406C has already been installed to measure the pressure.
QA/QC procedures to be applied:	The data displayed in the pressure gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Pressure gauge is calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**P_{WHRB4}**
Data unit:	Kg/cm^2
Description:	Average steam pressure from WHRB4
Source of data to be used:	Onsite instrumentation (Pressure gauge of Emerson make with accuracy of +/- 0.065%; Tag No: W-PT 506A, 506B, 506C)
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:	Pressure gauge of Emerson make with accuracy of +/- 0.065%; Tag No: W-PT 506A, 506B, 506C has been installed to measure the pressure.
QA/QC procedures to be applied:	The data displayed in the pressure gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Pressure gauge is calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**P_{AFBC1}**
Data unit:	Kg/cm^2

Description:	Average steam pressure from AFBC1
Source of data to be used:	Onsite instrumentation (Pressure gauge of Rosemount make, with accuracy of +/- 0.1%; Tag No: B-PT 314A, 314B,314C)
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:	Pressure gauge of Rosemount make, with accuracy of +/- 0.1%; Tag No: B-PT 314A, 314B,314C has been installed to measure the pressure
QA/QC procedures to be applied:	The data displayed in the pressure gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Pressure gauge is calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**P_{AFBC2}**
Data unit:	Kg/cm^2
Description:	Average steam pressure from AFBC2
Source of data to be used:	Onsite instrumentation (Pressure gauge of Rosemount make, Tag No: B-PT 614A, 614B, 614C)
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:	Pressure gauge of Rosemount make, Tag No: B-PT 614A, 614B, 614C has been installed to measure the pressure.
QA/QC procedures to be applied:	The data displayed in the pressure gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Pressure gauge is calibrated annually
Any comment:	This data will be measured

Data / Parameter:	**P_{TG1}**
Data unit:	Kg/cm^2

Description:	Average steam pressure inlet of Turbine (TG-I) of 40 MW CPP
Source of data to be used:	Onsite instrumentation (Pressure gauge of ABB make with accuracy of +/- 0.1%; Tag no: PT-103)
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:	Pressure gauge of ABB make with accuracy of +/- 0.1%; Tag no: PT-103 has been installed to measure the pressure.
QA/QC procedures to be applied:	The data displayed in the pressure gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Pressure gauge is calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**P_{TG2}**
Data unit:	Kg/cm^2
Description:	Average steam pressure inlet of Turbine (TG-II) of 60 MW CPP
Source of data to be used:	Onsite instrumentation (Pressure gauge of Rosemount make with accuracy of +/- 0.1%; Tag no: PT-202A, 202B,202C)
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:	Pressure gauge of Rosemount make with accuracy of +/- 0.1%; Tag no: PT-202A, 202B,202C has been installed to measure the pressure.
QA/QC procedures to be applied:	The data displayed in the pressure gauge will be recorded in the DCS. The shift engineer will archive the data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. This data will be available up to two years after the crediting period. A detailed calibration system is already in place at BPSL. The Pressure gauge is calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**H_{WHRB1}**
Data unit:	kCal/kg

Description:	Enthaply of steam generated from WHRB1
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 based on steam pressure (P_{WHRB1}) and steam temperature (T_{WHRB1}).
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
Any comment:	This data will be calculated from the steam tables

Data / Parameter:	**H_{WHRB2}**
Data unit:	kCal/kg
Description:	Enthaply of steam generated from WHRB2
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 based on steam pressure (P_{WHRB2}) and steam temperature (T_{WHRB2}).
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available upto two years after crediting period.
Any comment:	This data will be calculated from the steam tables

Data / Parameter:	**H_{WHRB3}**
Data unit:	kCal/kg
Description:	Enthaply of steam generated from WHRB3
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 based on steam pressure (P_{WHRB3}) and steam temperature (T_{WHRB3}).
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available upto two years after crediting period.
Any comment:	This data will be calculated from the steam tables

Data / Parameter:	$\mathbf{H_{WHRB4}}$
Data unit:	kCal/kg
Description:	Enthaply of steam generated from WHRB4
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 based on steam pressure (P_{WHRB4}) and steam temperature (T_{WHRB4}).
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available upto two years after crediting period
Any comment:	This data will be calculated from the steam tables

Data / Parameter:	$\mathbf{H_{AFBC1}}$
Data unit:	kCal/kg
Description:	Enthaply of steam from AFBC1
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 based on steam pressure (P_{AFBC1}) and steam temperature (T_{AFBC1}).
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available upto two years after crediting period.

