**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:

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Title of project activity : SHYAM DRI WHR CPP

CDM document version No : 3

Date of the CDM document : 09/04/2008

### A.2. Description of the project activity:

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**Purpose of project activity**

The purpose of the proposed project activity is to generate electricity by generating steam using waste heat contained in the waste flue gases released from 2 numbers of ABC (After Burning Chamber) from two numbers of DRI (Direct Reduced Iron) sponge iron kiln having 350 TPD X 2 Nos. The heat contained in waste gases will be transferred to water which converts water in to steam in two numbers of WHRBs (Waste Heat Recovery Boilers 38tph each) producing aggregate 76 tph steam at 66 $kg/cm^2$ pressure and $490 \pm 5^0C$ temperature to generate total 15 MW electricity from Waste Heat.

The purpose of the project activity is to achieve better energy efficiency, achieve sustainable development in the industry and improve the working environment of Sponge Iron-making process. The power so generated shall mainly be used to meet the captive power requirement of Shyam DRI Plant itself.

The net result is reduction in the demand of electricity from coal based captive power generation and resultant reduction in GHG emission

**Background of the company**

SHYAM DRI is putting up integrated steel complex to produce Sponge Iron, Steel billets, Rerolled Products, Ferro Alloys, Coal Washrey along with captive power plant. The company is implementing the project in 2 phases. In phase -1, the company has installed 2 No. DRI sponge iron rotary kiln with 350 TPD capacity using Coal as fuel, Induction Furnace, Ferro Alloys and Rolling Mill, Coal Washery along with aggregate 25 MW captive power plant out of which 15 MW power will be generated from WHRB route (which is the part of the present project activity) and balance 10 MW power will be generated from coal fired AFBC route. In second phase company will be installing additional 3 DRI Kiln having capacity of 100 TPD each with Preheating Kiln along with 30 MW x 2 Nos. (total 60 MW) power plant out of which 8 MW power will be generated from WHRB route (based on the CDM strength) and balance power will be generated from coal fired AFBC route.

Thus the company is presently implementing the 15 MW WHRB power plant as CDM Project activity and will be following CDM registration procedures for this capacity.

The generated power will firstly meet its present and future requirement of captive power. The balance back up or standby support power required to meet the fluctuating power generation from WHRB, would be drawn from WESCO which is the local grid and which is part of Eastern Regional Grid. In case of Surplus the unit will wheel the surplus power to the Grid.

Shyam DRI is having the following manufacturing facilities installed in their sponge iron plant premises; the connected load for the each facility and the respective power consumption of products from each facility is given as below:

| | **Facilities installed** | **Production (TPA)** | **Connected load in KW** | **Estimated Power consumption for each Unit of Product** |
|---|---|---|---|---|
| 1 | Sponge Iron Production (2 Kilns of 350 TPD each) | 200000.00 | 3317 | 85kWh/tonne[1] |
| 2 | Rolling Mill/ TMT Bar | 60000.00 | 3829 | 85kWh/tonne[2] |
| 3 | Induction Furnace (Steel Melting Shop with CCM) | 200000.00 | 36199 | 750kWh/tonne[3] |
| 4 | Coal Washery | 300000.00 | 1285 | 15kWh/tonne[4] |
| 5 | Auxiliary for Captive Power Plant (10%) | 25 MW | 4485 | 10% of Gross[5] generation |
| 6 | Light and Fan Load | - | 500 | |
| 7 | TOTAL | - | 49615 | **180980.00 MWh/year** |

Based on the planned production facilities power requirement was assessed on the basis of standard power consumption on per unit of production, the contract demand (captive power generation capacity) required is estimated approximately to be slightly above 25 MW. Similarly on the basis of each installed facility actual power requirement, the connected load chart has been prepared, which shows the connected installed load, is around 49 MW, however due to a number of stand-bye equipments installed, as well as due to variation in demand of power from time to time by the auxiliary facilities, the captive power demand is assessed to be slightly above 25 MW. The above demand of power is fulfilled by installation and operation of a 25MW captive power plant as stated above and by seeking the parallel back up power support from grid. The actual production from different facilities may vary due to a number of technical and commercial reasons, similarly the estimated per unit consumption of power may also vary due to variation in production and other technical reasons.

1 http://books.google.co.in/books?id=YIB7enjxW2UC&printsec=frontcover&dq=POWER+CONSUMPTION+IN+COAL+BASED+SPONGE+IRON+PLANTS#PPA250,M1 (at page 250)

2 http://www.energymanagertraining.com/Presentations2008/3L_2008Nov21_Iron&Steel/03-AKAsthana.pdf (at page2)

3 http://www.livemint.com/2007/08/07174444/India-No-5-in-steel-output-r.html

4 http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V3B-498TKRS-99&_user=10&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=fc021a75824ca33e51f8bfa6abe4a54f

5 www.mahagenco.in/Annex%20B%20%20MECON%20Report.pd *f*

The main carbon benefit from the facility of the project activity arises from the replacement / displacement of an equivalent amount of electricity to the extent of 15 MW electricity generated from steam which is produced from waste heat recovered from waste gases in two WHRBs, which would have been otherwise generated by increasing the capacity of the Boiler of the Coal based captive power plant.

The total $CO_2$ emission reduction for the entire crediting period of 10 years has been calculated as 943030.00 tonne $CO_2$- equivalent. The other benefits being reduction of $CO_2$ emissions considering global scenario, Sustainable development through better energy efficiency and it also leads to the improvement of local environment.

SHYAM DRI will have proper monitoring system to calculate the power generated out of the CPP and accurately record the reduction in $CO_2$ emissions. SHYAM DRI will follow monitoring plan to achieve complete transparency in monitoring, recording and calculating reduction in $CO_2$ emissions.

The Project activity achieves the following goals.

- Utilisation of heat energy of waste gas.
- Meet the power requirement without any significant T & D losses.
- Helps to become self reliant and less dependant on grid supply of electricity.
- Upgraded technology to achieve sustainable Industrial growth in State.
- Conserve natural resources and environment.
- Promotes the sustainable development.

The project activity will lead to sustainable development and promote sustainable Industrial growth by conserving natural resources and preventing the thermal impact even though no such statutory requirement exists.

**Social benefit to state**

The project activity increases the direct employment within the company for skilled manpower and Professionals as well as indirect employment opportunities out side the company, due to the project activity

**Economical Benefits to State**

The state will generate revenue out of the manufacturing activities supported by the captive power generation and due to purchase of equipment for execution of project by way of Sales Tax; Excise Duty; Entry Tax etc.

**Environmental Benefit**

The Project activity uses waste heat recovery based Power Plant by utilizing waste heat from flue gases coming from process and thus effectively saving environment of thermal pollution. The project activity displaces power from fossil fuel based Captive power of the company and hence reduces $CO_2$ emission

**Reduction of T & D Losses of Power**

The Power generated by the project activity will be used for in house requirement and consumption without any significant T&D losses. This is significant as grid has more than 32% losses in its T&D.

**Reduction in SPM level in the Atmosphere and other additional Economic benefits**

The proposed ESP shall remove the ash from Flue Gases which will be collected in ash hopper. This ash will be given free of cost to cement plants & brick manufactures for further Economic benefit and use. The ash used for production of bricks saves the valuable productive soil, also it reduces the air pollution caused by the conventional brick kilns due to the coal burning.

**A.3. Project participants:**

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| Name of the Party Involved (host) host party- | Private and/or Public entity (ies) Project Participant as applicable | Kindly indicate if the party involved wishes to be Considered as project participant (Yes/ No) |
|---|---|---|
| India (host)<br>**Ministry of Environment and Forest** | **SHYAM DRI Power Ltd.-** Private entity | No |

**A.4. Technical description of the project activity:**

**A.4.1. Location of the project activity:**

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**A.4.1.1. Host Party(ies):**

>> India

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

>> Orissa, India

**A.4.1.3. City/Town/Community etc:**

>> Village:Pandloi & Nishanbanga P.O. Lapanga/Rengali, Sambalpur District, Orrisa State

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

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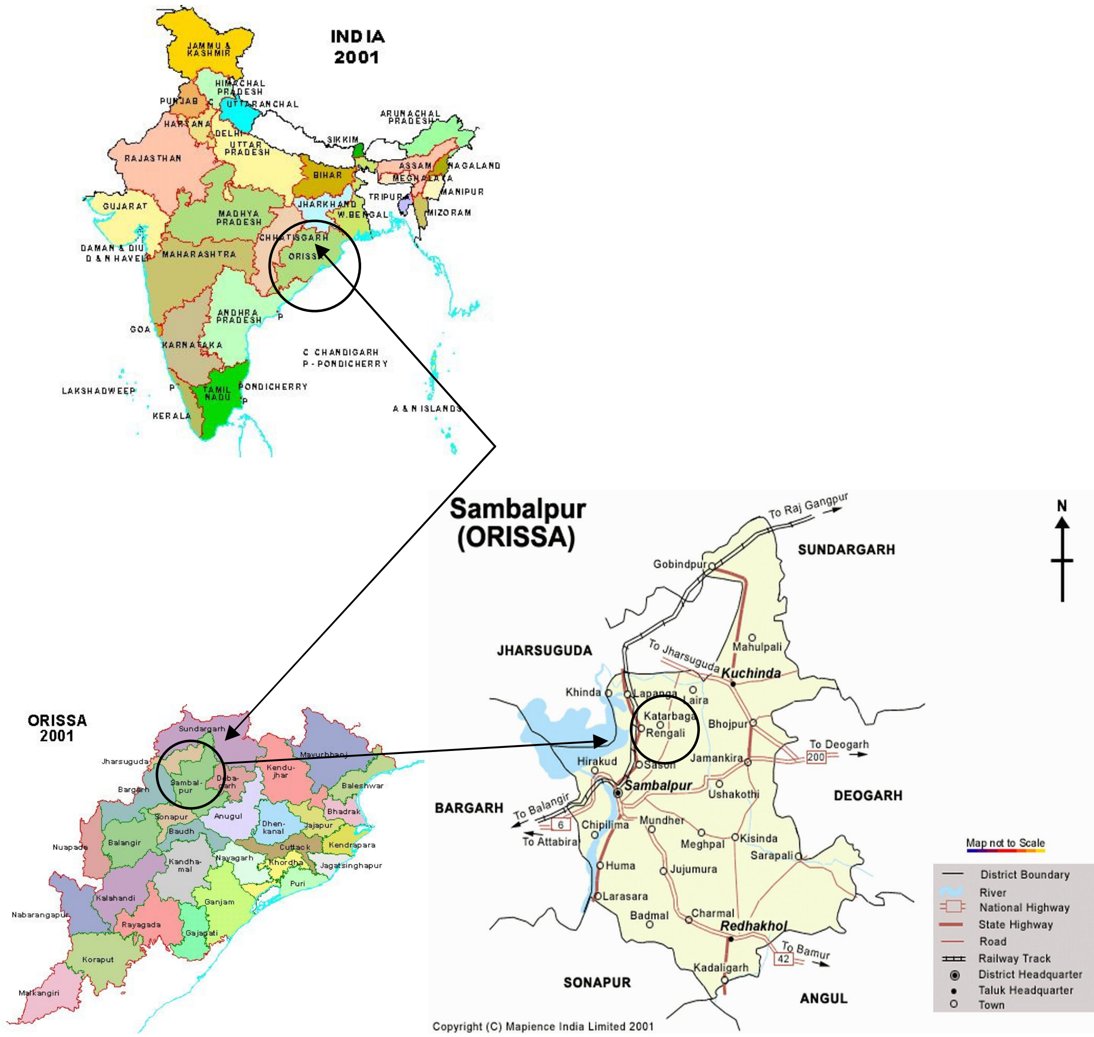
**Physical Location:**

The company is located at Village:Pandloi & Nishanbanga P.O. Lapanga/Rengali, Sambalpur District, Orrisa State at Plot No. & Chaka No. 981/1293, 949/1295, 1231/1349, 986, 1001/1382 & 1231/1383 and Khatiar Sl.No.116/192 of PS-Kararbaga, about 35 KM from Sambalpur Railway Station on State Highway No.10. Longitude= E $84^0$ 2’35” Latitude=N $21^0$ 40’50’’




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

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The project activity is an electric power generation project utilising waste heat where aggregate electricity generation savings is equivalent to 83160 MWh per year. The project activity may be principally categorised in category –1 Energy Industries (Renewable /non renewable) as per Scope of Projects activities enlisted in the "list of sectoral scopes and approved base line and monitoring "methodologies" on the website for accreditation of "Designated operational Entities".

The CDM PDD is based on approved methodology ACM0004 version 02 and sectoral scope; 01 03 March 2006 "Consolidated Baseline methodology for waste gas and/or heat and/or pressure for power generation"

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

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WHRB based captive Power Plant at SHYAM DRI is proposed to utilise the heat content of flue gases coming out of ABC of sponge iron kiln.

The Exhausted flue gases from rotary kiln shall be received at ABC for further incineration where the waste gas temperature likely to reach upto 950-1000$^0$C after ABC. No auxiliary fuel is fired in ABC. The generated quantity and the temperature of flue gases are influenced by a number of operating parameters of the sponge iron plant. At the best operating levels this waste heat shall produce producing aggregate 76 tph steam is generated at 66 kg/cm$^2$ pressure and 490$^0$C temperature. The WHRBs will be of single drum water tube with radiant chamber, along with convective super heater, radiant super heater, economiser, de-super heater and hoppers for ash Collection as ash comes with flue gases.

The outlet boxes of the WHRB, leads to ESP to remove SPM from exhaust gases. The exhaust gas temperature shall be kept at 170$^0$C. The feed water temperature will be maintained at the inlet to economiser 105$^0$C.

The high pressure steam from WHRB (76 tonnes/hr) will be used to operate high efficiency extraction cum condensing multi stage STGs to generate 15 MW Electricity from WHRB.

Ash collected from both WHRB hoppers & ESP will be conveyed pneumatically to ash silo.

Other systems required are circulating water, Demineralised water plant, Instrument Air Compressor and Exhaust Steam Condenser.

Steam from exhaust of STG rotor will be condensed in air cooled condenser.

Only DM (De Mineralised) water will be used in boiler to avoid scale formation on boiler tubes.

Total Waste water is recycled and reused after treatment.

The generated power shall be used to meet the captive power requirement of the company.

The technology is environmentally safe and abides all legal norms and standards for SPM, emissions.

Maximum, 350 operating days in a year have been considered for the project activity for arriving at the financial parameters. No supplementary fuel is used in WHRB.

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

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| Years | Annual estimation of emission reductions in tonnes of CO2eq |
|---|---|
| 2008-09 | 94303.00 |
| 2009-10 | 94303.00 |
| 2010-11 | 94303.00 |
| 2011-12 | 94303.00 |
| 2012-13 | 94303.00 |
| 2013-14 | 94303.00 |
| 2014-15 | 94303.00 |
| 2015-16 | 94303.00 |
| 2016-17 | 94303.00 |
| 2017-18 | 94303.00 |
| Total for credit period (tonnes of CO2e) | 943030.00 |
| Total number of crediting years | 10 |
| Annual average over the crediting period of estimated reduction (tonnes of CO2e) | 94303.00 |

**A.15. Public funding of the project activity:**

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

## SECTION B. Application of a baseline and monitoring methodology

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

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Consolidated baseline methodology for waste gas and/or heat and/or pressure for power generation.ACM0004/ Version 02, Sectoral scope : 01, 3rd March 2006 and ACM0002 Sectoral scope : 01 of EB-36.

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

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The methodology applies to electricity generation project activities;

- that displaces 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 pressure or the waste gas is produced after the implementation of project activity.

The methodology covers both new and existing facilities.

The project activity meets the applicability as it meets the above conditions set out in approved methodology

1. WHRB produces steam by recovering waste heat from flue gases coming out of DRI sponge iron kiln and this steam is used to generate electricity in STG.
2. The Power will be used in house.
3. In the absence of the Project activity, the electricity requirement would have been met by coal based captive power generation. The $CO_2$ emission reduction will be achieved by reduction of corresponding $CO_2$ emissions in fossil fuel based captive power plants of the company.
4. There will be no fuel switch in sponge iron manufacturing process after the implementation of the project activity.
5. The base line calculations for $CO_2$ emission reduction are in line with approved methodology and are calculated using IPCC values and the performance data provided by the manufacturer for the TG set and the Boiler.
6. The project activity also reduces the thermal impact on the environment of the local area by recovering waste heat from flue gases.
7. By successful operation of project activity, the project activity will be able to displace/ substitute equivalent to 15 MW power from Coal based captive power plant of the company, with an average emission reduction of 94303.00 $tCO_2$/annum
8. The project activity adds no additional GHG emission.

