CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

SRBSL – Waste Heat Recovery based Captive Power Project

Version – 01

Date of document –03rd March 2006

A.2. Description of the project activity:

Brief Introduction:

Sri Ramrupai Balaji Steel Limited (SRBSL) is an integrated steel company belonging to the Jai Balaji Group, a major Group among secondary steel producers in Eastern India. The Group has over 35 years of experience in steel industries and has earned its name in the market for quality production of various steel products.

SRBSL was incorporated on 6th May 2002 and has its production facility at Durgapur in West Bengal, India. The present manufacturing capacity of SRBSL consists of 80500 metric tonne per annum (MTPA) of pig iron, 80000 MTPA of steel bars and rods and 120000 MTPA of sponge iron. The total power requirement of the steel complex is met by importing power from electrical utility companies Durgapur Projects Limited (DPL) and Damodar Valley Corporation (DVC). These electrical utility companies come under the Eastern Regional electricity grid network of India. SRBSL proposes to install a 50MW captive power plant (CPP) at its facility to substitute grid power. The CPP will be run using waste heat and coal char from sponge iron process.

Purpose of the project activity

The primary purpose of the proposed project is to recover the sensible heat content of the waste gases generated from sponge iron kilns using Waste Heat Recovery Boilers (WHRBs) to generate power. The generated power will substitute grid power to meet the process requirement of SRBSL's steel plant.

Description of Project Activity:

Around 9.6 MW of power of the proposed 50 MW CPP will be generated by utilizing heat content of waste gases from the four Direct Reduction Iron (DRI) kilns of sponge iron manufacturing process. The constituent of total power contributed by waste heat recovery in SRBSL's CPP comes under the scope of the term ***Project Activity.*** The sensible heat component of the sponge iron kiln flue gases will be utilised in Waste Heat Recovery Boilers (WHRBs) to produce steam. Steam thus produced will be fed to a common steam header from where it will be finally fed to turbo-generator sets to generate power.

The power generated will be supplied to the steel complex of SRBSL. In effect, the waste heat power displaces power from Eastern Regional Grid, from where SRBSL would have imported in absence of the project activity. The project will lead to reduction of approximately **51504 tonnes of CO_2 emissions per annum** from the fossil fuel based power plants connected to the grid.

The CPP will operate in isolation from grid (stand alone mode) and supply power dedicatedly to the SRBSL's facility (sponge iron plant, ferro alloy plant, steel rolling mill, mini blast furnaces and their auxiliaries). All the power produced in the CPP will be consumed internally.

Gross power generation of captive power plant(kW)	50000
Power generation from waste gases of DRI kilns (kW) i.e. Project Activity	9640
Turbogenerator capacity (kW)	25000 x 2
Grid connection	The CPP would be solely supplying power to SRBSL's facility and will operate in isolation from DPL and DVC grid.
Plant load factor from 2nd year of operation	90%
Net Electricity Supply per annum from Waste Heat Recovery Steam Generation System at 90% PLF[Million kWh (MkWh)]	62. 60

Project's Contribution to Sustainable Development:

The project will contribute to the 'Sustainable Development of India' – the sustainability issues have been addressed under the following pillars:

Socio-economic well-being: The project helps in enhancing knowledge and skill of the employees with the new technology. It also helps in increasing the direct and indirect employment opportunity in the area of construction, operation and maintenance of the equipments.

Environmental well-being: The project activity helps in reducing thermal pollution at the facility. The project leads to conservation of coal at thermal power plants and emissions related to its transportation. It will also eliminate CO_2., SO_x and NO_x emissions at those power plants.

Further, under the project activity, air-cooled condenser is being installed rather than the conventional water-cooled condenser to keep the make-up water requirement to minimum. This is a commendable initiative in an area where water is a scarcity. On the whole, the project activity aims to contribute to a better local environment for the employees and the surrounding community.

Technological well-being: WHR based captive power plant developed as a cleaner technology will utilize waste flue gases of sponge iron kiln. The successful operation of the project can help in other sponge iron plants replicating this technology. The in-house generation of electricity will also reduce transmission & distribution loss (T&D loss), which would have occurred in case of supply of electricity to the manufacturing plant of SRBSL from the grid.

The project has already obtained the Host Country Approval Letter from the Ministry of Environment and Forests (the Indian Designated National Authority), Government of India.