Any comment:	This data will be calculated from the steam tables

Data / Parameter:	$\mathbf{H_{AFBC2}}$
Data unit:	kCal/kg
Description:	Enthaply of steam from AFBC2
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 based on steam pressure (P_{AFBC2}) and steam temperature (T_{AFBC2}).
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available upto two years after crediting period.
Any comment:	This data will be calculated from the steam tables

Data / Parameter:	$\mathbf{H_{feed\_WHRB1}}$
Data unit:	kCal/kg
Description:	Enthaply of feedwater at inlet to WHRB1
Source of data to be used:	Steam tables
Value of data applied for the purpose of calculating expected emission reductions in section B.5	155
Description of measurement methods and procedures to be applied:	The data is obtained from Steam tables.
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
Any comment:	This data will be calculated from the steam tables

Data / Parameter:	$\mathbf{H_{feed\_WHRB2}}$
Data unit:	kCal/kg
Description:	Enthaply of feedwater at inlet to WHRB2
Source of data to be used:	Steam tables
Value of data applied	155

for the purpose of calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	The data is obtained from steam tables.
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
Any comment:	This data will be calculated from the steam tables

Data / Parameter:	$\mathbf{H_{feed\_WHRB3}}$
Data unit:	kCal/kg
Description:	Enthaply of feedwater at inlet to WHRB3
Source of data to be used:	Steam tables
Value of data applied for the purpose of calculating expected emission reductions in section B.5	155
Description of measurement methods and procedures to be applied:	The data is obtained from steam tables.
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
Any comment:	This data will be calculated from the steam table

Data / Parameter:	$\mathbf{H_{feed\_WHRB4}}$
Data unit:	kCal/kg
Description:	Enthaply of feedwater at inlet to WHRB4
Source of data to be used:	Steam tables
Value of data applied for the purpose of calculating expected emission reductions in section B.5	155
Description of measurement methods and procedures to be applied:	The data is obtained from steam tables.

QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
Any comment:	This data will be calculated from the steam table

Data / Parameter:	**H_{feed_AFBC1}**
Data unit:	kCal/kg
Description:	Enthaply of feedwater at inlet to AFBC1
Source of data to be used:	Steam tables
Value of data applied for the purpose of calculating expected emission reductions in section B.5	182
Description of measurement methods and procedures to be applied:	The data is obtained from Steam tables.
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
Any comment:	This data will be calculated from the steam tables

Data / Parameter:	**H_{feed_AFBC2}**
Data unit:	kCal/kg
Description:	Enthaply of feedwater at inlet to AFBC2
Source of data to be used:	Steam tables
Value of data applied for the purpose of calculating expected emission reductions in section B.5	220
Description of measurement methods and procedures to be applied:	The data is obtained from steam tables.
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
Any comment:	This data will be calculated from the steam tables

Data / Parameter:	**H_{TG1}**

Data unit:	kCal/kg
Description:	Enthaply of steam at turbine inlet (TG-I) of the 40 MW CPP
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 based on steam pressure (P_{TG1}) and steam temperature (T_{TG1}).
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available upto two years after crediting period
Any comment:	This data will be calculated from the steam tables

Data / Parameter:	**H_{TG2}**
Data unit:	kCal/kg
Description:	Enthaply of steam at turbine inlet (TG-II) of the 60 MW CPP
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 based on steam pressure (P_{TG2}) and steam temperature (T_{TG2}).
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available upto two years after crediting period.
Any comment:	This data will be calculated from the steam tables

Data / Parameter:	**$ST_{whr1\&2, y}$**
Data unit:	kCal/ annum
Description:	Energy content of the steam generated in WHRB1&2 fed to the turbine via common header
Source of data to be used:	BPSL
Value of data applied	353,374,787,500

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 equation $ST_{whr,y} = QS_{WHRB - Net}$ X $(H_{WHRB} - H_{feed\_WHRB})$.
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available upto two years after crediting period
Any comment:	This data will be calculated