Hence it is concluded that the selected methodology meets the conditions set out in approved methodology

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

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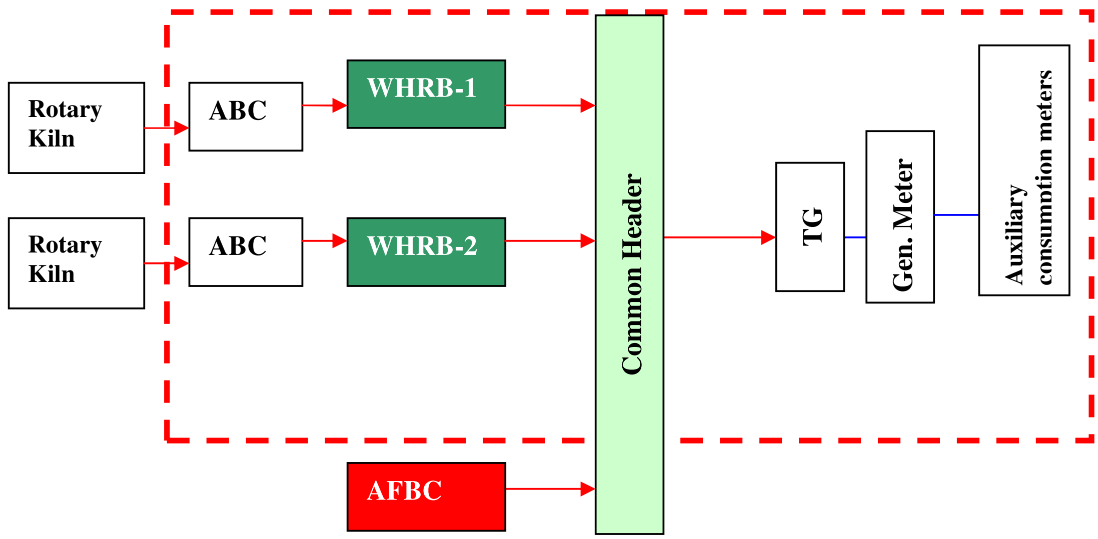
In line with methodology, the project activity is for the recovery of waste heat from flue gases for generation of steam for the electricity to be generated from CPP.

In the base line scenario, the electricity would have other wise been generated by fossil fuel based captive power plants of the company.

In line with methodology the project boundary comprises of the WHRBs, STGs, Auxiliary equipment, Power synchronising system, steam flow piping, flue gas ducts, where project participant has full Control.




***Overview on emission sources included in or excluded from the project boundary***

| | *Source* | *Gas* | | *Justification / Explanation* |
|---|---|---|---|---|
| *Baseline* | *Coal Based Captive Electricity generation* | $CO_2$ | *Included* | *Main emission source* |
| | | $CH_4$ | *Excluded* | *Excluded for simplification. This is conservative.* |
| | | $N_2O$ | *Excluded* | *Excluded for simplification. This is conservative.* |
| *Project Activity* | *Heat of waste gas for electricity generation* | $CO_2$ | *Excluded* | *In absence of the Project Activity the hot gases would have been let to the atmosphere. As well as no extra fuel or support fossil fuel is fired.* |
| | | $CH_4$ | *Excluded* | *Excluded for simplification* |
| | | $N_2O$ | *Excluded* | *Excluded for simplification* |

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

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We explain below the basic assumptions of the base line methodology.

1. Project activity displaces the electricity generation by coal burning in a Coal based captive power plant.
2. Project activity is based on waste heat utilisation to generate 15 MW electricity. This will be primarily used for captive purposes.
3. There is no provision to use any other fuel in the Project activity other than waste heat from flue gases coming from ABC of Rotary kilns.
4. There will be no fuel switch in rotary kiln from where the waste gases are produced and, further used in project. There will be no fuel switch in WHRBs power generation also.
5. In the absence of Project activity, the electricity requirement of 15 MW could be met by increasing the capacity of coal based boiler.
6. There is no legal binding that the waste heat is to be recovered.
7. The Project activity is being implemented to reduce the Coal based captive Power generation.
8. Project activity effectively uses the waste heat to generate 15 MW Power which would have otherwise been generated in the coal based captive power plant by combustion of fossil fuels.

The approved 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 pressure or waste gas is produced after the implementation of the project activity.

The baseline scenario "The electricity would have other wise been generated by installing a new coal based boiler or by increasing the capacity of existing coal based captive power plant. Hence the project activity displaces the captive power generation from fossil fuels. There is no fuel switch in rotary kiln where the hot waste gas is produced after the implementation of project activity"

Hence by installing the WHRB based CPP of 15 MW, the project activity displaces the $CO_2$ emissions by reducing the demand from coal based captive power plant.

Since the region is mainly a coal based mining area (Coal Belt), wherein setting up a coal based captive power plant is a natural choice. Therefore number of project proponents in region as well as surrounding region of Chhattisgarh have been putting up number of coal based captive power plants. A list of coal based captive power plants set up and being setup which is available from the official website of Government of India, Ministry of Environment and Forest (Reference E-01) The establishment of coal based captive power plant in itself is evidence that the grid based power is less attractive than the coal based power. It has been established in the PDD at Page No.14, Point No.2, under economical analysis of alternative, that the grids was having tripping due to poor infrastructure which results in financial losses, and also not economical attractive hence not a plausible option. Hence the available option to us was only to set up a coal based

Thermal Power Plant. Since the WHRB power plant had number of barriers explained in the Section B.5, Page No.24 to 33. Therefore it was not possible to set up a WHRB power plant without CDM support. Hence the most attractive option available to us was to implement the coal based captive power plant only. The cost of importing power from the Grid is determined based on the prevailing tariff as per which the cost of grid power was found above Rs.2.90 per kWh (Reference E-02 ). Whereas the coal based captive generation cost was only Rs 1.14 /kWh. Cost of the coal based captive power generation is given at PDD page No. 23 Section- B.5, Substep-2c. Also with the third party evidence showing the cost of power generation through coal based independent power plant (Enclosure Reference E-03), which proves that the grid based power supply is economically less attractive than the coal based thermal power plant. Hence as per the methodology it was selected as baseline. However the PP have adopted the most conservative approach while determining the $EFCO_2$ for the baseline coal based captive power plant, by considering the boiler efficiency as 100%.

Refer B.4 for explanation of how baseline methodology is applied to project activity.

**Description of the project activity scenario**

We have described project activity in Section A & B and give below summary of project activity.

1. The project activity includes waste heat recovery from waste flue gases generated from SHYAM DRI's sponge Iron kilns through WHRBs by producing steam. The steam will be utilised in turbine to generate 15 MW power.
2. In the absence of the Project activity, the Company would have generated equivalent of 15 MW power by installing a coal based boiler. Hence the power plant displaces 15 MW captive Coal power.
3. There will be no fuel switch in sponge iron manufacturing process after the implementation of the Project activity.

**Analysis showing why the emissions in the base line scenario likely to exceed the project activity scenario**

1. Project activity has no additional GHG emissions other than the normal running of the plant.
2. Project activity produces 15 MW power without adding any GHG emissions.

The absence of Project activity requires the production of additional 15 MW power by the Coal based captive power plant, which result in emissions of 94303.00 $tCO_2$ e./ annum.

As highlighted in baseline methodology we consider the following potential alternatives

1. Proposed project activity undertaken without being registered as a CDM project activity
2. Import of electricity from grid
3. New CPP based on Diesel oil as alternative fuels
4. New CPP based on Gas alternative fuels
5. New CPP based on Coal as other alternative fuels
6. A combination of 2,3,4 and 5
7. Alternative use of waste heat from flue gases
8. The continuation of the current situation

Detailed explanations of each alternative are given below:

1. **Proposed project activity undertaken without being registered as a CDM project activity**
In absence of the CDM benefit the proposed project activity possibly could not be implemented due to number of barriers such as Technology barrier, Investment Barrier, Financial barriers etc. as explained in B.3.

In absence of the proposed project activity the unit would met the complete electricity requirement by generating power from Coal based captive power plant and emit the waste heat into atmosphere.

2. **Import of electricity from grid**
This will meet all legal and statutory obligations of Country. As the power from WESCO grid is mainly fossil fuel based the reduction of $CO_2$ emissions is not achieved in this situation. The electricity purchase rate is high compared to Coal based captive power generation cost and company has to face power tripping due to poor grid infrastructure resulting in production loss. Hence, SHYAM DRI is putting up 25 MW captive power generating capacity to avoid production losses due to power interruptions.

3. **New CPP based Diesel oil as alternative fuels**
A CPP based on diesel oil/ furnace oil can be installed. The Diesel or any Petroleum Fuel based Power Plants are not feasible because of highly fluctuating rates and higher cost of generation, than the coal based CPP power cost and even grid power cost. Also this option will add GHG gas emissions to the existing scenario. It also involves high capital cost and high cost of operation.

4 **New CPP based Gas as alternative fuels**
Natural gas is not available in this area and hence ruled out as possible fuel.

5 **New CPP based on Coal as alternative fuels**
Coal is abundantly available fuel as the state lies within the coal belt. In addition company will be generating Washrey rejects and char/dolachar which can be used and char / dolachar can be sourced from other sponge iron manufacturers at no cost. The generating cost of power from, coal, char dolochar, Washrey rejects based CPP will be lower and generation will be regular and achieves +95% PLF.

There is no legal compulsion for Sponge Iron Plant to set up the captive power generation or to setup a waste heat recovery system. In addition to this there is also no restriction to generate own power through a CPP based on 100 % Coal or based on coal mixed with Char/ Dolochar and Washrey rejects. Hence Coal, Char/Dolachar based captive power plant is economically most attractive.

6 **A combination of 2&3/4/ 5**
The combination faces the same difficulties as in 2, 3, 4 or 5. Hence the combination is not feasible.

7. **Alternative use of waste heat from flue gases**
The waste heat is not useful in any form of use in the existing plant as SHYAM DRI does not have any heating requirements in the process of manufacture of sponge iron where thermic oil or

hot water or Hot Steam can be used. Generally the heat contained in the gases are let out into atmosphere leading to thermal emission. So far other use for waste gases and waste heat has not been developed in sponge iron manufacturing.

**8 The continuation of current situation**

Currently the SHYAM DRI is drawing power from WESCO grid. It can continue to do the same. However the company does not want to depend only on grid power as grid has frequent tripping of power which result in production losses.

Other alternatives common to similar units:

1. Most of the units operating induction furnaces independently have opted for grid power. But due to frequent power cuts and high tariff of power, they are facing problem.
2. A few units also have put up coal based captive power generation while only a few have put WHRB based CPP due to the CDM strength.

.

In view of the above, the only flexible alternative to SHYAM DRI is to select a coal based captive power plant which can run on Char/ Dolochar / Washery Rejects. Since WHRB based power is not consistent, Plant can not run only on WHRB power alone. Annualised generation cost of WHRB power is found to be higher than coal based CPP power due to poor PLF and other indirect costs.

Economical Analysis of alternatives

| Alternative | Capital Cost | Cost Comparison | Comment |
|---|---|---|---|
| 1.Project activity not as CDM activity but installed just as WHRB based power plant | Rs 45.00 million/MW | Annualized cost of power from WHRB without CDM support is found higher i.e 1853.18 Rs./MWh than AFBC boiler based cost of power ie. 1200.37 Rs./MWh. (refer to B.5., Step-2 Investment Analysis, comparative cost of power) | Various technology, investment & financial barriers will hinder the implementation of the project. Also annualized cost of power will become higher due to poor plant load factor and uncertain fluctuation. Hence can not be implemented. |
| 2. Import from grid | Will require payment for line laying cost + deposit as security for 15 MW supply | Power procurement cost is higher (including the weighted average of Demand Charge) than coal, char/dolochar, Washrey reject based captive power. | SHYAM DRI will face power tripping due to poor transmission system in grid power. This option faces no barrier. |
| 3Alternative fuel HSD | Rs.30.00 Million/MW | Above Rs 8/- unit. ref TISCO diesel power cost | HSD prices escalate regularly and generating cost high. Economically not attractive |

| | | | |
|---|---|---|---|
| 4 Alternative fuel GAS | Rs.30.00 million/MW | Not applicable | Not an option as GAS is not available in Orissa state |
| 5 Alternative fuel Coal+ Char/ Dolachar, Washery reject | Rs.35.00 million/MW | Cost of power consumed from captive generation will be lowest because of better PLF and availability of Coal, Char/ Dolochar / Washery reject. | SHYAM DRI could have put up additional 15 MW coal, char dolochar, Washrey rejects based CPP instead of WHRB with lower capital cost, lower generation cost and higher PLF. Company has put up 10 MW coal based AFBC along with 15 MW WHRB based CPP. Coal, char dolochar, washery rejects based CPP is economically most attractive. |
| 6.Combination of grid and coal power | Will require payment for line laying cost + deposit as security for 10 MW supply & Rs.35.00 million/MW for coal based CPP Power. | SHYAM DRI will be paying demand charges for the contract demand even if it is not required to draw power as well as incur the power generation cost in captive power plant hence the ultimate cost of power will be higher. | SHYAM DRI will be paying much higher cost compared to the coal based captive generation cost. SHYAM DRI will also bear power cuts and resultant production loss. .This option faces no barrier |
| 7.Alternative use of waste heat | Not applicable | Not applicable | SHYAM DRI has no alternative use for heat energy. |
| 8.Continuation of current situation | Same as alternative 2 | Same as alternative 2 | This is same situation as Alternative 2.this option faces no barrier |

The analysis of the above 8 alternatives shows that the best options available to SHYAM DRI is to go for alternative-5 i.e. Coal, Char / Dolochar, Washrey rejects based power plant .The methodology requires SHYAM DRI to select the baseline which is economically most attractive and faces no barrier. Normal choice for baseline is coal based CPP as per methodology.

The power is being used by the company for its sponge iron, steel production and other facilities. The company is installing 25 MW CPP, comprising of 10MW coal, char dolochar, Washrey rejects based CPP along with 15 MW WHRB. We selected coal based CPP captive power plant generated electricity as baseline.

The project activity displaces $CO_2$ emissions from the fossil fuel based captive power plant and hence achieves reduction of $CO_2$ emissions. We select Coal based captive electricity generation as base line to calculate the base line emissions. In line with methodology emission factor will be calculated as in ACM 0002.

**Summarization of National Policy on the Environment and Energy Conservation:**

**(A)** **<u>National Policy</u>**

In India the environment issues are regulated by a number of Acts, such as Environment Protection act 1986, Air (Prevention and Control of Pollution) Act 1981 and Water (Prevention and Control of Pollution) Act 1974, the above acts are enforced by the Ministry of Environment of Forest Govt. of India, Central Pollution Control Board and the State Pollution Control Board, (in Orissa State it is known as Orissa State Pollution Control Board). There are a number of notifications issued by Govt. of India as well as State Govt. towards the control of Air Pollution, Water Pollution and protection of the Environment. In addition to the above the govt. and the above agencies also issue certain guidelines and policies for better Environment protection and pollution control. But these policies and guidelines do not form the part of the Law and Rules to be enforced by the govt.

As per the prevailing Rule and Regulations it is not mandatory to establish WHRB Power Plant with Sponge Iron Plant. The Central Pollution Control Board New Delhi, had issued a draft code on Environment Standard Code of practice for Pollution Prevention of Sponge Iron Plants in November 2005. in which the board has proposed to the entrepreneurs having more than 100 TPD Kiln to establish the WHRB Power generation. But the same is not legally mandatory.

The above code is mainly the suggestive practice which the entrepreneurs can adopt and it is not the part of the Air (Prevention and Control of pollution) Act 1981. Hence this can not be considered as the legal requirement.

