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:

Aarti Steels Limited – Waste Heat Recovery based Captive Power Project.
Version: 01
Date: 15/05/2007

A.2. Description of the project activity:

Aarti Steels Limited (ASL) has set up an Integrated Steel Plant at Ghantikhal-Nidhipur in Athagarh Sub division of Cuttack District, Orissa for producing sponge iron, Power, Steel Billets, Squares and Ferro Alloys. The plant will finally produce about 0.5 Million tonnes of Value Added special steels annually in the form of billets, squares, rounds, flats, wires, etc.

Presently the complex consists of a coal washery, Sponge Iron unit, Fluidized Bed and Waste Heat Recovery Boilers, Steam turbine, Induction Furnace, Ladle Refining Furnace, Continuous Caster, Ferro Alloys Plant etc. Second unit of Power plant and sponge iron plant along with Arc Furnace, Vacuum Degassing unit, Mini Blast Furnace, Rolling Mill, Wire Drawing Mill will be added in immediate future.

The ASL Sponge Iron unit at present consists of one rotary kiln of 500 tons per day (TPD). The generation of flue gas from the kiln is about 120,000 Nm^3/hr at 950-1000^{0}C. The rotary kiln is directly connected to the waste heat recovery boiler (WHRB), with steam generation capacity of 52 TPH which is the project activity. The total waste flue gas generated is ducted to the WHRB to generate steam at 87 Kg/Cm^2 and 510^{0}C.

Flue gas with high heat content is generated in the Rotary kiln in the Sponge iron plant during conversion of Iron Ore into Sponge Iron. The entire gas coming out from after burning chamber (ABC) of the Direct Reduced Iron (DRI) plant at about 950-1000^{0}C is passed through the Waste Heat Recovery Boiler (WHRB). The volume of the gas generated is proportionate to the production of the DRI kiln. The boiler absorbs the sensible heat of gas and cooled gas at about 160^{0}C is passed through electrostatic precipitator (ESP) and subsequently vented to the atmosphere. The kiln when operating at full capacity can generate adequate waste gas to produce steam up to 52 TPH equivalent to 12 MW of power. The total power generated for the complex is about 40 MW, out which about 12 MW is generated by the WHR power plant and the balance power by coal and coal washery rejects based Atmospheric Fluidised Bed Combustion (AFBC) power plant. In exigency cases, power from the grid is also imported. The 12 MW electricity generated by the WHR power plant displaces electricity that would have otherwise been generated by a coal and coal washery rejects based captive power plant.

The purpose of the project activity is to generate power through WHRB to partially meet the in-house requirements of ASL or export the surplus power 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, ASL has replaced power generation from a coal and coal washery rejects based unit. 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, direct employment, indirect job generation, technological & 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 2762.4 Million in addition to which there will be continuous inflow of funds considering CDM revenues. In the absence of the project such an inflow of funds to the region was not envisaged. The project will also earn additional revenue to 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 Captive Power Plant (CPP) is based on the WHR technology, a clean technology for power generation from waste hot flue gas, which would otherwise be vented to the atmosphere. The project comprises of 52 tons per hour (TPH) capacity boiler with the outlet steam parameters of 87 kg/cm^2 and 510º 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	Aarti Steels Limited	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.:

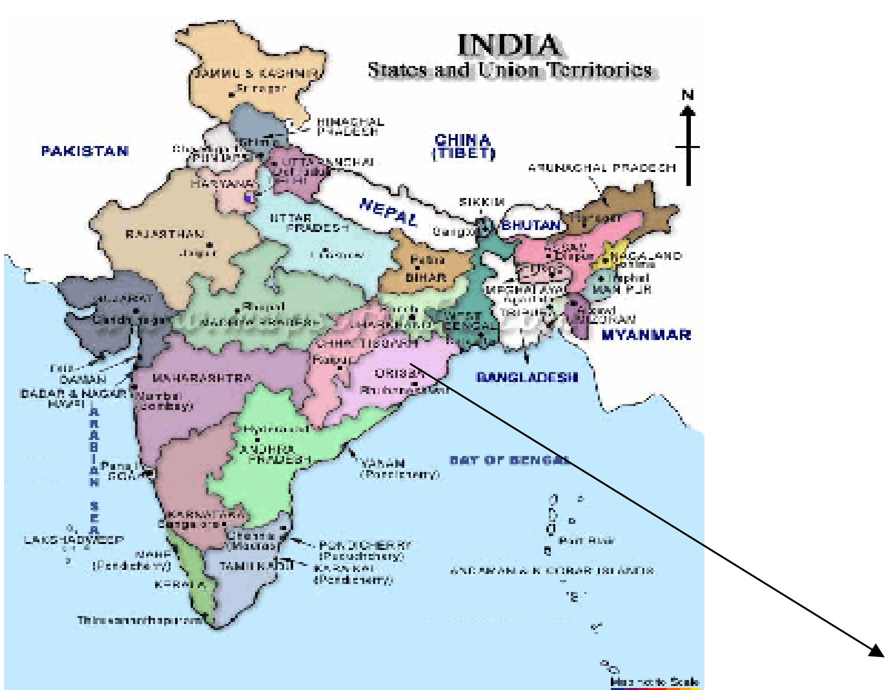
Orissa

A.4.1.3. City/Town/Community etc:

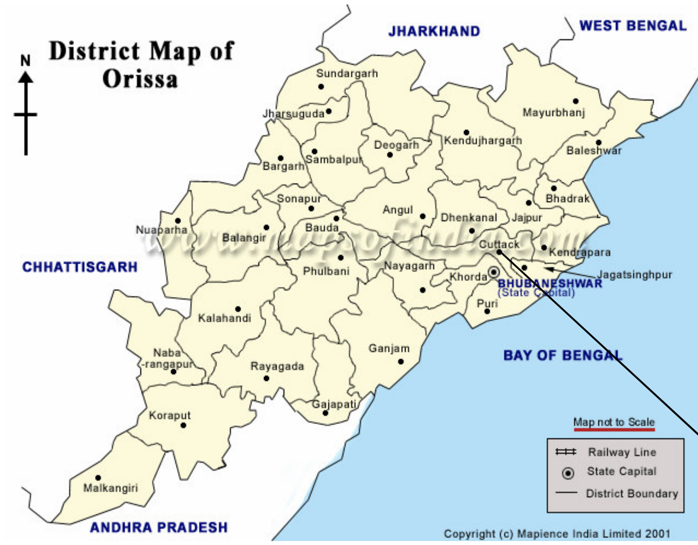
Ghantikhal, P.O. Mahakalabasta, Via. Athagarh, District Cuttack,

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

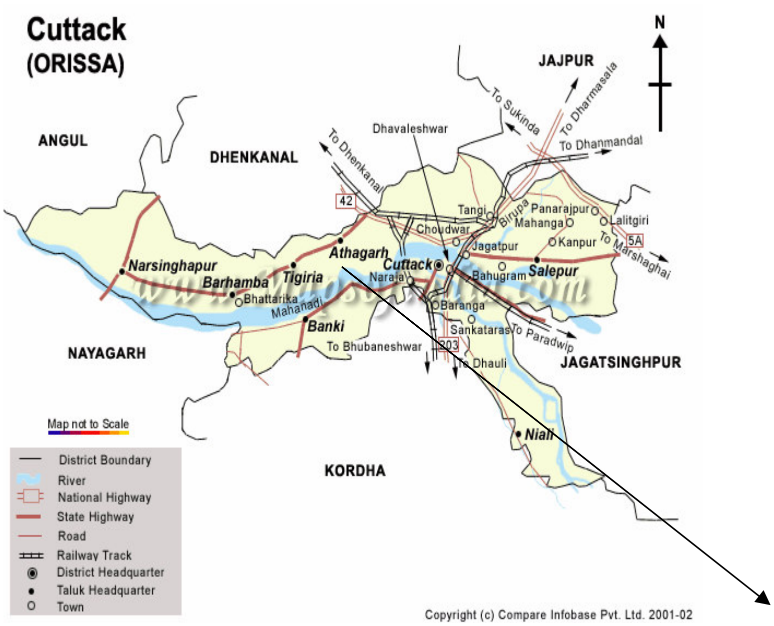
The Project has been implemented at Ghantikhal, P.O. Mahakalabasta, Via. Athagarh, District Cuttack It is located at latitude of 20^0 30' 30" to 20^0 31' 15" N and longitude of 85^0 44' 15" to 85^0 44' 15" E. The project site is situated at 40 kms from Cuttack town in Orissa State. Infrastructural requirements including water, motorable road, electricity *etc*. are available at the site. Railway siding is under construction.