Data / Parameter:	$\mathbf{ST_{whr3\&4, y}}$
Data unit:	kCal/ annum
Description:	Energy content of the steam generated in WHRB3&4 fed to the turbine via common header
Source of data to be used:	BPSL
Value of data applied for the purpose of calculating expected emission reductions in section B.5	258,723,428,600
Description of measurement methods and procedures to be applied:	This data will be calculated from equation $ST_{whr,y} = QS_{WHRB - Net}$ X $(H_{WHRB} - H_{feed\_WHRB})$
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available upto two years after crediting period
Any comment:	This data will be calculated

Data / Parameter:	$\mathbf{ST_{Other1, y}}$
Data unit:	kCal/ annum
Description:	Energy content of the steam generated in AFBC 1 fed to the turbine via common header
Source of data to be used:	BPSL
Value of data applied for the purpose of calculating expected emission reductions in section B.5	378,586,992,602

Description of measurement methods and procedures to be applied:	This data will be calculated from equation $ST_{other,y} = QS_{AFBC}$ X $(H_{AFBC} - H_{feed\_AFBC})$.
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available upto two years after crediting period.
Any comment:	This data will be calculated

Data / Parameter:	**$ST_{Other2, y}$**
Data unit:	kCal/ annum
Description:	Energy content of the steam generated in AFBC 2 fed to the turbine via common header
Source of data to be used:	BPSL
Value of data applied for the purpose of calculating expected emission reductions in section B.5	541,029,242,608
Description of measurement methods and procedures to be applied:	This data will be calculated from equation $ST_{other,y} = QS_{AFBC}$ X $(H_{AFBC} - H_{feed\_AFBC})$.
QA/QC procedures to be applied:	The shift engineer will archive the calculated data in the plant log book which will be reviewed by the GM (O&M) who will in turn report to the VP - Power on daily basis. The data will be archived either electronically or in paper and will be available upto two years after crediting period
Any comment:	This data will be calculated

B.7.2 Description of the monitoring plan:

Organisation structure and Procedure for Monitoring and Reporting of data:

The Organisation structure for monitoring of parameters for the CDM project activity is provided below in Fig B.2.

The Vice President - (VP - Power) is responsible for the operation and maintenance of the power plant. The VP is assisted by General Manager (Operation and Maintenance- O&M), Assistant General Manager (Controls & Instrumentation, C&I) and Manager - Power Plant (Manager – 60 MW, Manager – 40 MW, Manager - Utility). Regular shift engineers monitor the operation of the plant for all the three shifts and will prepare the daily and monthly reports which will be reviewed by the General Manager

(O&M) who will be reporting to the VP – Power on a daily basis. The VP reports to the Director and the Director would be overall responsible for the operation and maintenance of the power plant.

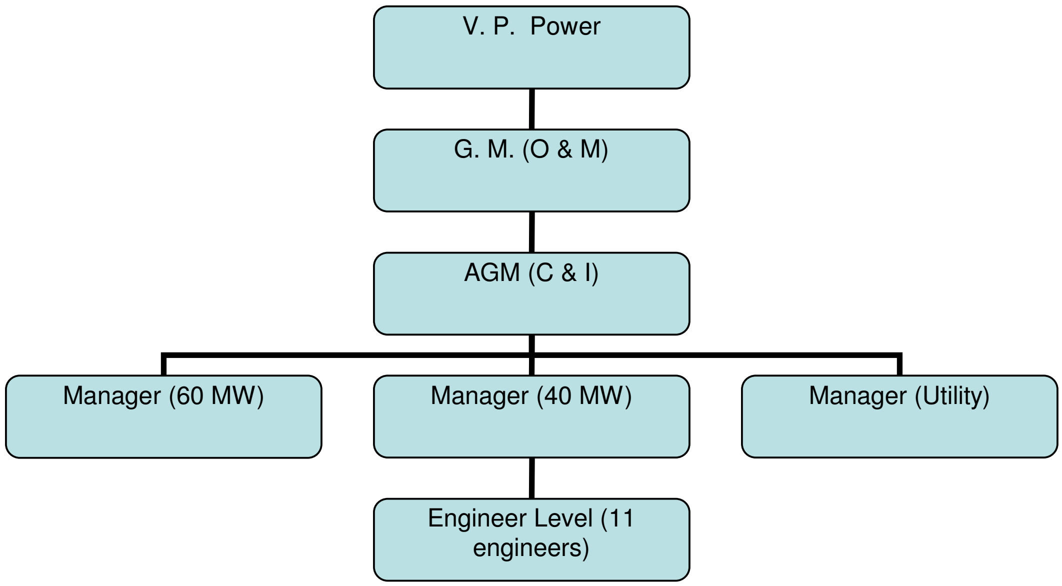

Fig B.2: Organisation structure at BPSL for Monitoring of Parameters in the CDM project