**(B)** **<u>Status of the Company</u>**

The company has entered into MOU with Government of Orissa on 09 February 2004 after firming up the project plan and subsequently applied for obtaining consent under Air Act and Water Act. Since any industrial activity is required to seek permission to establish & consent to operate from the State pollution Control Board before commencement of the activity . Hence the company applied for the same to OSPCB and the company sought clearances from OSPCB, in line with MOU with the mention of WHRB in the application and so OSPCB clearances mention WHRB, however there exists no regulation or the legal requirement in the present laws to establish WHRB captive power plant by the Sponge Iron Industry.

**Key methodological Steps followed in determining the baseline scenario**

1. The methodology requires SHYAM DRI to establish base line scenario by considering all possible options that provide or produce electricity for in house consumption and /or sale to grid and/or other consumers. The methodology also identifies six possible alternative scenarios.

We have discussed above, each alternative and shown that the Coal based captive electricity generation as base line scenario**.**

2. The methodology requires us to demonstrate the additionality of project activity using the "latest version of Tool for demonstration and assessment of additionality".

   We have shown the additionality of project activity using the "Tool for demonstration and assessment of additionality version-04 of EB-36'' In Section B.3

**3.** The methodology applies to electricity generation project activities; that displaces electricity generation with fossil fuels in the electricity grid or displaces captive electricity generation from fossil fuels, where no fuel switch is done in the process where the waste heat or pressure or the waste gas is produced after the implementation of project activity.

   We have established that project activity generates the electricity from waste heat and this electricity displaces Coal based captive electricity generation which is mainly fossil fuel power and there is no fuel switch being done in the Sponge Iron Rotary kiln where the waste gases are produced.

   In **Section B.6**; we have demonstrated the project activity is additional by using the tool for the demonstration of additionality.

**Key Information and data used to determine the baseline scenario**

Key information data like generation of electricity, turbine efficiency, auxiliary steam consumption, steam parameters and steam enthalpy, oxidation factor emission factors are taken from the following sources to determine the baseline scenario:

1) Steam consumption in TG set per MW of power Generation from the original equipment supplier specification.
2) IPCC Guidelines.
3) The base line calculations for $CO_2$ emission reduction are in line with approved methodology and data drawn from IPCC and turbine-generator specification of manufacturer. Coal based AFBC captive power plant boiler efficiency is conservatively calculated after considering as 100% in line with Option- B of methodology.

These data are given in Annex-3 under Base line information (Baseline calculations)

**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): >>**

Shyam DRI in it's board meeting dated 15/01/2004 seriously considered to seek CDM support for implementation of its waste heat recovery based power plant, based on flue gas generated from the DRI kilns. The board in its meeting discussed about the proximity of the project near to coal mines and availability of char/dolochar from the sponge iron plant which is a waste bye

product and could be used to generate captive power for the industry, accordingly coal based captive power plant was found to be financially most suitable and more reliable as compared to waste heat recovery based power plant. The possible benefits from CDM support were considered, therefore in spite of several barriers to implement the WHRB power plant, it was decided to implement WHRB power plant with consideration of CDM support.

It is already established that the only option to meet the power requirement of the project was by setting up a captive power plant because the grid was already facing power crisis. Further to this it has been well explained that the WHRB based power plant faces number of technology barrier as well as not a financially attractive option, hence it would have not been implemented in absence of the CDM support. Therefore as a prevailing practice establishment of coal based captive power plant was only option, implementation of which was therefore planned and executed to meet out captive power requirement.

Some delay has occurred between the date of decision to invest in the CDM project activity (WHRB Power Plant) and to get the project registered from CDM-EB. The reasons for delay are explained as below.

The chronological order for delay is given below:

1) Board resolution dated 15/01/2004 for setting up WHRB Power plant with consideration of CDM support.
2) MOU with State Government dated 09/02/2004
3) Issuance of LOI for Turbine dated.: 16/09/2004
4) Letter from financial consultant regarding un-viability of Project on dated 15/12/2004
5) Engagement letter from E&Y dated 03/06/2005 signed on 06/06/2005
6) Consent to Establish for Sponge Iron Plant dated 08/11/2005
7) Consent to Establish received for 18 MW Power Plant dated 04/02/2006
8) Pollution Consent on 09/02/2007.
9) Amended Consent to Establish for 17.5 MW on 17/04/2007
10) Consent to Establish for remaining capacity of CPP dated 22/09/2007
11) May-2007 to June 2007- delayed due to appointment of validators, DOE.
12) Validation process is going on since July 2007.

It may please be appreciated that in the starting period of the protocol we were not fully aware with the Procedures, Systems and Formalities required to be completed for seeking the support from the CDM-mechanism. It was a general apprehension that the financial support will be available after the implementation of the project activity, hence we had no hurry in the mind. We believed that that CDM support will be available from the date of generation up to 10 years hence we had no hurry to expedite the registration process.

Due to the lack of the complete knowledge about process of CDM mechanism PP were looking for the suitable consultants.

Therefore there were initial delays and subsequently PP appointed E&Y as their consultants on 03/06/2005. Subsequent to that the delay were caused by several “day to day urgencies” of setting up and operating an Industry like Sponge Iron in which every thing was in crisis, such as arrangements of ore, arrangement of coal, compliances with the massive Government formalities

with more than 23 department of Government, (Reference E-21) Marketing of material, arrangement of finance, arrangement of manpower, and so many such tough things were required to be managed in a Green Field Industry. Lack of PP's experience, lack of adequate staff and manpower, location of the project being in remote and backward area, also added to the problem. Thus PP's prime focus was firstly on to those priority and pressing issues. Therefore the delay in preparation of documents, submission of the same was caused, which is fully justified looking in to the prevailing circumstances.

The limited consultancy and professional services available at the district-Sambalpur had no competence to undertake the completion of formalities for CDM process. Thus PP had ultimately finalized consultant namely E&Y on 03/06/2005, who also had overburden with the activities and responsibility. PP were also waiting to seek the permission to establish for the remaining capacity of power generation, which was received on 09/02/2007. Since no satisfactory progress was received from consultants, thus PP started looking for and searching for another consultant who could help us to prepare the document and submit it for registration. With number of verbal enquiries PP could finally place their order for providing consultancy in the matter to M/s. I.T.F.C. Ltd. on 15/05/2007.

Consultants have enquired for validation to DOE's in June 2007. M/s. BVQI had given their offer on 04/07/2007. After deciding the DOE the process is ongoing on for validation since July 2007.

PP feel that the above delay caused was beyond their control hence may please be pardoned.

Based on these factors as well as looking in to common practice in the region and prevailing practice in the region PP states with full assurance that the project activity would have not been implemented, if PP had any doubt regarding getting the CDM support.

**Explanation of how and why the project activity is additional in accordance with the baseline methodology**

It is required to describe how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of registered CDM activity. The proposed CDM project activity is designed to generate power from the waste heat only contained in the flue gases emitting out of an established industrial manufacturing process i.e. ABC of Sponge Iron Kiln, only the waste heat in the flue gases is utilised to generate power without adding any GHG emission whereas in the absence of the proposed project activity power requirement would have been met by the unit by generating power from Coal based captive power plant at the same time the waste heat contained in the flue gases would have been continually emitted to the atmosphere.

Hence the project activity achieves reduction in $CO_2$ emission by displacing the fossil fuel based captive power of the company by WHRB based captive power which does not generate any $CO_2$.

It is required to explain how and why the proposed project activity is additional and therefore not the baseline scenario in accordance to the selected baseline methodology.

As per the decision 17/CP.7 AND 18/CP.9 a CDM activity is additional, if anthropogenic emissions of GHGs by sources are reduced below those that would have occurred in the absence of registered project activity. The tool for the demonstrations and assessment of additionality (version-04) approved at the 36$^{TH}$ meeting of CDM executive board requires the project participant to demonstrate and assess additionality, as per the steps given below:

1) Identification of alternative to project activity.
2) Investment analysis to determine that the project activity is not the most or financially attractive.
3) Barrier analysis.
4) Common practice analysis.

We have discussed realistic and credible alternatives available to project activity in B.2 and have come to conclusion that the generation of power from Coal based Captive power plant is the baseline scenario. We hereby proceed to establish the additionality of proposed project activity using "the tool for the demonstration and assessment of additionality" (version-04) of 36$^{th}$ meeting of CDM executive board.

We show that the project activity faces significant financial, technology and investment barriers and in the absence of CDM finance these barriers would have adverse impact in implementation of the project activity.

The base line methodology outlines four steps to demonstrate additionality.

**STEP 1 - Identification of the alternatives to the project activity considered with current law and regulations**

**Step 1.a**

| | | |
|---|---|---|
| | Identify realistic and credible alternatives including<br><br>• Proposed activity undertaken without being registered as a CDM project activity.<br>• All other plausible and credible alternative<br>• Continuation of current situation | In section B.4 all the possible alternatives have been discussed for the alternatives recognised were:<br>1) Project activity undertaken without being registered as a CDM project activity .<br>2) Import from Grid.<br>3) Alternative fuel HSD.<br>4) Alternative fuel Gas.<br>5) Alternative fuel Coal +Char/Dolochar + Washery reject.<br>6) Combination of grid and coal power.<br>7) Alternative use of Waste heat.<br>8) Continuation of current situation.<br><br>SHYAM DRI has concluded that use of coal as fuel is the most attractive option economically, as per ACM 0004. The grid power is being used by the company at the moment and |

| | | |
|---|---|---|
| | | company is installing coal based CPP. We select coal based captive electricity generation as baseline being financial most attractive, technically highly feasible and investment-wise also being most feasible. |

**Step 1.b Enforcement of applicable laws and regulations:**

| | | |
|---|---|---|
| 1 | Alternative shall be in compliance with legal and regularly requirements. | All the identified realistic and credible alternative scenarios are in compliance with current legal and regulatory requirements of the country and EB decision on national and / or sectoral Policies and regulation. |

**Sub-Step 2a. Determine appropriate analysis method**

We have determined to apply investment comparison analysis as per sub-step -2b Option-II. As the CDM project activity does not generate direct revenue, being a captive power plant, other than CDM related revenue. The economic benefits or financial gains are generated by use of power in the captive facilities only. Therefore investment comparison analysis Option II has been used. In this option we have selected levelized cost of electricity in terms of Rs./MWh as first preference to make the investment comparison; because the choice of the project proponent setting up a captive power plant would always be to select a route through which cost of captive power is minimum therefore this option for investment comparison analysis is most suitable for the project type being a captive power plant for decision making context.

**Sub-Step 2b. (Option –I):** Not considered for the purpose.

**Sub-Step 2b. (Option –II): Investment comparison analysis:**

We have identified unit cost of service (i.e. levelized cost of power in Rs./MWh) as most suitable financial indicator for the project type and decision making context.

**Sub-Step 2b. (Option –III): Apply bench mark analysis.**

The comparative unit cost of service (i.e. cost of power ) as provided in Option-II is selected for the purpose hence the bench mark comparison is not given.

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

The unit cost of service (e.g. levelized cost of power in Rs./MWh) has been used for the main comparison.

In this context the following facts of the project must be considered:

1) That, the total capacity of CPP is 25 MW.
2) That, in the 25 MW CPP only the capacity of Boiler is different for WHRB and for Coal based AFBC. Therefore based on the best steam generation possible from recovery of waste heat coming out of sponge iron plant the capacity for WHRB has been designed to15 MW and the remaining 10 MW capacity has been considered for AFBC. That, except for the boiler most of the all other facilities to generate power remain the same.

3) That, in absence of the project activity it would have been possible to install only one AFBC with increased capacity to generate entire quantity of steam required for 25 MW power only from Coal.

Hence in fact, in the decision making context the most important parameter for PP had been to calculate the returns on the additional investment required for setting up WHRB power generation facility to the extent of 15 MW in place of generating the total 25 MW power from AFBC. With this comparison PP had not found the installation of WHRB viable and financially attractive than setting up a single Coal based CPP. The method of comparison only in additional cost of the project or additional operation cost of project was not found as per the methodology hence the comparison as per the methodology was made by calculating the unit cost of power between the project activity and the baseline scenario.

It may be important to note that the OPLF (Operating PLF) fluctuation in WHRB is very high even on hours to hour basis, which may fluctuate from 0% to 100% also. The number of operating days for sponge iron plant is also estimated to be around 300 days in year, however the captive power demand facilities operate for 350 days in a year and the AFBC boiler also operates of 350 days in a year. Therefore, in order to meet the hour to hour fluctuation in power generation in WHRB the grid back up support is a must. Otherwise due to such fluctuation it will cause production loss in the captive production facilities. The annualized PLF of 66% does not mean that WHRB boiler would be operating constantly throughout the year at 66% level (i.e. at 9.9MW) of installed capacity(i.e.15MW). But in fact the WHRB operating PLF is likely to fluctuate from 0 to 100%. Whereas in case of Coal based AFBC the power plant will be constantly operating at 95% ±5% capacity. Therefore grid support is not required for AFBC.

In view of this the PP have made a comparison of “the unit cost of power” from project activity scenario including grid import energy cost with that of a 15 MW coal based power plant.

**The justification for not making the economic comparison with 66% annualized PLF of coal based 15 MWCPP, for unit cost of power :**

a. 25 MW captive power plant is put up for the Industrial activity which requires reliable power. Based on the normally known power consumption per tonne of the products to be manufactured, it was decided to setup 25 MW captive power plant; which would meet more or less the total requirement if operated with Coal through which 95% annualized PLF is possible to be achieved.
b. Since the very purpose of a captive power plant is to establish a resource of power which would reliably and economically meet it’s captive power requirement, at the best capacity at which it can operate. Thus the coal based AFBC power plant will not be operated at 66% annualized PLF.
c. It is a known engineering fact that operating a coal based power plant at 66% of the capacity rather than the possible 95% level (at which it can comfortably operate), will yield to higher fossil fuel consumption, lower operating efficiency, and will therefore add to higher GHG emission than the designed capacity; this will be against the CDM-EB- UNFCCC mandate.
d. Will full operation of the power plant at lower capacity is not a common business practice. Even if there is a less demand of captive power at any moment of time, then the generated surplus power can be exported to grid.

e. Since there is already a captive demand for more than 100% of generation capacity from CPP, thus the coal based AFBC will not be operated at 66% PLF on annualized basis. Otherwise again the remaining power requirement will have to be met by importing the power from the Grid and by keeping the AFBC of CPP to the extent of 34% as idol which is not likely to be a real situation.
f. The methodology refers to the economic comparison made in the "decision making context", whereas in decision making context coal based plant was considered and found to be reliable, mainly due to the generation 95% annualized PLF level and with constant generation, which could meet the captive power requirement. This is possible with AFBC and not with WHRB.
g. Therefore the logic to make an economic comparison between 15 MW Coal based AFBC at 66% annualized PLF level, will neither be realistic, nor credible, nor plausible. Hence the 66% level of annualized PLF for coal based AFBC type CPP is not considered for making economic comparison.

PP wish to submit some of the very important aspects to this comparison as under:

1. That the 15 MW WHRB based power plant,( the project activity,) faces significant technology barriers, due to which the operating PLF is fluctuating consequently the annualised PLF is low, which cannot be improved the same level as may be generated by coal based AFBC based power plant(i.e.at 95% annualised PLF level), but the deficit can be met by import of power from Grid. Therefore the achievable PLF by the project activity only has to be taken in for economic comparison consideration, and the cost of Grid Power required to be imported to meet the same level of energy which would have been otherwise made available by the Coal based 15 MW power plant; to make the levelized comparison in Unit Cost of Power.
2. It is also clarified that instead of 15 MW WHRB it is not possible to generate the same quantum of power (in MWh/Year terms) by installing a WHRB having 66% operating capacities i.e. 15 X 0.66 = 9.9 MW.
3. The project activity is implemented by reducing the size of the baseline boiler capacity, thus the total capacity of CPP in Terms of MW remains to the same level i.e 25 MW .
4. The most important factor in deciding to set up a captive power plant, as stated above, was the lowest cost of project and the lowest cost of operation to generate power. Since one single boiler with one turbine having 25 MW capacity would have provided the best power generation with minimum 95% PLF, as per which, the annual gross generation of power works out to 199500 MWh per year.
5. The available waste heat from the sponge iron plant can generate at best steam equivalent to 15 MW power only, therefore, in order to generate this steam we are required to install two WHRBs each with 38tph capacity by incurring additional cost. Even then to setup WHRB the additional cost of installation and operation was substantially high. Moreover, in spite of all this as explained earlier that fluctuation in steam generation may range from 0% to 100%. In many working days also the steam generation may be nil during shutdown of sponge iron plant. Therefore, it is quite difficult to achieve more than 66% PLF based on 350 days. Hence, in order to make up the loss of power generation during this fluctuating periods and shutdown days of WHRB, the easiest way is to obtain the remaining power from grid to make up the loss of units. For this PP has to pay additional charges to grid for quantum of energy to be purchased We are giving herewith the unit cost of power as arrived and calculated based on the applicable power tariff which would be required to be paid for making up the gap of power to reach to equal level of service required.