Orissa State



Cuttack District



Plant Site

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

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

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

ASL integrated complex consists of facilities amongst others are one AFBC and one WHRB boiler. The WHRB is a single drum water tube boiler of 52 TPH capacity operating at 87 ata and at a temperature of 510^0C. The Power generated from the generator at 11 kV is connected to other units after the auxiliary power consumption of WHR power plant. The technology used for this project activity is based on Rankine cycle technology.

The ASL Sponge Iron unit consists of one rotary kiln of 500 TPD. The generation of flue gas from the kiln at full capacity is 120,000 Nm^3/hr at $950\text{-}1000^0$C. The rotary kiln is directly connected to the WHRB Boiler, with a steam generation capacity of 52 TPH. The total waste flue gas generated is ducted to the WHRB to generate steam at 87 kg/cm^2 and 510^0C.

The generated steam is then introduced in to the Single flow with downward exhaust condensing Turbo Generator for power generation. After transferring the heat, the waste flue gas is passed through the Electro Static Precipitator (ESP) and vented to atmosphere. Fig 1 shows the schematic diagram of the 40 MW power plant at ASL.

Equipment Technical Details

Sr. No	Parameter	Details
A.	**Turbine**	
1.	Make	ALSTOM Power Turbine presently known as Siemens Ltd.
2.	Type	Single flow with downward exhaust condensing
3.	Rating	40 MW
4.	Inlet steam pressure	85 kg/cm^2
5.	Inlet steam temperature	500 ^{0}C
6.	Turbine Speed	7059 rpm
B.	**Boiler Make-Cethar Vessels Limited.**	
7.	Type	Single drum water tube boiler
8.	Net Steaming Capacity at MCR	52 TPH
9.	Super heater outlet pressure	87 kg/cm^2
10.	Super heater outlet temperature	510 ^{0}C
11.	Gas temperature	950-1000 ^{0}C

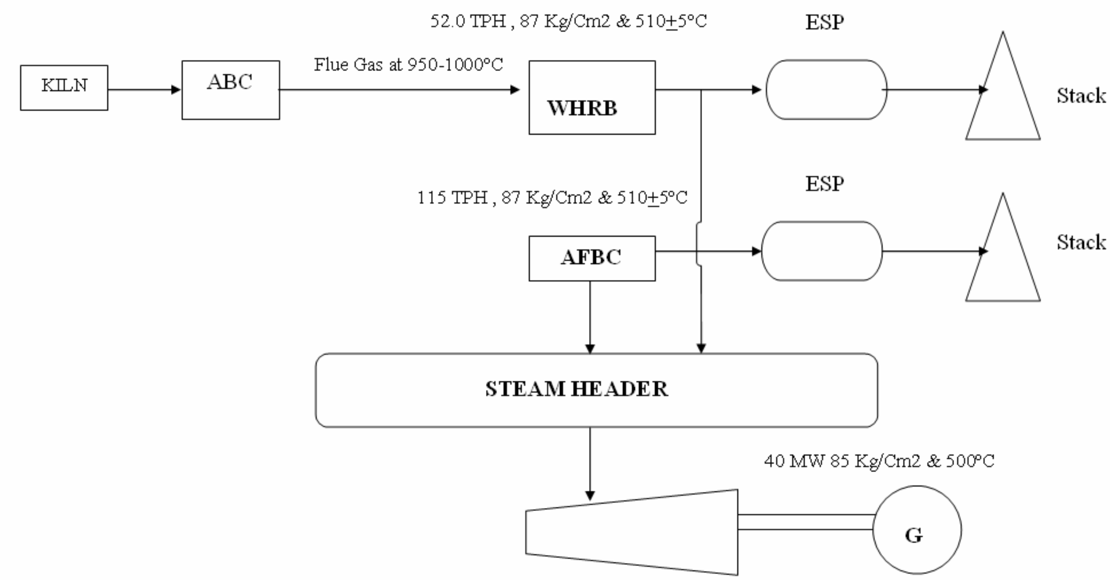


Fig 1: Schematic diagram of the 40 MW power plant at ASL

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

The project would result in a CO_2 emission reduction of 1,061,451 tons during the 10 -year crediting period from 2007 - 2017 which relates to the increased electrical energy generation from the project of about 870,042 MWh. The project activity enables reduction of greenhouse gas emissions as provided in Table below.