Procedures for emergency Preparedness

All the parameters measured (e.g. Temperature, pressure, flow) are having 200 % stand by. In the event of failure/ malfunctioning of one equipment/ instrument, the value from the standby can be considered.

Calibration of instruments

The monitoring equipments are calibrated as mentioned in section B.7.1 of this document to ensure the accuracy of all the monitoring parameters.

Modalities and Procedures towards periodic training for the monitoring personnel

1. A yearly internal training schedule is prepared to impart training to the monitoring personnel.

2. All monitoring personnel are trained as per the schedule and training is imparted on the maintenance and calibration of pressure, temperature and flow measuring systems.

3. In case of any change in the measuring system few selected engineers are sent to the supplier premises to be trained on operation, maintenance and calibration of such systems.

CDM internal audit team

A CDM internal audit team with representative from all the relevant departments will be responsible for data collection and archiving. The team will audit all aspects mentioned in the PDD and will report to the Board once a year. In case of any deviation, corrective and preventive action will be taken by the respective Head of Department (HOD).

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)

05/03/2008.
The contact detail of the person responsible is given in Annex-1.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

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:

01/07/2008 or subsequent to the date of registration of the project which ever is later.

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 Impacts due to the project activity was carried out as a part of the Environmental Impact Assessment (EIA) for the integrated steel plant which includes the project activity as well, 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. Certain impacts due to the project activity during construction and operational phases are discussed below:

During construction

Impacts on air

During construction phase civil works have been carried out which would have impacted the air quality. Water spraying was undertaken to suppress the dust from such activities. Further these impacts upon the ambient air quality will not be permanent and will cease once the construction is completed.

Impacts on water

During construction a lot of debris, mud etc, would have been generated and also during the monsoon season the storm water run-offs would have contained large amounts of suspended solids. However such storm water run-offs would have occurred only during the 2-3 months of monsoon season and hence all these impacts are very much temporary and would not exist after the construction phase.

Impacts on noise

Noise levels would have increased due to increased movement of trucks and other diesel powered material handling equipment. However the movement of trucks and machinery was regulated to only during day time to reduce the impacts of increased noise levels. Since the construction phase is temporary, the impact of noise levels would not exist beyond the construction phase.

Impacts on ecology

The integrated steel plant (including the project activity) has come up over about 1300 acres of land. Some part of this land is village forest for which de-reservation has been carried out with forest department official. As the area of land cleared is small, the impact will be insignificant.

Impact on socio-economics

The construction phase involved generation of lot of employment, both direct and indirect which has positively benefited the socioeconomic environment.

During operation

Impacts on air

The prime impacts on ambient air quality are due to stack emissions. However all the procedures have been applied to ensure that the stack emission is maintained within the norms of the ambient air quality. BPSL has installed electrostatic precipitators (ESPs) to reduce the particulate emissions to less than 100 mg/nm^3.

In order to reduce the effects of the fugitive emission and hence to maintain the work zone air quality all the fugitive emission points have been provided with dust suppression system/water sprinklers. As the habitation centres at Jharsuguda and Sambalpur are located about 16 km and 45 km away from the plant respectively, the impact of air pollutants on these receptors are expected to be negligible. Hence no significant impact is expected.

Impacts on water

The water system of the plant has been designed based on maximum re-circulation and thus effective discharge from the plant to outside will be almost insignificant. Thus no significant impact is expected.

The domestic and sanitary wastes expected to be generated from the identified facilities will be treated effectively and hence no adverse impact on water is envisaged.

Impacts on noise level

During normal operations, the ambient noise levels will increase significantly only close to the turbines and other machinery but this will be confined only within the shop boundary. The noise levels will be minimized when the noise reaches the plant boundary and the nearest residential areas beyond the plant boundary, as elaborate green belt development is envisaged for attenuation of noise. Personnel operating close to the noise generating equipments are provided with personnel protective equipments (PPE) in order to reduce the impacts of high noise levels.