1) Levelized unit cost of generation from 15 MW coal based AFBC : Rs. 1200.37/ MWh
2) Levelized unit cost of generation from 15 MW WHRB based Power + Grid support including make up energy charges Payable to the Grid : Rs. 1853.18 /MWh

As explained above in accordance to the methodology levelized cost of generation has to be compared with the project activity and baseline scenario. Hence the above comparison was made

It is evident with the above that the baseline scenario will remain coal based captive power plant; as it is found to be economically most attractive, which is also found as common practice in region (Reference E-01).

As per the calculations provided in comparative unit cost of services (i.e. unit cost of power) it is found as below : (Reference E-04)

The main parameters which are used to calculate the unit cost of power (for economic comparison) of the CDM project activity and a baseline scenario with same level of service, i.e. a 15 MW WHRB based power plant with a 15 MW coal based power plant at the same PLF; are as given below:

| S.No. | Particulars | For WHRB based 15 MW CPP | For Coal based AFBC 15 MW CPP | Unit |
|---|---|---|---|---|
| 1 | Capacity of Power Plant | 15.00 | 15.00 | MW |
| 2 | PLF required by the captive production facility | 95% | 95% | percentage |
| 3 | Net Energy required by Captive facility at 95% PLF | 107730.00 | 107730.00 | MWh/Year |
| 4 | Net Power Generation by the type of CPP | 74844.00 | 107730.00 | MWh/Year |
| 5 | Deficit power to be imported from grid | 32886.00 | 0.00 | MWh/Year |
| 6 | Project Cost in Million Rs. | 675.00 | 525.00 | Million Rs |
| 7 | Equity | 229.00 | 210.00 | Million Rs |
| 8 | Term Loan | 446.00 | 315.00 | Million Rs |
| 9 | Interest rate on TL | 12.75% | 12.75% | percentage |
| 10 | Interest rate on Working Capital | 12.75% | 12.75% | percentage |
| 11 | Depreciation rate on Plant & Machinery | 5.28% | 5.28% | percentage |
| 12 | Depreciation rate on Building and Civil | 3.34% | 3.34% | percentage |
| 13 | Repair and Maintenance rate | 3.00% | 3.00% | percentage |
| 14 | Administrative Expenses. | 1.12 | 1.12 | Million Rs/Year |
| 15 | Boiler Efficiency | 86% | 86.00% | percentage |
| 16 | Calorific value for various fuel | | | |
| | a) Coal | Not Required | 3800.00 | K Cal/Kg |

| | | | | |
|---|---|---|---|---|
| | b) Coal Middling | Not Required | 2800.00 | K Cal/Kg |
| | c) Char/Dolochar | Not Required | 2200.00 | K Cal/Kg |
| 17 | Backup power required in MVA | 7.50 | 0.00 | MVA (Contract Demand) |
| 18 | Demand Charges per KVA/Month | 200.00 | 200.00 | Rs./KVA/Month |
| 19 | Electricity import Tariff (per MWh) | 2900.00 | 2900.00 | Rs./MWh |

As per the parameters provided above for making comparison of unit cost of power the resultant unit cost of power is found as below: (Reference E-04)

| | | | | |
|---|---|---|---|---|
| | **15 Year Levelized Unit Cost of Power** | **1853.18** | **1200.37** | **Rs./MWh** |

This shows that at same level of service (which can be achieved from Coal based CPP) the unit cost of power from WHRB based CPP (1853.18 Rs./MWh**)** is higher than Coal based CPP (1200.37 Rs./MWh), hence WHRB based CPP is economically less attractive.

**Sub-Step 2d : Sensitivity analysis**

As per direction of EB-42, (J) (ii) The economic comparison of the CDM project activity and a baseline scenario with same level of service, i.e. a 15 MW WHRB based power plant with a 15 MW coal based power plant at the same level of service has been done, the sensitivity analysis is done by considering increased level of PLF improvement, up to two steps each with 5% improvement for WHRB system ( i.e. from 66% to 71% and up to 76%). The decrease in PLF of the WHRB will obviously have further increase in generation cost; which is already concluded at the 66% level of PLF, hence this was not calculated.

We have conducted the sensitivity analysis to show that the conclusion regarding the financial attractiveness, while comparing the unit cost of power is robust, by considering that the PLF of WHRB system is the most critical parameter. It is found that at best, the PLF of WHRB system can improve by 5% or further improve by 5%; over and above the considered PLF of 66%. The other cost parameters considered in the project are not likely to be influenced much. Therefore we have considered annualised PLF as the most critical parameter which influence on the unit cost of power due to all individual parameters. It is found that with the increase in considered PLF by 5% up to two steps; the cost of WHRB based captive power is found as below:

| | |
|---|---|
| Unit Cost of power at 95% PLF (Without CDM) at 66% PLF of WHRB based power plant | 1853.18 Rs./MWh |
| Unit Cost of power at 95% PLF ( Without CDM) at +5% PLF of WHRB based power plant | 1771.36 Rs./MWh |
| Unit Cost of power at 95% PLF ( Without CDM) at +10% PLF of WHRB based power plant | 1547.91 Rs./MWh |

Whereas the Unit cost of power from coal based captive power plant is found to be only 1200.37 Rs./MWh, which is found lower than unit cost of power from WHRB power plant even at increased level of PLF.

It is evident with the above that the cost of power to the project on per unit basis is lowest from coal based captive power plant hence it is found to be economically most attractive.

**STEP-3 SHYAM DRI selects step 3(barrier analysis) to show additionality**

**STEP –3 Barrier analysis to show additionality**

**Sub-Step 3.a Identification of barriers that would prevent the implementation of the proposed project *activity.***

Since it is not possible to pool Flue gases/waste heat from flue gases emitting from 2 different sponge iron kilns to generate WHRB power through a single boiler, hence in order to utilize waste heat to generate steam from waste heat recovery boilers PP have to invest on 3 different boilers and in place of 1 coal based AFBC boiler PP had to install 2 WHRB boilers. This required creating additional infrastructures, like land space, buildings, steam pipelines, additional balancing & auxiliary equipments etc at additional cost. These are the primary & most important evidence of the technology barriers faced by PP. Due to all these reasons the total number of man power requirement also went up several times, whereas the availability of manpower was already in crisis ( As also reported in JPC report please refer to PDD Page No. 36 to 37). The additional requirement of certified and qualified manpower (boiler operators) from one to three was also one of the barriers. It also resulted in to huge additional cost of operation

The process of sponge iron production and its related criticalities of operating WHRB power plant with Sponge Iron Kiln involve a number of technological issues, in sum and summary of which it was found that there are definitely large variation in operating conditions of sponge iron which definitely influence the operation of WHRB. The previous years capacity utilization of sponge iron plant is an evidence to establish up-to what extent the WHRB power plant can perform, during April-07 to December-07 (Reference E-05) the unit achieved less than 60% capacity utilization in sponge iron production due to a number of operational and technological barriers. The variations in raw material quality i.e. iron ore quality and coal quality, are evident through actual analysis report of the past. The impact of change in sponge iron kiln conditions influence the WHRB operations, as well as the operation of WHRB has influence on sponge iron plant operation. The installation of WHRB power plant in series to sponge iron plant may adversely influence the production of sponge iron during stoppage of WHRB or during the malfunction of WHRB. The freedom to operate sponge iron plant independently or captive power plant independently has to be sacrificed for installation of WHRB.

A copy of article written by one of the most known metallurgist Mr. A.N.Jha (Reference E-06) having more than 20 years experience in the field is appended and also a letter circulated by one of the reputed supplier of sponge iron kilns is appended to substantiate the claim. (Reference E-07)

The WHR boiler are also subject to Nitrous stress and frequent failures, as evidence in an article annexed as Reference E-08.

In addition to the above the third party evidenced about the WHRB with Sponge Iron Kiln process are as follows:

a. Validation Report of the registered project.

Even the CDM EB has accepted such technological barriers while registering various WHRB based power projects such as **1469 : Recycled Energy Electricity Generation Project by AMLSPL (http://cdm.unfccc.int/Projects/DB/TUEV-SUED1197477081.7/view** ) The technological apprehensions expressed in the letters submitted by the various plant suppliers are also valid for the proposed project activity as this project is also established on the same technology, within the same time frame, within the same geographical region. (http://cdm.unfccc.int/UserManagement/FileStorage/I3J0OMT67MB2WEJ2JW212H64YTXY8L) **&** Kohinoor Steel (http://cdm.unfccc.int/Projects/DB/SGS-UKL1187362013.9/view)

b. Discussion with the independent power plant consultants dealing with WHRB (Reference E-09)- letter from Engg. Consultant namely "Popuri Engineering & Consultancy Services, A copy of letter received from the Sponge iron plant manufacturer M/s Hari Machinery (Reference E-10),, which states the technology barriers faced by WHRB with sponge iron plant.

Due to these technology barriers PP would have not installed the WHRB power if CDM support would not be available. All this submissions establish the prohibitive nature of technology barriers preventing the project activity to occur.

In fact the lower PLF can be caused due to a number of problems most common of which is that the sponge iron plant faces frequent accretions therefore it is normally not able to operate more than 300 days, that means it can operate at about 82% of days in a years. During these days of operations also it is difficult to achieve 100% production level through out the operating time. Therefore on an average operating plant load factor is around 80% only, hence on annualized basis the PLF for sponge iron plant based WHRB is considered at around 66%, which is evidenced from the results of a number of operating WHRB power plant which have claimed CERs after seeking registration from UNFCCC. (Reference E-11)

In addition to the above, the following technological problems are still faced by the waste heat recovery boilers operating with sponge iron plants.

This may be noted that the impact of technology barriers is not only to the extent of lower capacity utilization up to 66%, but can be even more and in addition to capacity utilization. The impact of technology barriers are still higher and have different impacts also, some of which are as given below:

a) NOx impact on boiler tubes. **(**Reference E-08**)**
b) Tube failure due to higher erosion due to iron containing dust.
c) Backup power requirement due to tremendous fluctuation in power generation and unforeseen variations as well as breakdowns.
d) Higher maintenance in WHRB than normal boiler.
e) Greater uncertainty of generation level and duration in comparison to normal boiler.
f) Greater uncertainty of breakdown, it is difficult to forecast what type of breakdown may be caused in WHRB due to changes in the operating parameters of sponge iron kilns, ore quality, coal quality, change in weather condition etc.
g) Extra manpower requirement, specially certified boiler operators and certified electrical operators for each individual system.

h) Risk of sponge iron plant closure due to closure of WHRB power plant for any reasons of failures.

i) Risk of sponge iron quality problem: due to change in the furnace draft pressure, the reduction level of sponge iron can be badly influenced.

j) Risk of lower sponge iron production problem: the breakdowns in WHRB may require to close down the sponge iron kiln itself, some times due to any WHRB tube related problem, the sponge iron plant may be operated at lower capacity, or taken into hold to avoid any risk of tube failure.

k) Risk of generated power evacuation problem: Because of tremendous fluctuation some times the captive power facility may not be in a position to consume total generated power, in such situation if the grid evacuation is not available for any reason then it may require to close down the power plant or vent out the entire steam and if the problem persist for long time then even close down the sponge iron plant.

l) Risk of technology failure: at the time of inception of the concept not enough evidence of successful operation was there. Therefore, the risks of technology failure were also there.

m) Impact of local climate (extreme summer, rains, winter): the sponge iron kiln are normally operated in open atmosphere subjected to direct exposure to sun, rains and winter, the influence of change in climate , badly influences the moisture level in feed raw material which creates impact on sponge iron plant operation as well as WHRB operation also. Essential to have grid interface: the sponge iron rotary kiln is operated at $1100^{0}$C temperature therefore the continuous protection of the kiln is very-very important; any power failure may cause enormous damage to the kiln. Hence the grid interface is important for kiln operation also in case of any failure any captive power generation facility.

n) The fluctuation in power generation will require additional instrumentation than normally required by the coal based AFBC so as to maintain proper synchronization with the parallel operating system.

During the site visit for validation the following Technological barriers are demonstrated to the DOE:

1) It is not possible to control, increase or decrease the Flue Gas Temperature emitting out of DRI Kiln.
2) It is not possible to control, to increase or decrease the volume of Flue Gas emitting out of DRI Kiln
3) It is not possible to control, to increase or decrease temperature of WHRB steam generation from flue gas emitting out of DRI Kiln by making any adjustment in the Kiln.
4) It is not possible to control, to decrease or increase the flow of WHRB steam generated from flue gas emitting out of DRI Kiln by making any adjustment in the Kiln.
5) There is no provision to fire any extra fuel in WHRBs, this is technically not possible and not permissible.
6) The fluctuation in temperature of flue gases in day to day operation.
7) The fluctuation in production records of Sponge Iron Kilns from day to day basis.
8) The variation in quality of Iron Ore.
9) The variation in the quality of coal.
10) The frequent shut down records of the Kiln.
11) The campaign life parameters and data of the sponge iron kiln.
12) The history of shutdowns of kiln due to defect or fault caused in WHRB power plants also.
13) The detail about the fluctuation in temperature, pressure, flow of steam generation from WHRB.
14) The details about the fluctuating power generation from WHRB.

15) Demonstrated that if there is sudden drop in generation then how the captive power load operation will get affected.
16) Demonstrated that in case of captive demand is suddenly not there, then if the generated power can not be evacuated then the turbine will immediately trip and if the boiler is not switched off then the generated steam has to be vented to atmosphere, which also may cause problem. Thus if we have to stop the boiler then the sponge iron plant also has to be stopped.
17) Demonstrated that how critical is the slight positive pressure inside the Kiln in absence of which the total process of reducing sponge iron may be totally disturbed. It was explained that due to high dust load in flue gases the shoot blowing is required more frequently than the normal AFBC boiler. During this shoot blowing not only the power generation gets disturbed but also the Kiln process gets disturbed.
18) The evidence about the NOx impact on boiler tube.
19) The evidence about the Iron Ore dust impact on boiler tubes and boiler operation efficiency.
20) The evidence of impact of change in environment conditions i.e. rains, summer etc.
21) The problem relating to the availability of trained manpower, engineers, certified boiler operators, fitters, electrical engineers, helpers, certified wire mans, certified electricians etc.
22) The evidence about the influence of WHRB operation occasionally, on the quality of sponge iron and some time on productivity also.
23) Explained the difference in recovery of waste heat from a “blast furnaces” or “coke oven battery” and that of with sponge iron kiln.

The major technological difficulties as narrated above, and as demonstrated in the field influence the performance & operation. A number of 350 to 500 TPD plants located in the similar region have been also found to be facing the technological barriers based on which have sought registration with UNFCCC- CDM-EB (UNFCCC Ref:1462, 1644, 1169, 1149, 1469, 1324, 1151, 1140, 0853 etc.) and based on which those have been registered.

The Coal based sponge iron industry in India is a fairly recent expansion started in full swing from about 1998-99. The WHRB power is also a new concept introduced mainly because of CDM support.