A.3. Project participants:

Name of the Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants(*) as applicable	Kindly indicate if the party involved wishes to be considered as project participant (Yes/No)
Govt. of India	Sri Ramrupai Balaji Steels Limited (Public Entity)	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

India

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

South Asia, West Bengal

A.4.1.3. City/Town/Community etc:

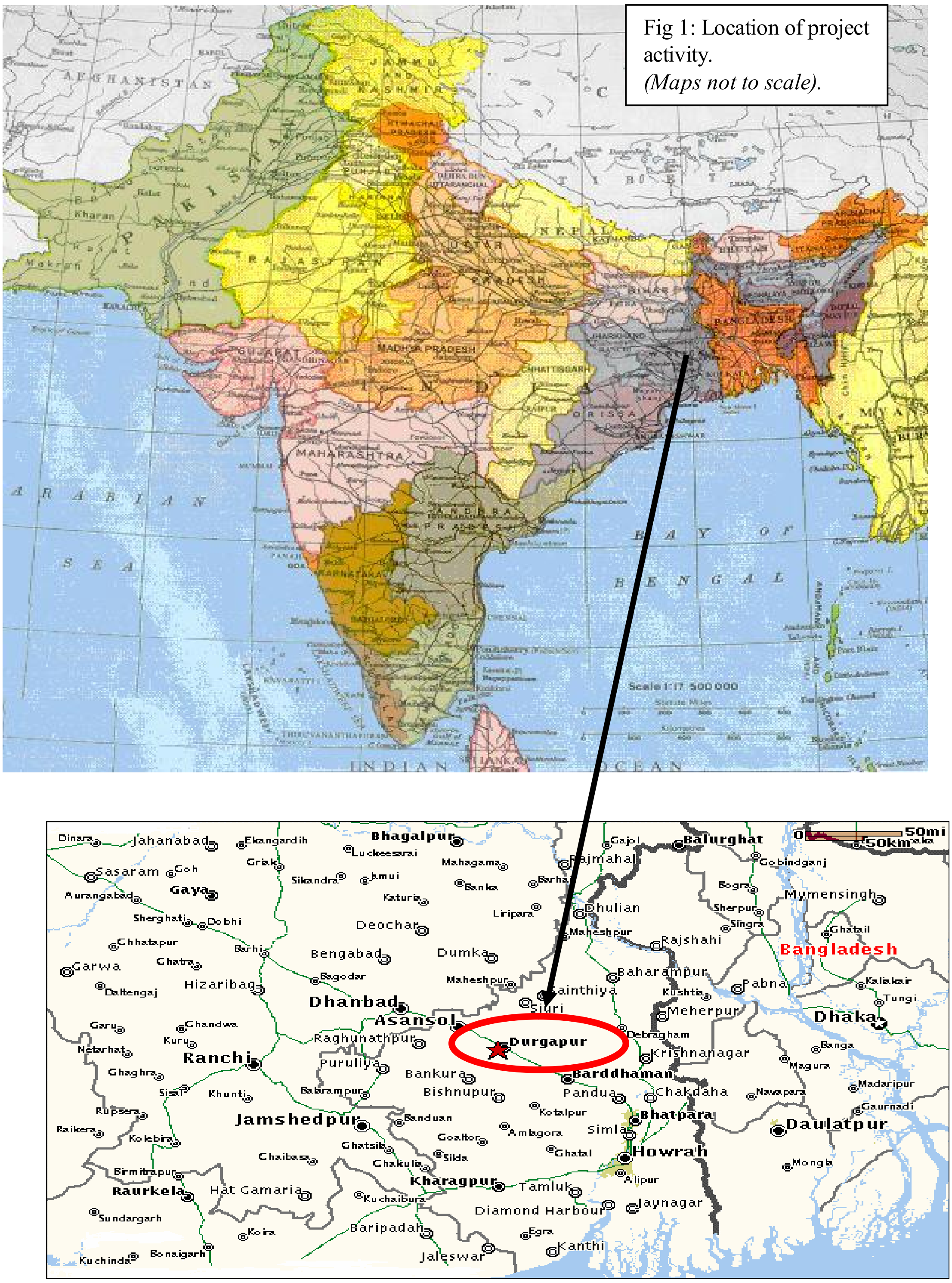
Banskopa Village, Durgapur, District - Burdwan

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

The proposed project activity will be located within SRBSL's sponge iron and mini steel plant at Banskopa village near Durgapur, Burdwan district of West Bengal state, India (see maps below). The plant is located about 170 Km away from the state capital Kolkata.