All the equipments have been designed as per the requirement of OSHA (Occupational Safety and Health Association) standard and hence no adverse impact due to the noise levels is envisaged.

Impact on ecology:

As the plant is designed for maximum recirculation after proper treatment, no effluent would be allowed to discharge into the water bodies. Therefore no adverse impact is expected on aquatic bodies and therefore the ecology. Greenbelt development would positively affect the ecology.

Socio-Economic Impacts

The project activity leads to up-liftment of skilled and unskilled manpower in the region. The project will be providing employment opportunities not only during the construction phase, but also during its operational lifetime. The project activity improves employment rate and livelihood of local populace in the vicinity of the project.

Conclusion

The net impact under environmental pollution category would be positive as all necessary abatement measures would be adopted and periodically monitored. BPSL monitors the Air and Water quality regularly and the reports are submitted to the local pollution control boards. The project activity does not have any major adverse impacts on environment during its construction or operational phase. The socio economic parameters would show positive impacts due to increased job opportunities.

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”. BPSL has also obtained environmental clearance from the Ministry of Environment and Forests (MoEF), Government of India.

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 detailed 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 conducted for the integrated steel plant (including the project activity) of BPSL, some of the stakeholders have emphasised upon creation of local employment opportunities.

The concerned stakeholders have given their consent to the project after due explanation from the project promoter that all the pollution control measures will be undertaken by the company to ensure no adverse impact on air , water, noise and solid wastes beyond the stipulated norms due to the project. All the rest of the stakeholders have supported the project activity considering the potential of the project to generate employment opportunities for unemployed youth in the nearby villages

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

BPSL has provided direct and indirect employment opportunities to local persons. BPSL has provided for adequate employment opportunities and infrastructure (water supply, electricity, sanitation facilities, schools etc)[30].

BPSL has taken measures to control air, water and noise pollution and are complying with the environmental standards prescribed by the State Pollution Control Board[31].

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[30] Reference: Document provided to DOE

[31] Reference: Document by OSPCB for air and water quality report at BPSL provided to the DOE:

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
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Telephone:	+ 91 172 3911738-39
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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

There was 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.

(I) Determination of Baseline Emissions		
(A) Determination of CO_2 Baseline Emission Factor for Electricity Displaced $EF_{Elec,i,j,y}$		
Description	**Value**	**Unit**
Net calorific value of coal	2500	kCal/kg
	0.010467	TJ/tonne
Energy input to the boiler	2.91	MWh/tonne
Boiler efficiency as per manufacturers' detail (%)	84.0%	
Energy available at the boiler outlet	2.4	MWh/tonne
	2100000	kCal/tonne
Turbine heat rate	3022.715	kCal/kWh
Energy available at the turbine outlet	694.7	kWh/tonne
Efficiency of the captive power plant (η_{plant})	0.2389	
Emission Factor of the baseline plant ($EF_{Elec,i,j,y}$)	1.44	tCO2/MWh

(B) Total electricity supplied by the Phase 1 - 40 MW CPP		
Total electricity generated by the 40 MW CPP	296,272,260	kWh/annum
Auxiliary consumption (10% of total electricity generated)	29,627,226	kWh/annum
Net electricity supplied by 40 MW CPP ((EGi,j,y-40MW)	266,645,034	kWh/annum
(C) Estimation of fraction of electricity generated using waste gas (fwg) for WHRB 1&2 (in Phase 1)		
Description	**Value**	**Unit**
Total steam generation from Phase 1(WHRB1&2 and AFBC 1)	1,197,165,000	kg/annum
Total steam loss due to venting and other blow down losses (Assumed as 5% of the generation)	59,858,250	kg/annum
Total Steam Generation from WHRB - 1&2	596,902,000	kg/annum
Net steam generated from WHRB - 1&2 (Total steam generation from WHRB1&2 - Total steam loss)	537,043,750	kg/annum
Steam generated from AFBC 1	600,263,000	kg/annum
Enthalpy of steam generated from WHRB 1&2 (based on steam pressure of 88 kg/cm2 and steam temperature of 520 deg C)	813	kcal/kg
Enthalpy of steam generated from AFBC 1 (based on steam pressure of 88 kg/cm2 and steam temperature of 520 deg C)	813	kcal/kg
Enthalpy of feedwater (at 155 deg C) at inlet to WHRBs	155	kcal/kg
Enthalpy of feedwater (at 180 deg C) at inlet to AFBC1	182	Kcal/kg
Steam energy content from WHRB1 & 2 ($ST_{whr1\&2,y}$)	353,374,787,500	kcal/annum
Steam energy content from AFBC 1 ($ST_{other1,y}$)	378,586,992,602	kcal/annum