*It would be evident with the above that low PLF may also be due to other reasons and also due to partial or full impact of technological barriers. The technology barriers remain over and above the low PLF and adversely impact the operation of WHRB power plant along with sponge iron kiln.*

Some of the documents toward technological problems faced :

1) The statement of daily generation of power shows frequent shutdown in WHRB#1, WHRB#2 on various occasion which range from 2 days to 15 to 29 days at a stretch. The copy of shutdown history from 1st September 2007 to 12th August 2008 **(**Reference E-12**)**
2) Monthly generation data in WHRB# 1 and WHRB#2 shows variation in generation ranging from 257.20 MWh to 5882.859 MWh in a month. **(**Reference E-13**)**
3) The shutdown report dated 30/04/2008 assigns the reason for shutdown as tube failure **(**Reference E-14**)**
4) Daily report dated 08/05/2008 shows generation low that due to WHRB#2 inlet gas temperature low due to kiln#1 hold for 2:00 hours for air tube replacement **(**Reference E-15**)**

5) Daily report 31/05/2008 shutdown due to WHRB#2, Kiln#1 has been taken shut down due maintenance job and coal injection jamming. (Reference E-16)
6) Daily report 01/02/2008 showing low generation due to Air tube replacement (Reference E-17)
7) Daily report10/02/2008 showing low temperature in WHRB (Reference E-18)
8) Daily report 11/11/2007 shows that hold due to Coal Injection Jam (Reference E-19)
9) Daily report 10/04/2007 show hold due to low temperature in WHRB etc. (Reference E-20)
10) A letter form Hari Machinery regarding impact of WHRB in DRI Kiln (Reference E-10)

The above technological causes for stoppages and failures of WHRB are sufficient reasons to believe that there exist sufficient technological barriers, over and above the lower capacity utilization.

Narration about documents submitted earlier:

a) The terms and condition stipulated by "Avani Industrial Machineries (P) Ltd." in their letter dated 22/11/2003 stipulate that they will not be standing guarantee for coal based sponge iron rotary kiln supplied by them if installed along with WHRB, which may cause problem in sponge iron plant performance. (Reference E-07)
b) Letter from "Popuri Engineering and Consultancy Services" dated 02/07/2008 (Reference E-09) give support regarding impact of WHRB on Kiln performance, efficiency of boiler, performance depending on quality of raw material and sponge iron production level, impact of dust on WHRB tubes, impact of shoot blowing resulting in lower power generation, high temperature leading to tube failure, impact of raw material on flue gas volume and dust load in flue gases and difference between waste heat recover in "coke oven" or "blast furnace" and waste heat recover in sponge iron kilns.
c) An article from Mr.A.N.Jha (B.E., Metallurgy) (Reference E-06) explains in details various problems related to installation and operation of WHRB power plant with Sponge Iron Kiln.
d) Nitrate stress corrosion cracking in waste heat recovery by R.G.I. Leferink, W.M.M., Huijbergts. C. (Reference E-08)

| | | |
|---|---|---|
| **3.a.1** | **Investment barriers** | |
| | No access to international capital markets due to real or perceived risks. | SHYAM DRI have not received any foreign assistance and they are not in a position to access the international capital markets. |
| **3.a.b** | **Technological barrier** | |
| | Skilled and or properly trained labour not available<br><br>Lack of infrastructure for implementation of the technology | 1) As per Joint Plant Committee report "Survey of Sponge Iron Industry 2005-06".<br>A. 77 units out of 147 coal based unit are going in for expansion in capacity.<br>B. Jharkhand, Chhatisagarh and Orissa are states where majority of expansion activities will be installed.<br>C. Constraints faced by sponge iron industry are: |

| | | |
|---|---|---|
| | | a) Raw Material<br>b) Power<br>c) Finance<br>d) Labour<br>Company has to procure iron ore from the market from various sources. Due to change of sources the iron ore quality is not consistent. The company is required to use coal of Grade "A" to achieve better efficiency. As the availability of grade "A" coal is problematic. Hence Coal of various grades as per availability is used. The variation in quality of coal also creates operational problem.<br>All the above pose technological problem as the variations in iron ore and coal quality lead to variations in flue gas temperature and quantity. This has impact on WHRB power generation.<br><br>As so many units are expanding in the area, the availability of skilled technical personnel is a problem. Company has to hire the untrained personnel and impart the training.<br><br>2) Company has to procure all the necessary equipment required for proper implementation of the project. Extra synchronisation infrastructure was also required due to the requirement of remaining connected to WESCO grid. So when 15 MW WHRB power has to be synchronised with grid power, company has to install grid synchronisation system resulting in additional cost.<br><br>3) Company has started venture in integrated steel project they did not had any previous experience in generation of power. Hence having no previous experience in power generation, acts as technical barrier. |

| | | |
|---|---|---|
| | | 4) The Sponge Iron Rotary Kiln operation is dependant on many factors such as Iron Ore quality, Coal quality etc., the flue gas temperature and quantity variations result in lowered steam generation and hence reduced power generation.<br><br>Due to the variations observed, the PLF of WHRB is more affected than the coal based captive power plant.<br><br>5) The Sponge Iron Kiln has to take frequent shut down due to the raw material quality problem, this results in WHRB shut down also and hence the power generation loss. Due to the inconsistency of WHRB power generation, company has to maintain the agreement with WESCO for supply of backup power.<br>6) The documentation in the form of WESCO agreement is available.<br>7) If the temperature of flue gas exceeds $1000^0$C, then the boiler is in danger as the higher temperatures are damaging to the boiler tubes. As no control is there on exit temperatures of kiln, this acts as technical barriers. The company has procedures laid out to encounter flue gas high temperatures to carry out remedial measures like water spraying, opening steam drains and finally opening of stack cap to release hot gases to atmosphere bypassing WHRB. This leads to loss of power generation.<br>8) The inlet temperature to ESP has to be maintained at about $160^0$C, as the higher or much lower temperature of flue gas will damage ESP.<br><br>Hence the boiler has to work at its design parameters as any disturbance in performance of boiler due to any reasons affects the ESP and also power generation. This acts as a technological |

| | | |
|---|---|---|
| | | barrier. |
| | **Barriers due to prevailing practice.** | |
| | Discuss the project activity in host country. | Prevailing practice in the Orrisa region is to operate Sponge Iron Kiln, without WHRB and release waste heat contained in flues gases to atmosphere.<br><br>However considering CDM benefit few units have gone for WHRB based captive power plant (refer to appendix-II). Being a coal and iron ore rich area, the prevailing practice for captive power plant is to go for coal based captive power generation.<br><br>1) In year 2004-2005 when the company decided to set up the WHRB power plant there was not many example of successful operation of a WHRB power plant based on any 350 TPD DRI plants, who had utilised the waste heat of flue gases to generate power, in state of Orissa. The company was finding it as a matter of substantial risk and barrier to pool the heat and to convert this in to steam and then in to power. The company was able to successfully implement the project because of the possible CDM strength.<br>2) Even at the current scenario as per the Joint Plant Committee report as "Survey of Indian Sponge Iron Industry 2005-06" lists the following:<br>1) Out of 147 surveyed Sponge Iron Industry surveyed only 16 have captive power generation, 8 out of 16 them are in adjoining state Chhattisgarh. Balance states of India have 89 Sponge Iron Units (out of 147 Surveyed) and only 8 have captive power generation<br>2) In the state of Orissa almost every sponge iron plant who has put up WHRB power is based on CDM strength. CDM activity can not be treated as common practice.<br>3) The captive power generation |

| | | |
|---|---|---|
| | | based on WHRB (without CDM) is not sufficiently diffused in the region/ country, thus WHRB based captive power project is not prevailing practice.<br>JPC Report can be made available and the units going in for CDM benefit can be checked from UNFCC website. |
| | Operational Barrier | Being almost the first company in Orissa to put up a WHRB project in a group of 2 numbers of 350 tpd capacity DRI Kilns had all the risks of operation.<br><br>In addition the project is located in remote area where not enough technical support infrastructure was available. All these had operational barriers to set up and run the project. |
| | Regulatory Barriers | 1) The provision to export surplus power for sale to the grid is not available.<br>2) The demand charges payable even if WESCO is not in position to supply power as a result of power shortage and resulting power cuts or even if the company is not in position to use this power due to any reason.<br><br>Hence these can be considered as regulatory barrier |

**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).**

As above the identified barriers are:

1) 3.a.a. investment barrier
2) 3.a.b technological barrier
3) 3.a.c prevailing practice barrier
4) 3.a.d operational barrier
5) 3.a.e regulatory barrier.

The identified other alternatives are:

**1) Drawing power from existing WESCO grid (Alternative-2)**

None of the above barriers act as barriers in this alternative and WESCO would be having no objections to continue to supply the additional demand of power as already and presently the

required power is being provided by WESCO. But the grid power is costlier than coal based captive power, as well as the grid is having poor infrastructure resulting in interruption of supply.

**2) CPP based on HSD/Gas ( alternatives 3 and 4)**
None of the above act as a barrier in this alternative. However CPP based on HSD will have additional GHG emissions from the plant. Availability of Gas is not there in the region.

**3) Alternative 5 CPP based on coal**
None of the above barriers act as barriers in this alternative. This option is economically most attractive as increase in the capacity of coal based CPP can be achieved with minimum cost to meet the total steam requirement of the CPP.

**4)** Combination of grid and coal power (Alternative 6) also faces some barriers faced in a Grid based alternative (1.); i.e. cost of power as well as interruption due to poor infrastructure. The SHYAM DRI would have to invest in both the sources; thus investment barrier will prevent this combination. No other barriers acts as barrier to this alternative too.

**5)** Alternative use of Waste Heat from Flue Gases (Alternative 7) -there is no use of waste heat form flue gas in the SHYAM DRI hence, no such heat requirement in the plant. No other beneficial use of the waste heat is in practice in the region.

**6)** Continuation of the current situation, as shown above the continuation of current situation is to draw more power from grid. This option will face no barrier but company has to face power cuts and pay higher tariff than self generated Coal based captive power plant.

**STEP-4 Common practice analysis**
We identify and discuss the existing Common practice through the following sub-steps which Complements additionality tests.

**Sub-Step-4.a Analyse other activities similar to project activity.**

| | | |
|---|---|---|
| 1. | Provide an analysis of any other activity implemented | 1) In Orissa state Tata Steel, Orissa Sponge, Orissa Cement are a few pioneers which have gone ahead to establish WHRB power plant based on CDM strength, to the best of information available there is no sponge iron plant in the state which has implemented waste heat recovery boiler based power plant without the CDM support. The company is also one of the pioneer company to establish WHRB power based on the CDM strength by combining the waste heat from two numbers of 350 tpd capacity kilns.<br>2) As per JPC report as “ Survey of Indian Sponge Iron Industry 2005-06” only 16 units out of 147 sponge iron units in India have captive power generation, as on 31/08/2005. |

| | | |
|---|---|---|
| | | Afterward many new Sponge Iron plants had come up, and some new WHRB based captive power plant have also been established in Orissa Region while considering CDM support.<br><br>Further based on most recent web search in UNFCCC website, we can find that 16 units have opted for CDM project benefits in Orissa State alone. (refer to appendix - II)<br><br>This reveals that in Orissa State total 79 Sponge Iron Units were operating, out of which 16 Number of units are going for WHRB based captive power generation considering CDM support, as per the available information there is no unit having WHRB captive power generation facility without CDM support.<br><br>This concludes that the installation of WHRB captive power plant without considering the CDM support along with Sponge Iron Kilns, is not a common practice in Orrisa region. |
| 2 | Activities in similar scale. | The project activity is 700 TPD (2 nos. X 350 TPD,) Sponge Iron capacity. As per the available information there is no other plant of this combination in Orissa state which has gone for WHRB based captive power generation. |

**Sub-Step-4.b Discuss any similar options that are occurring**

| | | |
|---|---|---|
| 1. | Discussion of similar activities | The present project activity is WHRB based 15 MW captive power plant based on the waste heat available from two number of kiln of 350 tpd production capacity.<br><br>As per the available information all sponge iron projects who are putting up WHRB power plant of this capacity are in the process of CDM validation or PDD preparation stage to seek the CDM support. |

**JOINT PLANT COMMITTEE REPORT ON "SURVEY OF INDIAN SPONGE IRON INDUSTRY 2005-06"**

Under the aegis of the Ministry of steel, a joint plant committee (JPC) was constituted, by government of India, and is the sole custodian of authentic database on the Indian iron and steel industry. The following are major findings:

**Report in the "Survey of Indian Sponge Iron Industry 2005-06" has the following statement on Page-3 of 11.**
"growth of domestic steel demand, vigorous growth in domestic steel production in secondary steel making sector, techno economic like relative low cost of investment, ease of setting of sponge iron plant, clear cut technology of direct reduction, better quality in end product, availability of mineral resources, abundant labour as well as professional/ technical expertise, frequent problem of scrap, all operating in the facilitating backdrop provided by a free market economy have boosted the growth of the industry"

**Indian sponge iron industry summarised table given in JPC report**

| **Table 1** | **Indian Sponge Iron Industry : Both Coal & Gas Segments** | | | | | |
|---|---|---|---|---|---|---|
| | **Data Collected** | | **Additional / Industry/ Field sources^** | | **Total** | |
| | **No of units** | **Capacity (Unit :mt)** | **No. of units** | **Capacity# (unit:mt)** | **No. of units** | **Capacity (unit:mt)** |
| Operating | | | | | | |
| Coal | 147 | 11 | 56 | 2 | 203 | 13 |
| Gas | 3 | 6 | - | - | 3 | 6 |
| Total | 150 | 17 | 56 | 2 | 206 | 19 |
| Under commissioning (Coal) | 58 | 6 | 167 | 12* | 225 | 18 |
| Brownfield Expansion : 77 out of 147 working coal based unit | - | 7 | - | - | - | 7 |
| ^=State DI Offices; #=Estimated, *=included units in proposal/ planning stage | | | | | | |

**Raw materials:**
JPC survey list the following the main constraints faced by sponge iron industry, on Page 7 of 11.

"Analysis of the data shows that out of 147 units surveyed, raw material (availability and prices), accounts for the largest ( 96%) amongst the nature of constrains faced by a coal based sponge iron unit today, followed by power (cost), and to lesser extent finance (availability), and labour negligible".

JPC survey on page 5 & 6 of 11 :

"**Coal Linkage**: Analysis of the data shows that out of the 147 units surveyed, 60% has their own coal linkage. The state wise picture shows Orissa and Chhattisgarh tops the list with West Bengal close behind. But the scenario in the other states is not much encouraging, indicating the Indian coal based sponge iron producers are dependent on market sources for procuring this key raw material.