Years	**Annual estimation of emission reductions in tonnes of CO_2 e**
Year 1	106,145.1
Year 2	106,145.1
Year 3	106,145.1
Year 4	106,145.1
Year 5	106,145.1
Year 6	106,145.1
Year 7	106,145.1
Year 8	106,145.1
Year 9	106,145.1
Year 10	106,145.1
Total CER's	1,061,451
Crediting Period	10 years
Annual average over the crediting period of estimated reductions ((tonnes of CO_2 e)	106,145.1

A.4.5. Public funding of the project activity:

The project has not received any public funding.

SECTION B. Application of a baseline and monitoring methodology

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

Title: "Consolidated baseline methodology for waste gas and /or heat and /or pressure for power generation".

Reference: Approved consolidated baseline methodology ACM0004.

Version : 02,

Sectoral Scope : 01

Date: 03 March 2006

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

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

The methodology applies to electricity generation project activities:

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

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

The project activity utilizes the waste gas emanating from the DRI kilns to produce electricity. The generated electricity will be displacing the electricity generation by another coal and coal washery rejects based AFBC boiler which has capacity to generate additional power. In the project activity, no fuel switch is being done in the process where the waste heat is produced. Thus the project activity satisfies all the applicability conditions as specified in the methodology ACM0004, and hence the methodology is applicable for the project activity.

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

	Source	Gas	Included	Justification/Explanation
Baseline	Grid Electricity Generation	CO_2	Yes	Main emission source
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
	Captive Electricity	CO_2	Yes	Main emission source

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

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

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

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

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

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

Alternative 1: Proposed project activity without CDM benefits

ASL have set up a 12 MW waste heat recovery based electricity generation at its facility for meeting in-house requirements and export of surplus power to the state grid. This alternative is in compliance with all applicable legal and regulatory requirements. In order to implement this project activity ASL had to face number of barriers, financial and technological barriers, which makes this alternative, less attractive for the project activity without CDM benefits. Hence this option can be eliminated for consideration as a baseline scenario.

Alternative 2: Import of electricity from Eastern regional grid

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

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

In the absence of the proposed CDM Project activity, ASL could generate electricity by implementing a coal and coal washery rejects based CPP to meet their demand. A coal, coal washery rejects based CPP would be meeting the requirement of the project participant as the company is already operating one AFBC boiler using coal, coal washery rejects from their existing washeries. Additional power generation of 12 MW (equivalent to the capacity of the project activity i.e. the WHRB) could have been achieved with a marginal increase in cost of FBC boiler. Another AFBC boiler with coal and coal washery rejects would also have had technological advantages of higher PLF and also abundant availability of fuel from their existing and nearby coal washeries resulting in lesser capital cost and cost of generation per unit.

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

Alternative 3b: Diesel based captive power generation

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

Alternative 3c: Gas based captive power generation

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

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

ASL has the option of satisfying its captive power requirements using grid power as well as generating captive power from other fuels such as coal and coal washery rejects, diesel or gas. This alternative is in compliance with the existing legal and regulatory requirements. However ASL already has an existing AFBC boiler based on coal and coal washery wastes, it makes economic sense for them to go for this coal/ coal washery waste based CPP only rather than the combination of two (grid power and CPP). Therefore this option is ruled out for further consideration. Therefore the options 2, 3a and 3b are most likely when compared to option 4.

Alternative - 5 Other uses of waste heat and waste gas

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

Evaluation of alternatives for baseline selection:

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

Among all these alternatives, the one that does not face any prohibitive barrier and is the most economically attractive should be considered as the baseline scenario. Thus from the above identified alternatives, it can be found that alternatives 2, 3a & 3b are the most likely alternatives for the baseline scenario.

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

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

Source: Central Electricity Authority

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

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality): >>

As per the decision 17/cp.7, paragraph 43, a CDM project activity is additional if anthropogenic emissions of green house gases by sources are reduced below those that would have occurred in absence of registered CDM project activity. The methodology requires the project proponent to determine the additionality based on 'Tool for the demonstration and assessment of additionality ver 03' as per EB-29 meeting.