Fraction of electricity generated using waste gas from WHRB1 & 2 ($f_{wg-WHRB1\&2}$) = $ST_{whr1\&2,y}$/ ($ST_{whr1\&2,y}$ + $St_{other1,y}$)	0.483	
(D) Total baseline emissions from electricity displaced due to WHRB1 & 2 in the project activity		
Baseline emissions from electricity that is displaced by the project activity ($BE_{Elec,y-40 MW}$) = f_{cap} X $f_{wg-WHRB1\&2}$ * $EG_{i,j,y-40MW}$ X $EF_{Elec,i,j,y}$	185,606.3	tCO2/annum

(E) Total electricity supplied by the Phase 2 - 60 MW CPP		
Total electricity generated by the 60 MW CPP	358,183,485	kWh/annum
Auxiliary consumption	35,818,349	kWh/annum
Net electricity supplied by 60 MW CPP ((EGi,j,y-60MW)	322,365,137	kWh/annum

(F) Estimation of fraction of electricity generated using waste gas (fwg) for WHRB 3&4 (in Phase 2)		
Description	**Value**	**Unit**
Total steam generation from Phase 2 (WHRB3&4 and AFBC 2)	1,374,146,000	kg/annum
Total steam loss due to venting and other blow down losses (Assumed as 5% of the generation)	68,707,300	kg/annum
Total Steam Generation from WHRB - 3&4	461,904,000	kg/annum
Net steam generated from WHRB - 3&4 (Total steam generation from WHRB3&4 - Total steam loss)	393,196,700	kg/annum
Steam generated from AFBC 2	912,242,000	kg/annum
Enthalpy of steam generated from WHRB 3&4 (based on steam pressure of 88 kg/cm2 and steam temperature of 520 deg C)	813	kcal/kg
Enthalpy of steam generated from AFBC 2 (based on steam pressure of 88 kg/cm2 and steam temperature of 520 deg C)	813	kcal/kg
Enthalpy of feedwater (at 150 deg C) at inlet to WHRBs	155	kcal/kg
Enthalpy of feedwater (at 215 deg C) at inlet to AFBC2	220	Kcal/kg
Steam energy content from WHRB3 & 4 ($ST_{whr3\&4,y}$)	258,723,428,600	kcal/annum
Steam energy content from AFBC 2 ($ST_{other2,y}$)	541,029,242,608	kcal/annum
Fraction of electricity generated using waste gas from WHRB 3 &4 ($f_{wg-WHRB3\&4}$) = $ST_{whr3\&4,y}$/ ($ST_{whr3\&4,y}$ + $St_{other2,y}$)	0.324	
(G) Total baseline emissions from electricity displaced due to WHRB 3&4 in the project activity		
Baseline emissions from electricity that is displaced by the project activity ($BE_{Elec,y-60MW}$) = f_{cap} X $f_{wg-WHRB3\&4}$ * $EG_{i,j,y-60MW}$ X $EF_{Elec,i,j,y}$	150,362.7	tCO2/annum

(II) Determination of Project Emissions (startup power, maintenance of WHRB, exigencies)		
Source of power for startup/ maintenance purpose	Coal based AFBC	
Power required by each WHRB & its auxiliaries for start up purpose	2	MW
Average duration of each start up	72	hrs
Number of startups in a year	3	nos
Number of WHRBs in the project activity	4	nos

Power required for startup due to the project activity	1728	MWh/ annum
Emission factor for the CPP (assumed as per ACM0012)	1.30	tons CO2/MWh
Project emissions (PEy)	**2246.40**	**tons CO2/annum**