**Iron Ore:** Analysis of thee data shows that out of 147 units surveyed, iron ore from mines, be it captive (virtually nil) or leased (minimal), plays an insignificant part in meeting iron ore requirements of the domestic coal based sponge iron segment. In other words, this indicates that in case of iron ore also, Indian coal based sponge iron producers are dependent on market sources"

***Captive power generation***
On page-7 of 11 of JPC report under the heading "captive generation facility"

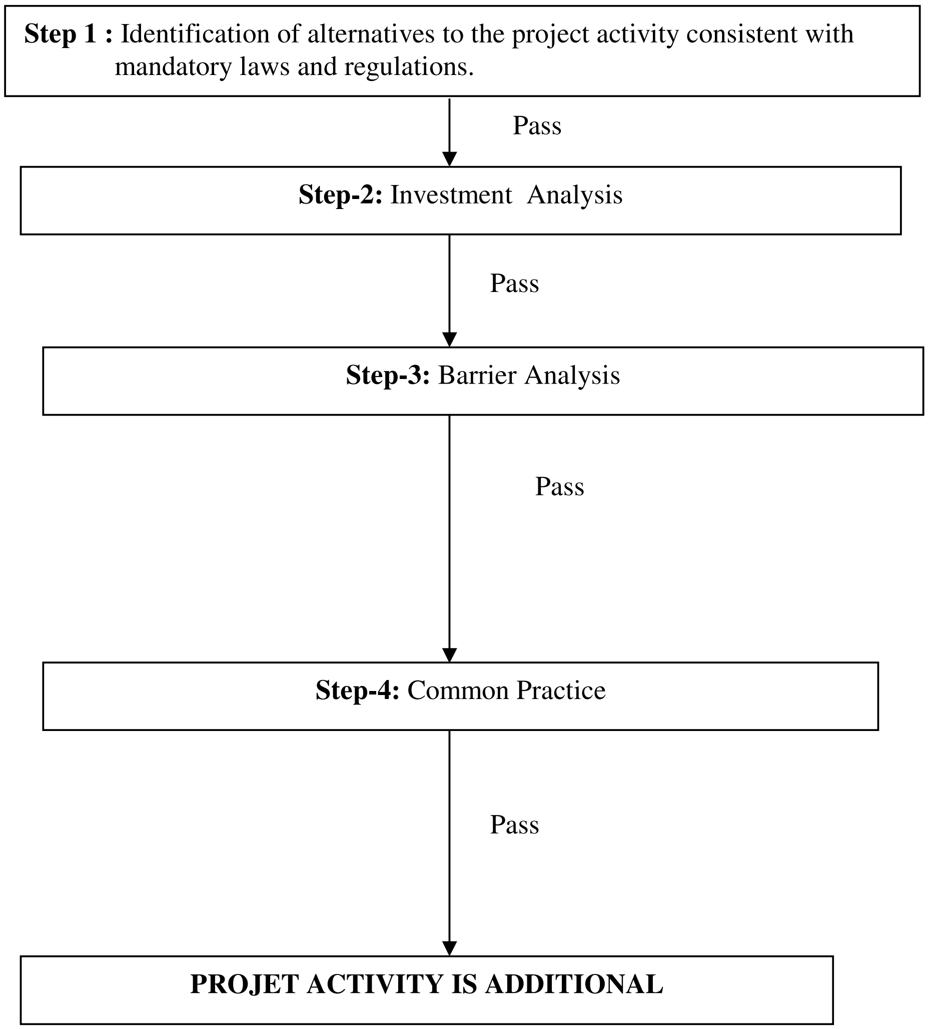
"Analysis of the data shows that out the 147 units surveyed, the number of units with captive power generation facility is quite low; total of such units being only 16, with maximum concentration occurring in Chhattisgarh ( 8 units)"

***Expansion***
**"**77 out of 147 coal based units are going in for expansion of existing capacity."
Jharakhand, Chhatisgarh and Orissa are states where majority of this fresh capacity will be installed

JPC report is provided as part of proof for the following barriers

1. Investment barrier due to shortage of iron ore and coal and market variation
2. Common practice analysis/prevailing practice.
3. Technological barrier due to shortage of technical manpower due to heavy expansion in sponge iron industry

**Flow Chart : How the Project is additional**



## B.6. Emission reductions:

### B.6.1. Explanation of methodological choices:

>>

Selected methodology is ACM 0004 Version 02, 3rd March 2006 and ACM0002 Version-07, EB-36.

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

*(Copy this table for each data and parameter)*

| **Data / Parameter:** | $EFCO_2$ i |
|---|---|
| Data unit: | t C/TJ |
| Description: | $CO_2$ emission factor of fuel used in captive power generation |
| Source of data used: | IPCC guidelines |
| Value applied: | 26.2 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | IPCC value give conservative emission factor |
| Any comment: | Nil |

| **Data / Parameter:** | $EF_{captive}$, y |
|---|---|
| Data unit: | $tCO_2eq./MWh$ |
| Description: | Emisison factor for captive power generation |
| Source of data used: | Calculated |
| Value applied: | 1.26 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | This data has been calculated as required by methodology ACM 0004 Version 2 assuming boiler efficiency as 100% as per Option B of methodology to be conservative. |
| Any comment: | Nil |

### B.6.3 Ex-ante calculation of emission reductions:

>>

We have followed the approved baseline methodology ACM0004 for formulas used is estimating base line emissions:

If the baseline scenario is determined to be captive power generation either (existing or new), the Emissions factor for displaced electricity is calculated as follows;

Calculation of emission factor for captive power baseline:

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

Where.

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

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

**Option A**

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

**Option B**

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

We have selected Option B .

**Leakage (Ly)**

There is no leakage in the project activity

**Emission Reductions**

Project activity mainly reduces $CO_2$ through substitution of coal based captive electricity generation.

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 emission reduction of the project activity during the year y in tons of $CO_2$. |
| BE y | = | are the baseline emissions due to displacement of electricity during the year y in tons of $CO_2$, |
| PE y | = | are the project emission during the year y in tons of $CO_2$ |

No project emission is considered and no leakage is considered

Where the baseline emissions

$BE_y$ in $tCO2 = EF_{captive,y} \times EG_y$

$EG_y = E_{GEN} - E_{AUX}$ = Net electricity supplied by project activity

No project emission and no leakage is considered in line with methodology

We have followed the approved baseline methodology ACM0002 for formulas used is estimating base line emissions:

**Calculation of Baseline Emission Factor**
Base line emission factor will be constant as Ex ante based and fixed for the entire credit period.

**Calculation of Net Emission Reduction:**

| | |
|---|---|
| Installed capacity of power generation | 15 MW |
| Number of working days/year | 350 |
| Number of working hours/day | 24 |
| Gross generation of electricity at 100% PLF | 126000 MWh |
| Gross Generation at 66% PLF | 83160.00 MWh |
| Auxiliary consumption (10%) | 8316.00 MWh |
| Net Generation (EGy)<br>(Gross Generation – Auxiliary consumption) | 74844.00 MWh |
| Emission Factor (EFcaptive y) | 1.26 $tCO_2e$/MWh |
| Emission Reduction/Year (ERy) | 94303.44 $tCO_2e$/Year<br>Or say 94303.00 $tCO_2e$/Year |

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

>>

| **Year** | **Estimation of project activity emission (tonnes of CO2e)** | **Estimation of baseline emission (tonnes of CO2e)** | **Estimate of leakage (tonnes of CO2e)** | **Estimation of overall emission reduction (tonnes of CO2e)** |
|---|---|---|---|---|
| 2009-10 | 0 | 94303.00 | 0 | 94303.00 |
| 2010-11 | 0 | 94303.00 | 0 | 94303.00 |
| 2011-12 | 0 | 94303.00 | 0 | 94303.00 |
| 2012-13 | 0 | 94303.00 | 0 | 94303.00 |
| 2013-14 | 0 | 94303.00 | 0 | 94303.00 |
| 2014-15 | 0 | 94303.00 | 0 | 94303.00 |
| 2015-16 | 0 | 94303.00 | 0 | 94303.00 |
| 2016-17 | 0 | 94303.00 | 0 | 94303.00 |
| 2017-18 | 0 | 94303.00 | 0 | 94303.00 |
| 2018-19 | 0 | 94303.00 | 0 | 94303.00 |
| Total :: | 0 | 943030.00 | 0 | 943030.00 |

## 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:** | $EG_{GEN\ CPP}$ |
| Data unit: | MWh |

| | |
|---|---|
| Description: | Gross electricity generated by entire CPP |
| Source of data to be used: | Data is measured through the electronic meter provided at the output of TG. The meter reading will be available on DCS continuously and same will be transferred to log book to be maintained by shift engineer , approved by shift in charge as the daily report. The metes will be regularly calibrated by approved agencies. |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 162960 |
| Description of measurement methods and procedures to be applied: | Log book maintained based on DCS data which receive data from meters |
| QA/QC procedures to be applied: | Log book will signed by plant manager daily. Meters will calibrated regularly. The meters will regularly under QC/QA procedure for any variation. If variation noticed the recalibration will be done immediately. |
| Any comment: | Data will be kept for crediting period + 2 years |

| **Data / Parameter:** | $EG_{AUX\ CPP}$ |
|---|---|
| Data unit: | MWh |
| Description: | Auxiliary electricity consumption |
| Source of data to be used: | Date will measured through the electronic meters provided at the feed to each auxiliary consumption source. The meters readings will be available on DCS continuously and same will be summed up by DCS to arrive total auxiliary consumption. This data will transferred to log book to be maintained by shift engineer, approved by shift in charge as the daily report |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 16296 |
| Description of measurement methods and procedures to be applied: | Log book maintained based on DCS data which receive data from meters connected to DCS. |
| QA/QC procedures to be applied: | Log book signed by plant manager daily. Meters calibrated regularly |
| Any comment: | 10% Auxiliary consumption has been considered for the sake of estimated emission reduction. Actual consumption will be used for calculating actual emission reduction. Data will be kept for crediting period + 2 years |

| **Data / Parameter:** | $EG_{y\ CPP}$ |
|---|---|
| Data unit: | MWh |

| | |
|---|---|
| Description: | Net electricity generated |
| Source of data to be used: | calculated EG y CPP =EG GEN CPP -EG AUX CPP |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 146664 |
| Description of measurement methods and procedures to be applied: | Log book will be maintained based on DCS data which is based on data from meters connected to DCS. |
| QA/QC procedures to be applied: | Log book signed by plant manager daily. Meters calibrated regularly |
| Any comment: | Data will be kept for crediting period + 2 years |

| **Data / Parameter:** | $E_{GEN}$ |
|---|---|
| Data unit: | MWh |
| Description: | Gross electricity generation due to WHRB |
| Source of data to be used: | Calculated based on measured data. |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 83160 |
| Description of measurement methods and procedures to be applied: | Calculated based on measured data. |
| QA/QC procedures to be applied: | Calculated data. |
| Any comment: | Data will be kept for crediting period + 2 years. |

| **Data / Parameter:** | $E_{AUX}$ |
|---|---|
| Data unit: | MWh |
| Description: | Gross Auxiliary consumption for WHRB electricity generation. |
| Source of data to be used: | Electronic Meter/ Calculated |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 8316 |
| Description of measurement methods | Calculated data based on measured data. |

| | |
|---|---|
| and procedures to be applied: | |
| QA/QC procedures to be applied: | Calculated data. |
| Any comment: | Measured data will be used for auxiliary consumption calculation, but for estimation of emission reduction in PDD 10% auxiliary consumption is considered in calculation however the actual recorded data will be applied. Data will be kept for crediting period + 2 years. |

| **Data / Parameter:** | EGy |
|---|---|
| Data unit: | MWh |
| Description: | Net electricity generated due to WHRB. |
| Source of data to be used: | Calculated |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 74844 |
| Description of measurement methods and procedures to be applied: | Calculated :<br>EG y = $E_{GEN} - E_{AUX}$ |
| QA/QC procedures to be applied: | Calculated data as per formulae given above. |
| Any comment: | Data will be kept for crediting period + 2 years. |

| **Data / Parameter:** | Steam Temp. (T1, T2 & T3) |
|---|---|
| Data unit: | $^0$C |
| Description: | Temperature of steam at outlet of WHRB-1, WHRB-2 & AFBC |
| Source of data to be used: | The temperature meter provided at the output of WHRB-1, WHRB-2 and AFBC. The meter reading will be available on DCS continuously and same will be transferred to log book to be maintained by shift engineer, approved by shift in charge as the daily report |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 490 |
| Description of measurement methods and procedures to be applied: | Meter provided at output of WHRB-1, WHRB-2 and AFBC, reading will available at DCS. DCS data will be used for logbook. |
| QA/QC procedures to be applied: | Meters are regularly calibrated. |

| | |
|---|---|
| Any comment: | The data used from manufactures specification, however actual measured data will used and be kept for crediting period + 2 years. |

| **Data / Parameter:** | Steam Pressure (P1, P2) |
|---|---|
| Data unit: | Kg/cm$^2$ |
| Description: | Pressure of steam at outlet of WHRB-1, WHRB-2 |
| Source of data to be used: | The steam pressure gauges are provided at the output of WHRB-1, WHRB-2. The reading will be available on DCS continuously and same will be transferred to log book to be maintained by shift engineer, approved by shift in charge as the daily report |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 66 |
| Description of measurement methods and procedures to be applied: | Steam pressure gauge provided at output of WHRB-1, WHRB-2, reading will available at DCS. DCS data will be used for logbook. |
| QA/QC procedures to be applied: | Regular calibration of equipments will be done. |
| Any comment: | The data used from manufactures specification, however actual measured data will used and be kept for crediting period + 2 years. |

| **Data / Parameter:** | Steam Pressure (P3) |
|---|---|
| Data unit: | Kg/cm$^2$ |
| Description: | Pressure of steam at outlet of AFBC |
| Source of data to be used: | The steam pressure gauges are provided at the output of AFBC. The reading will be available on DCS continuously and same will be transferred to log book to be maintained by shift engineer, approved by shift in charge as the daily report |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 67 |
| Description of measurement methods and procedures to be applied: | Steam pressure gauge provided at output of AFBC, reading will available at DCS. DCS data will be used for logbook. |
| QA/QC procedures to be applied: | Regular calibration of equipments will be done. |
| Any comment: | The data used from manufactures specification, however actual measured data will used and be kept for crediting period + 2 years. |

| **Data / Parameter:** | Steam Flow (F1, F2) |
|---|---|
| Data unit: | Tonnes per hour |
| Description: | Steam flow at outlet of WHRB-1 & WHRB-2 |
| Source of data to be used: | The steam flow meters are provided at the output of WHRB-1 and WHRB-2. The reading will be available on DCS continuously and same will be transferred to log book to be maintained by shift engineer, approved by shift in charge as the daily report |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 38 |
| Description of measurement methods and procedures to be applied: | Steam flow meters are provided at output of WHRB-1 and WHRB-2 , reading will available at DCS. DCS data will be used for logbook. |
| QA/QC procedures to be applied: | Regular calibration of equipments will be done. |
| Any comment: | The data used from manufactures specification, however actual measured data will used and be kept for crediting period + 2 years. |

| **Data / Parameter:** | Steam Flow (F3) |
|---|---|
| Data unit: | Tonnes per hour |
| Description: | Steam flow at outlet of AFBC |
| Source of data to be used: | The steam flow meter is provided at the output of AFBC. The reading will be available on DCS continuously and same will be transferred to log book to be maintained by shift engineer, approved by shift in charge as the daily report |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 54 |
| Description of measurement methods and procedures to be applied: | Steam flow meters are provided at output of AFBC, reading will available at DCS. DCS data will be used for logbook. |
| QA/QC procedures to be applied: | Regular calibration of equipments will be done. |
| Any comment: | The data used from manufactures specification, however actual measured data will used and be kept for crediting period + 2 years. Data will be kept for crediting period + 2 years. |

| | |
|---|---|
| **Data / Parameter:** | Steam Flow (F4) |
| Data unit: | Tonnes per hour |
| Description: | Steam flow at input TG |
| Source of data to be used: | The steam flow meter is provided at the in put of TG. The reading will be available on DCS continuously and same will be transferred to log book to be maintained by shift engineer, approved by shift in charge as the daily report |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 117 |
| Description of measurement methods and procedures to be applied: | Steam flow meter is provided at in put of TG, reading will available at DCS. DCS data will be used for logbook. |
| QA/QC procedures to be applied: | Regular calibration of equipments will be done. |
| Any comment: | Data will be kept for crediting period + 2 years. |

| | |
|---|---|
| **Data / Parameter:** | $EG_{IMPORT}$ |
| Data unit: | MWh |
| Description: | Gross electricity imported from Grid |
| Source of data to be used: | Data is measured through the electronic meter provided at the substation of the facility where the interface with the grid is established. The monthly Joint Meter Reading will be available at plant. The metes will be regularly calibrated by approved agencies. |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Nil |
| Description of measurement methods and procedures to be applied: | Joint meter reading from grid interface meters |
| QA/QC procedures to be applied: | Meter will sealed by the grid authorities, and calibrated at required intervals as per prevailing law of grid. |
| Any comment: | Data will be kept for crediting period + 2 years |

| | |
|---|---|
| **Data / Parameter:** | $EG_{EXPORT}$ |
| Data unit: | MWh |
| Description: | Gross electricity exported to the Grid |
| Source of data to be used: | Data is measured through the electronic meter provided at the substation of the facility where the interface with the grid is established. The monthly Joint Meter |

| | |
|---|---|
| | Reading will be available at plant. The metes will be regularly calibrated by approved agencies. |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Nil |
| Description of measurement methods and procedures to be applied: | Joint meter reading from grid interface meters |
| QA/QC procedures to be applied: | Meter will sealed by the grid authorities, and calibrated at required intervals as per prevailing law of grid. |
| Any comment: | Data will be kept for crediting period + 2 years |

**B.7.2 Description of the monitoring plan:**

>>

**(A) Purpose**

To define the procedures and responsibilities for GHG Performance, monitoring, measurement, reporting of data, dealing with uncertainties, and covers the responsibilities regarding plant operation and maintenance.

**(B) Scope**

This procedure is applicable to 15 MW waste heat based WHRB power project of SHYAM DRI.