Additionality of project activity as described is discussed hereunder.

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

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

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

Sub-step 1b

Consistency with mandatory applicable laws and regulations

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

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

Step-3. Barrier Analysis

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

Investment Barrier

ASL has installed an AFBC boiler at 115 TPH for their captive power generation which would cater to their power requirement of 28 MW. In order to meet the additional power requirement of 12 MW, ASL could have set up another AFBC boiler of this capacity as it requires marginal increase in the project cost. However, ASL in order to reduce the GHG emissions and also to avail the carbon benefits due to power generation from WHRB, proposed to set up a WHRB with 52 TPH capacity

The cost of setting up a WHRB of this high pressure and temperature configuration is much higher as compared to setting up another small AFBC boiler or augmenting the existing capacity. The company has installed one boiler based on waste heat recovery and steam piping which is at additional cost as compared to only up-gradation of coal and coal washery rejects based FBC Boiler to generate the balance steam. The cost of adding this additional steam generation capacity would have been marginal as compared to setting up of WHRB for power generation.

Comparing with similar projects, it can be noted that ASL is the second in the region to implement a WHRB boiler with high pressure and temperature configuration of 87 ata and 510 deg C respectively which requires greater investment when compared to other WHRB configuration (<67 ata pressure) already implemented in the sector.

Technological barriers

The operation of the 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 are routed through WHRB. Any instability in the quality of raw material of the DRI kiln, affects 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 boilers are to be taken to shut down for maintenance and kiln also has to be stopped. The cooling and heating cycle of the kiln takes minimum of about 5-6 days involving a substantial expenditure. Also, off grade sponge iron generation takes place in the kiln while cooling and restarting it. Moreover such irregularities in boiler operation also hamper smooth functioning of electric furnaces. Thus all these technical difficulties lead to colossal operational barriers which need to be properly addressed to ensure smooth functioning of the unit. Whereas all these technical barriers do not appear for other alternatives discussed above in section B.4.

The quantum of generation of power from WHRB depends on the quantum of gas generated from the kiln which in turn depends on the production of sponge iron. Kiln always does not run at rated capacity which leads to shortfall in power generation leading to financial loss.

For ensuring continuous power generation consistent supply of gas at requisite heat value to the WHRB is required. This would require proven technology and trained manpower to operate such kind of system. As ASL had no prior experience in this sector, it had to face many technological barriers during and after commissioning of the plant. ASL was aware that they would have to get people trained to operate and maintain the system for ensuring consistent and reliable power generation through the waste heat recovery from the DRI kilns without adversely affecting the kiln operation and product quality. However, to sort out the problems associated with operating WHRB at high pressure (87ata) and 510^0C temperature, ASL had to shut down the kiln many a times leading to huge financial loss to the tune of INR 135 Million. The other production units of the plant could also not be run due to non-availability of power. The details of various technological barriers faced by ASL and the subsequent financial loss due to it will be given to the DOE during the validation.

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

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

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

Despite all the above technical barriers ASL has opted for WHRB considering the flow of CDM revenues.

Barriers due to prevailing practice

ASL was the 2nd company[1] in the state to initiate the work on its plant and signed a Memorandum of Understanding (MOU) with the Orissa Government. Though, ASL had initiated the work of setting up the integrated complex earlier, it could not do so in time, as it faced many barriers during the

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

implementation of the project. ASL was amongst the first companies to set up the WHRB at high operating parameters (i.e. 87 ata).

Institutional Barrier

ASL has signed a power purchase agreement (PPA) with Grid Corporation of Orissa (GRIDCO) for exporting power to the grid. GRIDCO has signed the PPA for a tariff of INR 2.02 for the whole tenure of the PPA. Also, as per the PPA, GRIDCO has to pay ASL for the power exported within seven days of the receipt of the invoice. However, there have been consistent delays in payment from GRIDCO. This has led to further financial constraints to ASL. Carbon funds i.e. CDM revenues, will ease out these financial constraints.

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 washery reject based captive power plant which is the most likely and economically attractive alternative to the project. This is considering the below:

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

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

Step 4. Common practice analysis

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

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 Chhattisgarh. Thus it clearly indicates that captive power generation is not a common phenomenon in the similar industrial units. Captive power generation includes waste heat recovery based power generation as well.