(III) Determination of Emission Reductions from the Project activity		
Emission reductions (ERy) = Baseline emissions (BEy)- Project emissions (PEy)		
Baseline emissions from electricity that is displaced by the project activity - BEy = $(BE_{Elec,y\text{-}40MW}) + (BE_{Elec,y\text{-}60MW})$	335,969.0	tCO2/annum
Project emissions (PEy)	2246.4	tons CO2/annum
Emission reductions (ERy)	333,722	**tCO2/ annum**

Annex - 4

MONITORING PLAN

A. THE METHODOLOGY REQUIRES MONITORING OF THE FOLLOWING:

1. Net electricity generation
2. Auxiliary power consumption
3. Steam flow at the outlet of WHRB 1, 2, 3&4, AFBC boiler 1&2 and inlet to TGI & II
4. Steam Temperature at the outlet of WHRB 1, 2, 3&4, AFBC boiler 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
6. Feed water temperature and enthalpy at the inlet of WHRBs and AFBC boilers
7. Quantity of waste gas used for energy generation.

BPSL has installed meters to monitor all the above mentioned parameters. All the meters are calibrated to ensure a proper monitoring mechanism. The monitoring plan is detailed in Sections B.7.1 and B.7.2 of the PDD.

Organisation structure and Procedure for Monitoring and Reporting of data:

The Organisation structure for monitoring of parameters for the CDM project activity is provided in Fig B.2 in section B.7.2. The Vice President - (VP - Power) is responsible for the operation and maintenance of the power plant. The VP is assisted by General Manager (Operation and Maintenance- O&M), Assistant General Manager (Controls &Instrumentation, C&I) and Manager - Power Plant (Manager – 60 MW, Manager – 40 MW, Manager - Utility). Regular shift engineers monitor the operation of the plant for all the three shifts and will prepare the daily and monthly reports which will be reviewed by the General Manager (O&M) who will be reporting to the VP – Power on a daily basis. The VP reports to the Director and the Director would be overall responsible for the operation and maintenance of the power plant.

Procedures for emergency Preparedness

All the parameters measured (e.g. Temperature, pressure, flow) are having 200 % stand by. In the event of failure/ malfunctioning of one equipment/ instrument, the value from the standby can be considered.

Calibration of instruments

The monitoring equipments are calibrated as mentioned in section B.7.1 of this document to ensure the accuracy of all the monitoring parameters.

Modalities and Procedures towards periodic training for the monitoring personnel

- A yearly internal training schedule is prepared to impart training to the monitoring personnel.

- All monitoring personnel are trained as per the schedule and training is imparted on the maintenance and calibration of pressure, temperature and flow measuring systems.

- In case of any change in the measuring system few selected engineers are sent to the supplier premises to be trained on operation, maintenance and calibration of such systems.

<u>*CDM internal audit team*</u>

A CDM internal audit team with representative from all the relevant departments will be responsible for data collection and archiving. The team will audit all aspects mentioned in the PDD and will report to the Board once a year. In case of any deviation, corrective and preventive action will be taken by the respective Head of Department (HOD).

Annex – 5: ABBREVIATIONS

ABC	After Burning Chamber
AFBC	Atmospheric Fluidised Bed Combustion
BPSL	Bhushan Power & Steel Limited
CDM	Clean Development Mechanism
CPP	Captive Power Plant
CER	Certified Emission Reduction
CERC	Central Electricity Regulatory Commission
CEA	Central Electricity Authority
Cm	Centimeter
CO2	Carbon dioxide
DRI	Direct Reduced Iron
DOE	Designated Operational Entity
EIA	Environmental Impact Assessment
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
MoEF	Ministry of Environment and Forests
MOU	Memoranding of Understaning
OERC	Orissa Electricity Regulatory Commission
OPTCL	Orissa Power Transmission Corporation Limited
OSPCB	Orissa State Pollution Control Board
PLF	Plant Load Factor
PPA	Power Purchase Agreement
PPE	Personal Protective Equipment
RETL	Reliance Energy Trading Limited
RPM	Revolutions per minute
SLDC	State Load Despatch Centre
TG	Turbine Generator
TPD	Tons per day
TPH	Ton Per Hour
UNFCCC	United Nations Framework Convention of Climate Change
WHR WHRB	Waste Heat Recovery Waste Heat Recovery Boilers

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**
8.	CEA Report of the Expert Committee on fuels for Power Generation, Executive Summary – By Government of India, Central Electricity Authority, Planning Wing, dated February 2004