**(C) Responsibilities**

Shift Engineer (Operations): Responsible for proper operation of the mechanical equipments, reporting shift wise or eight hourly data of steam generated from WHRB, steam fed to turbines, parameters of steam and flow meter reading of the captive power plant. The report is then sent to the Manager (O & M) for his review.

Shift Engineer (Electrical): Responsible for proper operation of electrical equipment and taking meter reading for electricity generation and monthly joint meter reading for import and export of power from and to the Grid.

Shift Engineer (maintenance): Responsible for proper maintenance management.

Manager (Plant): Responsible for operation, maintenance and management of plant will be reviewing the monitored parameters shift-wise and presenting a daily executive summary report, duly signed by himself, to the General Manager (Plant).

General Manager/Vice President (Power Plant) : Responsible and in charge of complete operation, maintenance and management of all plant and CDM related matters

He will be in charge of all CDM related matters and CDM officer will be directly reporting to him

CDM Officer : He will be reporting to General Manager and will be responsible for preparing required documentation and reviewing the accuracy of various reports with counter checks along with project developer. He will be responsible for internal audit regarding CDM project matters.

Details of monitoring plan is provided in Annexure 4

**Why the Power Import & Export to the Grid is not considered in the Monitoring Plan**:-

Since the methodology requires to monitor the activities within the Project Boundary where in the project proponent have full control and the emission reduction calculation is based on the power generated due to the project activity, therefore while monitoring the power generation due to the Project Activity, there was no purpose and need found for monitoring of power import or export to the Grid. The auxiliary power consumed by the auxiliary facilities supporting the power generation are monitored independently, transparently and reliably, irrespective of the fact that such auxiliary power is supplied by the captive generation or by the Grid (because at such moments when the CPP is not generating power then emergency support, power for the auxiliary consumption has to be drawn from the grid or any other backup source). All such power consumed by the "Project Activity auxiliary" is monitored and deducted from the Gross Generation to arrive at the Net Power Generation; to calculate the net Emission Reduction. The methodology also does not require to monitor the import or export of power from Grid.

The downstream facilities which consume the captive power as well as seek the power from the Grid are outside the project boundary. The baseline selected is coal based captive power hence also the monitoring of Grid power import or export is not required. Moreover the monitoring plan has been prepared in accordance to the approved methodology which does not require to monitor any power import and export from or to the Grid. Hence it is felt that this may not be necessary.

However it may be noted that at every Grid interface there exists the import and export metered data of power, which is metered and monitored by Grid for billing purposes. Even if these data are included in monitoring plant even then there seems to be no application of the same for any purposes for determining of emission reduction by the project activity.

As per the direction EB-41 End Note-5 the Import/Export of power is included in the monitoring plan as follows:

$EG_{IMPORT}$ = The quantity of power imported within the facility from the grid shall be monitored by installation of an energy meter. The monitoring of the same will be done on monthly basis as Joint Meter Reading between the PP and Grid authorities.

$EG_{EXPORT}$ = The quantity of power exported from the facility to the grid shall be monitored by installation of an energy meter. The monitoring of the same will be done on monthly basis as Joint Meter Reading between the PP and Grid authorities.

The energy consumed for operation of auxiliary facilities of the project activity (i.e. WHRB based power plant) by utilisation of power imported from the grid shall be taken in to account as auxiliary consumption and shall be deducted from gross power generation due to project activity. The applied methodlogy ACM0004 requires to calculate the emission reduction only after deducting the auxiliary power consumed in the project activity from the gross power generation due to the project activity. Thus any power consumed in the auxiliary system of the project activity will be deducted as per the monitoring plan even if it is imported from the grid.

**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)**

>>

Date of Completion of application and baseline study : 23 June 2007

Preparation of this document has been done by "Indus Technical and Financial Consultants Ltd.", whose address is :

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Shri Vikas Thakur
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In front of Shikapuri Panchayat Bhawan.
Raipur City , Chhattisgarh State . 492001. INDIA
Phone : 0771-2255186 Fax : 0771-2254188, Email : indusryp@satyam.net.in ,
Mobile: 094252-08189, 093011-93400

## 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:

>> 09/09/2004 (order date for 2 Nos. of WHRB Boiler)

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

>> 15 Years

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

Project activity will use a fixed crediting period of 10 years.

#### C.2.1. Renewable crediting period

*Not applicable*

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

>> Not applicable

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

>> Not applicable

**C.2.2. Fixed crediting period:**

Project activity will use a fixed crediting period of 10 years 0 Month.

**C.2.2.1. Starting date:**

>> From the date of registration. Or 10/05/2008, which ever is later.

**C.2.2.2. Length:**

>> 10 Years 0 Months.

## SECTION D. Environmental impacts

>>

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

>>

The Project activity is to produce 15 MW power based on waste heat recovery based steam generation (WHRB) and steam turbines. There are no additional GHG emissions other than the existing GHG emissions in the absence of project activity.

The installation of WHRB and CPP requires approvals of IBR (Indian Boiler Regulation) and Orissa State Pollution Control Board (OSPCB) and both the approvals will be received before the Commissioning of project activity.

Environmental impact is negligible as the project activity benefits the local, regional and global environment by,

1. Reducing the thermal pollution which could have been caused by emitting waste gases at $950^0$C into atmosphere. Project activity recovers the waste heat and save; energy and reduces thermal emission by controlling gas temperature below $200^0$C.
   i) Generates electricity without adding any additional GHG emissions.
   ii) The power generated by the project activity will be used for in house activity will be used for in house requirement and consumption without any T&D losses as the location of power generation is in the same premises.
2. Noise level from equipments shall be kept within legal limits.
3. The project will not generate on its own any Fly Ash due to Power generation from the project activity. But ash contained in flue gases will be collected in ash hoppers provided in WHR boiler.
4. The proposed ESP shall remove the ash from flue gases which will be collected in Ash Hopper. This ash will be given free of cost to cement plants and brick manufacturers for further Economics benefits and use. The ash used for production of bricks saves the valuable productive soil; also it reduces the Air Pollution caused by the conventional brick kilns, due to the coal burning. The Ash consumed in Cement making reduces the limestone and coal consumption, thus natural resources are saved.

SHYAM DRI have not carried out EIA Study for the first phase, project activity got the all environment clearance i.e. "consent to operate" to operate by State Pollution Control Board after satisfactory compliance of all the requirement. EIA study for the II phase is under progress.

### 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:

>>

Environmental impact are considered in-significant as enumerated in D1, No adverse impact on environment will be there due to project activity.

**Noise Pollution**

Equipments like Boiler and STGs shall be provided with noise depressing facilities to dampen and to reduce the noise level to permissible levels at the nearest village. In the plant the noise level will be kept below 90dB.

**Thermal Pollution:**

In current situation the hot flue gases will be let out causing considerable thermal pollution.

The heat shall be recovered in the boiler and the flue gases be let out by stack of 70 m height below $200^0$C and hence thermal pollution shall be reduced considerably.

**Air emission:**

An ESP provided at the outlet of boiler effectively reduces the flue dust level below to 100 $mg/nm^3$ while acceptable legal standard is 150 $mg/nm^3$ .

**Impact on Water environment**

Blow down water shall be used for plantation. Sources of waste water are DM Plant and Blow down.

All the waste water will be neutralized before using for plantation.

Monitoring of waste water will be done to limit pH, BOD and COD levels within the stipulated levels.

No discharge will be there outside the premises. Hence due to the zero discharge condition, no adverse impact will be there in the water regime.

**Solid waste management**

Ash collected from bottom of hopper of ESP shall be transported to Ash Silo equipped with bag filters to ensure clean air.

Ash collected shall be supplied to cement manufacturing/ brick manufacturing units and as back fill material for filling of the low lying area.

**Safety Management**

To ensure safe working conditions:

1) All moving parts shall be provided with guards/ hoods.
2) Insulation of all hot parts shall be done.
3) Full fledged maintenance department shall ensure the healthy condition of equipments.
4) A disaster management plan already exists to handle crisis situation.

All efforts will be done to create clean environment.

Parameters like Noise, Fugitive Emission as well as point source emissions will be monitored regularly.

**Conclusion:**

Project activity is environment friendly and creates employment and other benefits and promotes sustainable developments.

## SECTION E. Stakeholders' comments

>>

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

>>

SHYAM DRI identifies the following as stake holders to keep the transparency in the operational activity of the project promoter and thereby meeting local/ environmental regulations

1) Local authority of Village –Pandloi Gram Panchayat
2) Western Electricity Supply Company of Orissa Ltd (WESCO)
3) State Pollution Control Board, Orissa (OSPCB)
4) Ministry of Commerce and Industry.

Management of Shyam DRI invited comments from local stakeholder by newspaper advertisement in newspaper namely "Dharitri Oriya Daily, Bubhneshwar" on 22/08/2007 & "Samvad" in Oriya language (local language) on dated 03/09/2007. A local stake meeting was held on 25/08/2007 at Village- Pandloi to aware the villagers regarding the project activity i.e. regarding WHRB based electricity generation.

Shyam DRI management representatives met various stake holders for appraisal regarding project activity and sought the support.

### E.2. Summary of the comments received:

>>

SHYAM DRI management apprised the representatives of village Panchayat of village-Pandloi about the project activity. The members of Panchayat appreciated and had expressed their no objection for project activity. Gram Panchayat have issued no objection certificate.

Sarapanch , village Pandloi raised the points of activities required to be carried out by company during periphery development committee meeting.

Permission have been sought from the State agencies like WESCO,OSPCB, etc. wherever required legally and have been received and other State agencies have been apprised of the project activity

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

>>

As suggested by Sarapanch Shyam DRI Power Ltd. had done the peripherial development work, and list of which is provided.

No adverse comment was received on project activity.

## Annex 1

### CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

| | |
|---|---|
| Organization: | SHYAM DRI Power Ltd. |
| Street/P.O.Box: | ------- |
| Building: | ------ |
| City: | Village:Pandloi, P.O. Lapanga/ Rengali, distt: Sambalpur |
| State/Region: | Orissa |
| Postfix/ZIP: | 768212 |
| Country: | India |
| Telephone: | +91-0663-2230484 |
| FAX: | +91-0663-2230486 |
| E-Mail: | shyamdri@sancharnet.in |
| URL: | www.shyamgroup.com |
| Represented by: | |
| Title: | |
| Salutation: | Mr. |
| Last Name: | Agrawal |
| Middle Name: | |
| First Name: | Sanjay |
| Department: | Board of Director |
| Mobile: | +91 98318 35605 |
| Direct FAX: | +91-033 22852212 |
| Direct tel: | 91-033-22852330 (extn.)116 |
| Personal E-Mail: | sanjay@shyamgroup.com |

## Annex 2

### INFORMATION REGARDING PUBLIC FUNDING

No Public Funding is available from Annexure-I Country

## Annex 3

### BASELINE INFORMATION

**Base line information (sources of information)**

| S.No. | Parameter | Source |
|---|---|---|
| 1 | Steam parameters considered | From AFBC Boiler Specification. |
| 1 | Boiler Efficiency | Consider 100% as per methodology on conservative side. |
| 2 | Steam consumption / MWh | Turbine manufacturer's performance guarantee data. |
| 3 | Steam enthalpy | ISI Steam Table in SI Units |
| 4 | Emission factor ($EF_{CO2}$) for coal | IPCC default value |
| 5 | Carbon to Carbon-di-oxide conversion factor | IPCC default value |

**Technical Specification of Turbine as per Manufacturer:**
**TG**

1. Capacity of Turbine : 30 MW
2. Inlet Steam pressure : 63.7 bar (a)
3. Inlet Steam Temperature : $485^0$C
4. Steam Consumption : 117 T/hr.

**Specification of AFBC boiler**
**AFBC**

1. Capacity of Boiler : 54 T/hr.
2. Steam pressure : 67 ksc(g)
3. Steam Temperature : $490\pm5^0$C

**Specification of WHR boilers**

1. Capacity of Boiler : 38 T/hr.
2. Steam pressure : 66 $kg/cm^0$
3. Steam Temperature : $490\pm5^0$C

**Formulae used to estimate baseline emissions (units of $CO_2$ equ.)**

We have followed the approved baseline methodology ACM0004 for formulas used is estimating base line emissions:

If the baseline scenario is determined to be captive power generation either (existing or new) ,the Emissions factor for displaced electricity is calculated as follows;

Calculation of emission factor for captive power baseline :

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

Where.

$EF_{captive,y}$ : Emission factor for captive power generation ($tCO_2$/MWh)

$EF_{CO2}.i$ : $CO_2$ emission factor of fuel used in captive power generation tC/TJ

| | | |
|---|---|---|
| $Eff_{captive}$ | : | Efficiency of captive power generation (%) |
| 44/12 | : | Carbon to Carbon Dioxide conversion factor |
| 3.6/1000 | : | TJ to MWh conversion factor |

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

**Option A**

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

**Option B**

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

We have selected Option B .

# Annex 4
# MONITORING INFORMATION

## Calculation of Net Power Generated

To achieve the above we follow the steps below (as per instrumentation plan given in the schematic diagram):

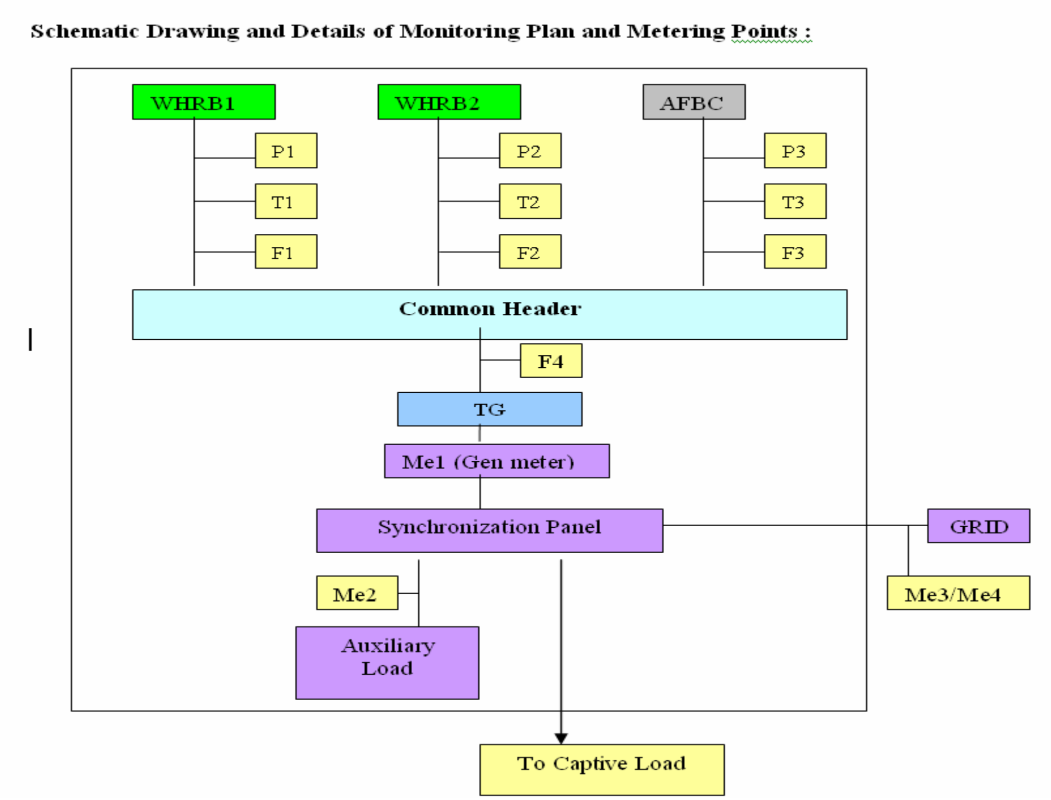
**Calculation of Net Power Generation**:

| | | | |
|---|---|---|---|
| A | Calculation of Enthalpy of Steam fed from WHRB-1 ($H_1$) | = | $E_{nt}$ X $F_1$ = $H_1$ |
| B | Calculation of Enthalpy of Steam fed from WHRB-2 ($H_2$) | = | $E_{nt}$ X $F_2$ = $H_2$ |
| C | Total Enthalpy of Steam fed from WHRB-1 & 2 ($H_5$) | = | A + B = $H_5$ |
| D | Calculation of Enthalpy of Steam fed from AFBC ($H_3$) | = | $E_{nt}$ X $F_3$ = $H_3$ |
| E | Calculation of Enthalpy of steam fed to TG ($H_4$) | | $E_{nt}$ X $F_4$ = $H_4$ |
| F | Electricity Generated by TG ( $EG_{GEN\ CPP}$ ) | = | $Me_1$ |
| G | Auxiliary Consumption by CPP($EG_{AUX\ CPP}$) | = | $Me_2$ |
| H | Net Electricity generation by CPP ( $EG\ y_{CPP}$) | = | F-G |
| I | Proportional Percentage Contribution in Enthalpy of Steam from WHRB-1 & 2 in total enthalpy of steam used for power generation by TG<br>= Enthalpy of Steam from [(WHRB 1 &2 / Total Enthalpy of steam fed into TG) X 100] | = | (C/E) X 100 |
| J | Electricity Generation from WHRB = % Contribution of Enthalpy of Steam from WHRB X Gross Electricity Generated by TG($E_{GEN}$) | = | F X I |
| K | Auxiliary Electricity consumption by WHRB ($E_{AUX}$) | = | G X I |
| L | Net Electricity generated by WHRB (EGy) | = | J-K or (H x I) |

**Note** : (1) Steam enthalpy $E_{nt}$ in K Cal/Kg is arrived by using thermodynamic steam tables, based on the pressure and temperature readings.