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

Such an advanced technology based WHR power generation unit has been employed in only one unit in Orissa prior to ASL. Thus in light of the above discussion it can be concluded that difficulties associated with such kind of project activities has restricted other similar industrial units from establishing such a project where as ASL has gone ahead with the proposed project activity considering CDM revenue into account.

Step 4b: Discuss any similar options that are occurring

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

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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

a) Project Emissions

The project emissions are given as:

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

Where,

PE_Y : Project emission in year y (t of CO_2)
Q_i : Mass or volume unit of fuel i consumed (t or m^3)
NCV_i : Net calorific value per mass or volume unit of the fuel i (TJ/t or m^3)
EF_i : Carbon emission factor per unit of energy of the fuel i (tC/TJ)
$OXID_i$: Oxidation factor of the fuel i (%)

b) Baseline Emissions

Baseline emissions are given as:

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

Where,

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

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

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

(Copy this table for each data and parameter)

Data / Parameter:	EF
Data unit:	T CO_2/MWh
Description:	Captive Power Plant
Source of data used:	-
Value applied:	1.22
Justification of the choice of data or description of	Emission factor for coal has been taken from IPCC guideline and as a conservative approach the efficiency of the boiler has been assumed at 100% where as the turbine efficiency has been estimated at 27 %.

measurement methods and procedures actually applied :	
Any comment:	This data has been calculated and the details are given in Annex – 3

B.6.3 Ex-ante calculation of emission reductions:

a) Project Emissions

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

b) Baseline Emissions

The baseline emissions are given as

$BE_y = EG_y \times EF_{captive,y}$

Since the baseline scenario has been determined as the captive power generation. The emission factor for displaced electricity is calculated as follows.

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

where:

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

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

Option A

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

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

Option B

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

As a conservative approach ASL has considered OPTION B.

The baseline emissions are given as

$BE_y = EG_y \times EF_{captive, y}$

$EF_{captive, y}$ the CO2 baseline emission factor for the electricity displaced due to the project activity during the year in tCO2/ MWh which has been calculated at 1.22 tCO_2/MWh.

EG_y i.e. the net quantity of electricity generated by utilizing the waste gases are calculated as under:

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

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

The emission reduction ER_y by the project activity during a given year y is the difference between the baseline emissions through substitution of electricity generation with fossil fuels (BE_y) and project emissions (PE_y), as follows:

$ER_y = BE_y - PE_y$

Where:

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

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

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

$ER_y = BE_y - PE_y$

ER_y = 106,145.1 - 0 = 106,145.1 t CO_2/yr

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

Year	Estimation of project activity emissions (tons)	Estimation of baseline emissions (tons)	Estimation of leakage (tons)	Estimation of overall emission reductions (tons)
Year 1	0	106,145.1	0	106,145.1
Year 2	0	106,145.1	0	106,145.1
Year 3	0	106,145.1	0	106,145.1
Year 4	0	106,145.1	0	106,145.1
Year 5	0	106,145.1	0	106,145.1
Year 6	0	106,145.1	0	106,145.1
Year 7	0	106,145.1	0	106,145.1
Year 8	0	106,145.1	0	106,145.1
Year 9	0	106,145.1	0	106,145.1
Year 10	0	106,145.1	0	106,145.1
Total	0	1061451	0	1061451

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

B.7.1 Data and parameters monitored:
(Copy this table for each data and parameter)

Data / Parameter:	EG_{Gen}
Data unit:	MWh/year
Description:	Total Electricity generated
Source of data to be used:	Onsite Instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	288,000
Description of measurement methods and procedures to be applied:	Monitoring Location: Meters at plant and DCS will measure the data. Manager In-charge would be responsible for regular calibration of the meter, which would be carried out annually.
QA/QC procedures to be applied:	This can be cross-checked with the individual consumption of the different load centres. The verifier can check the calibrated equipments. Calibration of all the measuring meters will be done once a year.
Any comment:	This data will be measured

Data / Parameter:	EG_{Aux}
Data unit:	MWh/yr
Description:	Auxiliary Consumption
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	28,800
Description of measurement methods and procedures to be applied:	Monitoring Location: Meters at plant and DCS will measure the data. Manager In-charge would be responsible for regular calibration of the meter, which would be carried out annually.
QA/QC procedures to be applied:	This data will be recorded online continuously. Calibration of all the measuring meters will be done once a year.
Any comment:	This data will be measured