The site is well connected with rail and road. The nearest railway station is at Durgapur town, about 10km from the site.

Fig 1: Location of project activity.
(Maps not to scale).



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

The project activity is an electricity generation project utilizing waste heat where aggregate electricity generation savings of the project exceeds the equivalent of 15 GWh per annum. The baseline and monitoring methodology is adopted as per ACM0004. The project activity may principally be categorized in Category 1-Energy Industries (Renewable/Non-Renewable sources) as per the scope of the project activities enlisted in the 'list of sectoral scopes and approved baseline and monitoring methodologies' on the UNFCCC website for accreditation of Designated Operational Entities[1].

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

SRBSL proposes to install a waste heat recovery steam generation system (WHRSGS) for the four DRI kilns (each of 100 MTPD capacity) at their Durgapur facility. The quantum of waste gases at the exhaust of each kiln is estimated at 24000 Nm^3/hr and 900^0C. The hot gases will undergo secondary combustion in the After Burning Chamber (ABC) of the individual kilns where traces of carbon monoxide in the waste gases will be burnt. Subsequently, the hot gases from each ABC at 950^0C will be passed through a WHRB to generate 10 tonnes of steam per hour at $87kg/cm^2$ and 515^0C. A total of 40 tonnes per hour (tph) of steam will be generated from the four WHRBs. This steam will be fed to two sets of 25 MW double extraction–cum-condensing Steam Turbine Generators (STGs) of the CPP to generate electricity at 11kV. A total of 9.6 MW of power will be generated from the sensible heat content of waste gases from DRI kilns. Power thus generated will be fed to meet the in-house power requirement of SRBSL steel plant. The CPP will operate in isolation from the grid.

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

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

SRBSL proposes to set up its Waste Heat Recovery Based CPP under Clean Development Mechanism with an objective to utilize waste resources available from sponge iron manufacturing process and use it to generate electrical energy for its own utilization.

In the absence of the project activity the electricity requirement of SRBSL's plant would be met by importing power from Eastern Regional grid. Corresponding amount of CO_2 emissions would have resulted at the thermal power stations connected to the grid. The project activity therefore contributes to reducing power demand on the grid and marginally alters the combined margin of the grid mix thereby reducing anthropogenic emissions by sources that would have occurred in absence of the project activity.

The Department of Power, Government of West Bengal or the Central Government does not require sponge iron and steel industries to recover the heat content of the waste gases generated from the DRI kilns and produce electricity for internal consumption. SRBSL would be implementing the project over and above the national or sectoral requirements. The GHG emission reductions by the project activity are additional to those directed by the government policies and regulations. The other 'additionality' factors are dealt in detail in Section B3.

The project activity will be generating an output of approximately 62.60 MkWh/annum after auxiliary consumption. The average estimated total of emission reductions to be achieved by the project is 51504.0 tonnes of CO_2/year and 515040 tonnes of CO_2 for the entire 10 years of crediting period.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

Years	Annual Estimation of emission reductions in tonnes of CO_2 e
November 2006 - March 2007	21460
2007-2008	51504
2008-2009	51504
2009-2010	51504
2010-2011	51504
2011-2012	51504
2012-2013	51504
2013-2014	51504
2014-2015	51504
2015-2016	51504
April 2016 – October 2016	30044
Total estimated reductions CO_2 e	**515040**
Total number of crediting years	**10**
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**51504**

A.4.5. Public funding of the project activity:

There is no public funding available from any Annex I party for the project activity.

SECTION B. Application of a baseline methodology

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

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

Reference: Revised approved consolidated baseline methodology ACM0004/ Version 02, Sectoral Scope: 01, 03 March 2006[2]

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

As stated in ACM0004, "*This methodology applies to project activities that generate electricity from waste heat or the combustion of waste gases in industrial facilities*". The project activity under consideration recovers the heat content of waste gases emitted from the DRI Kilns of SRBSL facility to produce steam which is further used to generate electricity.

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

The methodology applies to electricity generation project activities:

1. *"that displace electricity generation with fossil fuels in the electricity grid or displace captive electricity generation from fossil fuels,"*-As per the Baseline Scenario analysis, conducted in Section B.2 of this PDD, the project activity displaces electricity generation from Eastern Regional grid which is dominated by fossil fuel (coal)[3]. Therefore the project activity meets the above applicability criteria.
2. *"where no fuel switch is done in the process where the waste heat or waste pressure or the waste gas is produced after the implementation of the project activity"*- The project activity involves utilization of the heat content of waste gases of the sponge iron kilns, which would have been dissipated into the atmosphere otherwise, for power generation. There is no fuel switch involved in the sponge iron kiln operation where the waste gas is generated.