(2) Since the temperature and pressure at TG inlet are maintained at same level as that of WHRB-1& 2 outlet, hence separate monitoring of temperature and pressure at TG inlet is not required.

(3) The auxiliary power consumption meter shall record the entire quantity of energy supplied for the auxiliary consumption to the captive power plant, even if it is imported from the grid or even if it is generated by the captive power plant.




| **Steam Monitoring Parameter** | **Metering Point** |
|---|---|
| Pressure at Outlet of WHRB-1 | $P_1$ |
| Pressure at Outlet of WHRB-2 | $P_2$ |
| Pressure at Outlet of AFBC | $P_3$ |
| Temperature of  Outlet of WHRB-1 | $T_1$ |
| Temperature at Outlet of WHRB-2 | $T_2$ |
| Temperature at Outlet of AFBC | $T_3$ |
| Flow of steam  at  Outlet of WHRB-1 (after vent) | $F_1$ |
| Flow of steam  at  Outlet of WHRB-2 (after vent) | $F_2$ |
| Flow of steam  at  Outlet of AFBC (after vent) | $F_3$ |
| Net of Flow of steam  in to TG | $F_4$ |

**Electrical Parameter**

| **Electrical Monitoring Parameter** | |
|---|---|
| Gross Power Generation from TG | $Me_1$ |
| Auxiliary consumption meter | $Me_2$ |
| Gross quantity of Power Imported from the Grid(EG $_{IMPORT}$[6]) | Me3 |
| Gross quantity of Power Exported to the Grid(EG $_{EXPORT}$) [6] | Me4 |

[6] Me3 and Me4 data will be recorded normally by a single meter having facility to record import of power and export of power.

## I. Table for monitoring

| Serial No. | Activity |
|---|---|
| 1.0 | **GHG Performance Parameter** |
| 1.1 | The monitoring protocol requires SHYAM DRI to monitor the following GHG Performance parameters for estimating the emissions reductions from the waste heat based CPP:<br>• Gross generation of electricity by the CPP<br>• Auxiliary consumption<br>• Net quantity of steam available from the waste heat recovery boiler (WHRB-1&2) for electricity generation in CPP.<br>• Total Steam availability to and consumed in TG sets.<br>• Temperature and pressure of steam from WHRB boiler.<br>• Net electricity generation from waste heat recovery.<br>• Gross quantity of power imported and or exported from and to the grid. |
| 2.0 | **Metering System** |
| 2.1 | The metering system for the waste heat based CPP consist of<br>• Internal metering system calibrated and sealed by Deputy Electrical Inspector Generation for metering total generation from each TG Set.<br>• In house metering system of SHYAM DRI for metering the generation of power, auxiliary consumption,<br>• Steam Flow meters for monitoring net steam flow from WHRB-1 & 2 after the vent before the common header at entry port.<br>• Flow meter for steam inlet to turbine TG.<br>• Temperature gauge for WHRB-1&2, boiler.<br>• Pressure gauge for WHRB-1 & 2 boiler. |
| | The two numbers TG meters are located in the TG room itself. They are used to monitor SHYAM DRI's net electricity and total generation from the CPP. These meters are maintained and calibrated by SHYAM DRI. All these meters are cross calibrated from standard testing laboratory Govt of Orissa, Bhubaneshwar and sealed by DEI(G). |
| 2.2 | **In house Metering System of SHYAM DRI**<br>SHYAM DRI has an in-house metering system, which monitors the overall performance of the waste heat based CPP. The metering system mainly comprises of three meters.<br>• 1 in-house generation meter- One for TG set.<br>• In-house Auxiliary consumption meter. (one)<br>The in-house generation meters (or the Energy Meter) and consumption meters are micro-processor based metering device which monitor the net unit of Energy generated and auxiliary electricity consumed by SHYAM DRI's CPP. |

| | |
|---|---|
| | In-house captive auxiliary power consumption meters (or the Kilowatt Hour meter) are mainly micro-processor based metering device. In case or requirement the SHYAM DRI may also install the normal energy meters at various location. The number and place of metering can be changed to suit the actual field requirement. Installation of all such meters will be well documented. All the meters will be calibrated from the reputed agencies. |
| 3.0 | **Calibration of the Metering System** |
| 3.1 | All the metering devices are calibrated at regular intervals so that the accuracy of measurement is ensured all the time. The meters recording total generation is calibrated by standard testing laboratory Govt of Orissa, Bhubaneshwar and sealed by DEI(G). The other meters are calibrated internally as per suppliers calibration schedule following the standard procedures for calibration. |
| 4.0 | **Reporting of the Monitored Parameters/ Authority and Responsibility of monitoring and reporting** |
| 4.1 | **Metering System**<br>The SHYAM DRI personnel read the power generation from metering system for recording the net electricity and the total generation from the CPP on the last day of every month or First day of the subsequent month and keep the complete and accurate records for proper administration. In case of requirement the accuracy of the main meter reading may be substantiated by the check meter reading. In the event that the main meter is not at service, then the check meter shall be used. A monthly report is prepared based on the meter readings, which is sent to the Electrical Inspector as monthly legal return.<br><br>The Shift Engineer (Electrical) takes daily reading (at 6.00 AM) of the Main meters of the metering system and keeps the complete and accurate records in the reading book (maintained at the plant) for proper administration. The reading are verified by the Manager (Electrical and Instrumentation) on a daily basis and sent to the General Manager (Plant) at the Administrative Building in the plant for his review and for preparing the daily report. The import & export of power shall be monitored on monthly basis by the Grid authorities and the PP. |
| 4.2 | **In-house Metering System of SHYAM DRI**<br>The Shift Engineer (Electrical) monitors shift wise and eight hourly data on total generation, auxiliary consumption, net electricity available. The shift data or eight hourly data are recorded in the log book. The complete and accurate records in the log book are signed by the Shift Engineer (Electrical). Both of these reports are sent to the Manager (Electrical & Instrumentation) for his review on a daily basis.<br>On the basis of the reported parameters, a complete and accurate executive daily summary report is prepared and signed by the General Manager (Electrical & Instrumentation) and sent to the unit head for proper administration.<br><br>The flow meter reading, temperature and pressure gauge and DCS will measure the respective parameters and reporting is done shift wise by shift in-charge (operations) based on the online measurements. |
| 5. | **Uncertainties and Adjustments:** |
| 5.1 | The shift wise or eight hourly, daily and monthly data are recorded at various points |

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| | as stated above. Any observations (like inconsistencies of reported parameters) and/or discrepancies in the operation of the power plant will be documented as "History" in the daily report prepared by the General Manager (Plant) along with its time of occurrence, duration and possible reasons behind such operational disruptions. Necessary corrective actions will be undertaken at the earliest.<br><br>Any discrepancies in the Main reading for example, difference between main meter and check meter reading or extreme deviation in the net generation figure, if identified, will immediately be brought to the notice of General Manager, as well as Electrical Inspector. Corrective actions to be undertaken at the earliest after identification of reason of such discrepancy.<br><br>Furthermore, as a safety measure, the total power generating system is equipped with an Automatic Alarming System which gives a prior indication of any fluctuations in the operating parameters of the power plant thereby enabling the operators to take necessary preventive measures.<br><br>These measures will be undertaken in order to detect and minimize the uncertainty levels in data monitoring. |
| 6.0 | **Experience and Training** |
| 6.1 | All the Shift Engineers (Electrical and Instrumentation, Operations) are qualified engineers/ technologists. All the operators of the boiler power plant are IBR certified and NPTI certified engineers, and they also undergo an exhaustive on-the-job training program including plant operations, data monitoring and report preparation. |
| 6.2 | **Emergency Preparedness Plan**<br>The total power generating system of the waste heat based CPP is equipped with an "Automatic Alarming System" which helps the operators to take necessary preventive actions before any kind of non-functioning of the power plant results in. SHYAM DRI. CPP has a fire fighting system in place.<br><br>In addition SHYAM DRI has standard procedures for tackling emergencies arising from<br>• Blackout<br>• Low boiler drum level/ low feed water level<br>• High flue gas temperature from sponge iron kiln.<br>• Load throw off<br>• Boiler Tube leakage.<br>• Boiler tripping at alarm systems. |
| (f) | **Reference**<br>Project Design Document, maintenance manuals and standard OEM procedures. |
| | **Records**<br>1. Log Book, maintained by electrical & instrumentation department at site, containing daily data for all the in-house |

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| | | metering system. |
| | 2. | Daily Executive Summary submitted to the Vice president/General Manger (Plant), prepared by electrical & instrumentation department at site containing daily data for all the in-house metering system and record of any history with details. |
| | 3. | Daily report containing the performance parameters of the power plant and record of any history with details, maintained at site with a copy being sent to the unit head of the SHYAM DRI . |
| | 4. | Monthly Report on net quantity of electricity generated at SHYAM DRI's Captive Power Plant and Electricity Duty returns submitted by SHYAM DRI on generation archived at site with a copy being sent to the unit head of SHYAM DRI. Monthly report shall contain the gross quantity of power imported and/or exported by the facility |
| | 5. | Calibration certificate of the meters maintained at site. |

**(A) Purpose**

To define the procedures and responsibilities for GHG Performance, Project Management , Registration, Monitoring, Measurement and Reporting of data and dealing with uncertainties.

**(B) Scope**

This procedure is applicable to 15 MW waste heat based i.e. WHRB power project of SHYAM DRI, India.

**(C) Authorities and Responsibilities of Project Management, Registration, Monitoring, Measurement and Reporting:**

**Shift Engineer (Operations)**: Responsible for reporting shift wise or eight hourly data of the steam generated from boilers, steam fed to turbines, parameters of steam and flow meter reading of the Captive Power Plant. The report is then sent to the Manager (O & M) for his review.

**Manager/Sr. Manager (O&M)** : Responsible for reviewing the monitored parameters on an eight hourly or shift based and presenting a daily executive summary report, duly signed by himself, to the General Manager (Plant).

**Shift Engineer (Electrical)**: Responsible for taking meter reading for electricity generation and wheeling shift-wise. The report is then sent to the Manager (E&I) for his review on a daily basis.

**Manager/Sr. Manager (E&I)**: Responsible for reviewing the monitored parameters shift-wise and presenting a daily executive summary report, duly signed by himself, to the General Manager (Plant). Also responsible for the monthly joint meter reading for the import and or export of power from the facility from and to the grid.

**General Manager / Vice President (Plant)**: Responsible for summarizing data of Electrical, Mechanical, Process (/operation) Departments and report the same to the Vice President (Power) and CMD (SHYAM DRI) on a daily basis.

## Appendix I : Abbreviation

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| $^{0}C$ | Degree Centigrade |
| ABC | After Burning Chamber |
| AFBC | Atmospheric Fluidized Bed Combustion |
| Annex | Annexure |
| BOD | Biochemical Oxygen Demand |
| CDM | Clean Development Mechanism |
| CER | Certified Emission Reduction |
| COD | Chemical Oxygen Demand |
| CPP | Captive Power Plant |
| dB | Decibel |
| DEI(G) | Deputy Electrical Inspector (Generation) |
| DM | De-Mineralized |
| DRI | Direct Reduced Iron |
| E&I | Electrical and Instrumentation |
| EB | Executive Board |
| EHT | Extra High Tension |
| EIA | Environmental Impact Assessment |
| ESP | Electro Static Precipitator |
| GHG | Green House Gas |
| SHYAM DRI | SHYAM DRI Power Generation Ltd. |
| HSD | High Speed Diesel |
| HT | High Tension |
| IBR | Indian Boiler Regulation |
| Kcal | Kilo calorie |
| $kg/cm^2$ | Kilogram per centimeter square. |
| kWh | Kilo Watt hour |
| $M^3/hr.$ | Meter cube per hour |
| MU | Million Units |
| MW | MW |
| MWh | Mega Watt hour |
| $Nm^3/h$ | Normal Meter Cube per Hour |
| NPTI | National Power Training Institute |
| OSEB | Orissa State Electricity Board |
| OSERC | Orissa State Electricity Regulatory Commission |
| OSPCB | Orissa State Pollution Control Board |
| O&M | Operation and Maintenance |
| PDD | Project Design Document |
| PLF | Plant Load Factor |
| Qty | Quantity |
| SE(P) | Superintending Engineer (Project) |

## Appendix II : LIST OF WHRB POWER PROJECT UNDER CDM PROCESS

| S. No . | Project Title | Capa-city | No. of Kiln connected to WHRB<br>Kiln Capacity |
|---|---|---|---|
| 1 | TSIL – Waste Heat Recovery Based Power Project | 7.5 MW | 2 Kilns<br>120000 TPA |
| 2 | OSIL - Waste Heat Recovery Based Captive Power Project | 10 MW | 1 Kiln<br>100000 TPA |
| 3 | 8 MW Waste Heat Recovery based Captive Power Project at OCL | 8 MW | 4 Kilns X 100 TPD |
| 4 | RSP – Waste gas based captive power project in Integrated Iron & Steel Plant | 15 GWh/Annum | Waste gases from B.F. |
| 5 | Bhushan Steel & Strips Limited (BSSL) : Grid –Connected Electricity Generation by Waste Heat Recovery from Sponge Iron Direct Reduction (DR) Kilns | 33 MW &<br>77 MW | 8 Kiln X 500 TPD |
| 6 | Utilization of waste gases for power generation at NINL, India | 8.7 MW | Waste gases of B.F. |
| 7 | Power generation from waste heat of submerged arc furnaces | 13 MW | Heat of Waste gases from SAM |
| 8 | "Bhaskar Steel & Ferro Alloys Ltd. (BSFAL) 8 MW captive power generation through waste heat | 8 MW | 1 Kiln X 350 TPD |
| 9 | AIPL WHRB 1&2 | 16 MW | 2 Kilns X 350 TPD |
| 10 | SMC WHRB 1&2 | 16 MW | 2 Kilns X 300 TPD |
| 11 | SML WHRB CPP | 17.7 MW | 1 Kiln X 300 TPD<br>4 Kilns X 100 TPD<br>2 Kilns X 50 TPD |
| 12 | Bhushan Power and Steel Limited– Waste Heat Recovery Based Captive Power Project. | 40 MW & 60 MW | 4 Kilns X 500 TPD |
| 13 | Aarti Steels Limited – Waste Heat Recovery based Captive Power Project | 12 MW | 1 Kiln X 500 TPD |
| 14 | Utilization of waste heat of Coke Dry Cooling Plant gas for power generation at NINL, India | 5.3 MW | Coke Oven gases |
| 15 | SHYAM DRI WHR CPP | 19 MW | 2 Kiln X 350 TPD |
| 16 | 10 MW Waste Heat Recovery (WHR) project by Deepak Steels and Power Limited, India | 10 MW | 2 Kiln X 50 TPD, 2 Kiln X 100 TPD |

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