Data / Parameter:	EG_{Net}
Data unit:	MWh/yr
Description:	Net electricity generated
Source of data to be used:	Data records of ASL
Value of data applied for the purpose of	259,200

calculating expected emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	-
QA/QC procedures to be applied:	-
Any comment:	This parameter is calculated using the formulae $EG_{Gen} – EG_{Aux}$

Data / Parameter:	S_{WHRB}
Data unit:	T/day
Description:	Total steam generation from WHRB
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	1164
Description of measurement methods and procedures to be applied:	This data will be monitored daily and recorded in the logbooks. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
QA/QC procedures to be applied:	All necessary procedures will be followed. This will be used to calculate the effective waste heat generation. All instruments will be calibrated annually
Any comment:	This parameter will be measured

Data / Parameter:	S_{AFBC}
Data unit:	T/day
Description:	Total steam generation from AFBC
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	2303
Description of measurement methods and procedures to be applied:	This data will be monitored daily and recorded in the logbooks. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
QA/QC procedures to be applied:	All necessary procedures will be followed. All instruments will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	S_{TG}

Data unit:	T/day
Description:	Total steam inlet to the turbine
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	3467
Description of measurement methods and procedures to be applied:	This data will be monitored daily and recorded in the logbooks. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
QA/QC procedures to be applied:	All necessary procedures will be followed. All instruments will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**T_{WHRB}**
Data unit:	^0C
Description:	Average steam temperature from WHRB
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	510
Description of measurement methods and procedures to be applied:	This data will be monitored daily from the temperature gauge and recorded in the logbooks. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
QA/QC procedures to be applied:	All necessary procedures will be followed. All instruments will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**T_{AFBC}**
Data unit:	^0C
Description:	Average steam temperature from AFBC boiler
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	510
Description of measurement methods and procedures to be	This data will be monitored daily from the temperature gauge and recorded in the logbooks. The data will be archived either electronically or in paper and will be available up to two years after crediting period.

applied:	
QA/QC procedures to be applied:	All necessary procedures will be followed. All instruments will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**T_{TG}**
Data unit:	^0C
Description:	Average steam temperature at the inlet of Turbine
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	500
Description of measurement methods and procedures to be applied:	This data will be monitored daily from the temperature gauge and recorded in the logbooks. The data will be archived either electronically or in paper and will be available upto two years after crediting period.
QA/QC procedures to be applied:	All necessary procedures will be followed. All instruments will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**P_{WHRB}**
Data unit:	Kg/cm^2
Description:	Average steam pressure from WHRB
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	87
Description of measurement methods and procedures to be applied:	This data will be monitored daily from the pressure gauge and recorded in the logbooks. The data will be archived either electronically or in paper and will be available upto two years after crediting period.
QA/QC procedures to be applied:	All necessary procedures will be followed. All instruments will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**P_{AFBC}**
Data unit:	Kg/cm^2
Description:	Average steam pressure from AFBC
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of	87

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

Data / Parameter:	**P_{TG}**
Data unit:	Kg/cm^2
Description:	Average steam pressure inlet of Turbine
Source of data to be used:	Onsite instrumentation
Value of data applied for the purpose of calculating expected emission reductions in section B.5	85
Description of measurement methods and procedures to be applied:	This data will be monitored daily from the pressure gauge and recorded in the logbooks. The data will be archived either electronically or in paper and will be available upto two years after crediting period.
QA/QC procedures to be applied:	All necessary procedures will be followed. All instruments will be calibrated annually.
Any comment:	This data will be measured

Data / Parameter:	**h_{WHRB}**
Data unit:	kCal/kg
Description:	Enthaply
Source of data to be used:	Steam tables
Value of data applied for the purpose of calculating expected emission reductions in section B.5	815
Description of measurement methods and procedures to be applied:	This data will be calculated from steam tables. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
QA/QC procedures to be applied:	-
Any comment:	This data will be calculated from the steam table
Data / Parameter:	**h_{AFBC}**
Data unit:	kCal/kg

Description:	Enthaply
Source of data to be used:	Steam tables
Value of data applied for the purpose of calculating expected emission reductions in section B.5	815
Description of measurement methods and procedures to be applied:	This data will be calculated from steam tables. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
QA/QC procedures to be applied:	-
Any comment:	This data will be calculated from the steam table

Data / Parameter:	**h_{TG}**
Data unit:	kCal/kg
Description:	Enthaply
Source of data to be used:	Steam tables
Value of data applied for the purpose of calculating expected emission reductions in section B.5	810
Description of measurement methods and procedures to be applied:	This data will be calculated from steam tables. The data will be archived either electronically or in paper and will be available up to two years after crediting period.
QA/QC procedures to be applied:	-
Any comment:	This data will be calculated from the steam table

B.7.2 Description of the monitoring plan:

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

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

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

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

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

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)

15/05/2007.

The contact detail of the person responsible is given in Annexure-1.

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:
07/03/2004

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

25 years

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

Fixed crediting period is chosen

C.2.1. Renewable crediting period

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

C.2.1.2. Length of the first crediting period:
>>

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

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

C.2.2.2. Length:
10 years, 0 months

SECTION D. Environmental impacts

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

Assessment of Environmental Impact due to the project activity was carried out and submitted to the local pollution control board. On reviewing and assessing the report, the Orissa State Pollution Control Board (OSPCB) has accorded clearances to set up the plant.

ASL has installed an electrostatic precipitator to reduce the particulate emissions less than 100 mg/Nm^3. All effluent and blow down water of power plant are treated in a neutralisation pit made for this purpose. The treated water is used for ash slurry making and disposed to Ash Pond. The return water from Ash Pond is recycled for Ash disposal.

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

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

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

SECTION E. Stakeholders' comments

>>

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

The stakeholders' meeting inviting views and comments of the stakeholders involved was conducted on 17th November, 2003 at 11.00 a.m. in the Revenue IB Athagarh. The stakeholders identified for the project are state government, state pollution control board, representatives of the local panchayat etc. After a detailed discussion a 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 and the same would be produced to the DOE during validation.

E.2. Summary of the comments received:

As per the public hearing document, all the stakeholders have given their consent for the project subject to upbringing of the socio-economic condition of the habitats. Since the proposed project has already provided employment to the local people during its implementation the members attended the meeting have appreciated the work of ASL in setting up the plant. There were no adverse comments on the project. The details of the public hearing would be made available to the DOE.

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

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

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Aarti Steels Limited
Street/P.O.Box:	Plot No. 11/1B/41,
Building:	Sector-11, C.D.A., Bidanasi
City:	Cuttack
State/Region:	Orissa
Postfix/ZIP:	753014
Country:	India
Telephone:	+ 91 671 2603285
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E-Mail:	aartisteel@mail.lnsel.net
URL:	
Represented by:	
Title:	Vice President (Sponge Iron & Power)
Salutation:	Mr.
Last Name:	Narayan
Middle Name:	
First Name:	L.T.P
Department:	Sponge Iron & Power.
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Direct FAX:	+ 91 671 2603407
Direct tel:	+ 91 671 3093814
Personal E-Mail:	narayan.ltp@gmail.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding for this project

Annex 3

BASELINE INFORMATION

The project activity generates electricity by using waste gases emanating out of the DRI kiln in the production facility. Thus it displaces equivalent quantum of power which otherwise would have been generated in a captive coal and coal washery rejects 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 and coal washery rejects based captive power plant.

Emission Reduction Estimation from the Project Activity	
Calculation of baseline emission factor (t CO_2/MWh)	
Carbon Emission Factor of the Coal (including coal washery rejects)used in the baseline plant (tC/TJ)	26.1
Efficiency of the baseline plant	28 %
Emission Factor of the baseline plant (t CO_2/MWh)	1.22
Emission Reduction due to the project activity	
Year	Emission Reduction (t CO2)
Year 1	106,145.1
Year 2	106,145.1
Year 3	106,145.1
Year 4	106,145.1
Year 5	106,145.1
Year 6	106,145.1
Year 7	106,145.1
Year 8	106,145.1
Year 9	106,145.1
Year 10	106,145.1

Annex 4

MONITORING PLAN

A. THE METHODOLOGY REQUIRES MONITORING OF THE FOLLOWINGS

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

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

B. ESTIMATION OF NET POWER GENERATED FROM WHRB

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

Note :

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

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

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

Annex 5

ABBREVIATIONS

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

Annex 6

LIST OF REFERENCES

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