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

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

The project activity under consideration meets all the applicability conditions of the baseline methodology. This justifies the appropriateness of the choice of the methodology in view of the project activity and its certainty in leading to a transparent and conservative estimate of the emission reductions directly attributed to the project activity.

B.2. Description of how the methodology is applied in the context of the project activity:

The project activity involves setting up of a CPP by SRBSL which generates 9.6 MW from waste heat sources to meet a part of its total in-house power consumption of its steel complex. The methodology is applied in the context of the project activity as follows:

Project Boundary:

The spatial extent of the project boundary comprises of the hot waste gases from the four sponge iron kilns, the respective waste heat recovery boilers and power generation set with its auxiliaries. There will be no auxiliary fuel used for supplementary firing in the WHRBs and hence project emissions will be zero.

For the purpose of determining baseline emissions – CO_2 emission factor of Eastern Regional grid is calculated as per ACM0002. This is further explained in detail in Section B4.

Identification of Alternative Baseline scenarios and selection of appropriate baseline scenario:

As per the methodology, the project proponent should include all possible options that provide or produce electricity (for in-house consumption and/or other consumers) as baseline scenario alternatives. These alternatives are to be verified for legal and regulatory compliance requirements and also for their dependence on key resources such as fuels, materials or technology that are not available at the project site. Further, among those alternatives that do not face any prohibitive barriers, the most economically attractive alternative is to be considered as the baseline scenario.

[3] Refer - http://ereb.org/ergridov.htm

As mentioned earlier, the project activity will be supplying a total of 9.6 MW of power to SRBSL. Five conceivable alternative scenarios were available with the project proponent that was contemplated during project inception stage:

Baseline Option 1: Continuation of current scenario i.e. Import of power from grid
SRBSL would continue to import power from DPL and DVC utilities that belong to the Eastern Regional grid network. The waste gases from the sponge iron kilns would be released to the atmosphere without utilizing its energy content. This alternative is in compliance with all applicable legal and regulatory requirements and can be a baseline option.

Baseline Option 2: Fossil fuel (coal) based captive power plant
The power to be generated from the project activity is over and above the power proposed to be generated from coal char, coal fines and coal washery rejects, all of which are available from the sponge iron process of SRBSL. Thus, the project proponent could set up a 9.6MW power plant that will run on freshly procured coal as fuel. However, for setting up such a coal based CPP statutory requirements exist due to linkage of coal, air pollution hazards and ash handling problems. Nevertheless, this alternative is in compliance with all applicable legal and regulatory requirements and can be one of the baseline options.

Baseline Option 3: Fossil fuel (gas) based captive power plant
The project proponent could generate their own power using natural gas based captive power plant. Though this alternative is in compliance with all regulatory and legal requirements, it is not a realistic alternative due to non-availability of natural gas and its supply to the state[4]. Therefore, this alternative can be excluded from the baseline scenario.

Baseline Option 4: Fossil fuel (Light diesel oil or furnace oil) based captive power plant
The project proponent could set up 9.6MW light diesel oil (LDO) or furnace oil (FO) based CPP at its steel complex. The waste gases from the sponge iron kilns would be released to the atmosphere without utilizing its energy content. This alternative is in compliance with all applicable legal and regulatory requirements and can be a baseline option.

---

[4] State wise/Sector wise Allocation of Natural Gas - http://petroleum.nic.in/ngbody.htm

Baseline Option 5: Implementation of project activity without CDM benefits

SRBSL may set up a 9.6MW waste heat recovery based CPP without considering CDM at its steel complex to partially meet its demand. This alternative is in compliance with all applicable legal and regulatory requirements. However, for this option, the project proponent would face a number of investment and technological barriers (as detailed in Section B3 below) making it predictably prohibitive. Hence this option is not a part of the baseline scenario.

Evaluation of the alternatives on economic attractiveness:

From the discussion above it is found that options 1, 2 and 4 can be a part of baseline scenario. Further, as per the methodology, these options are evaluated on the basis of economic attractiveness to find the appropriate baseline scenario. The broad parameters used for the evaluation of sources of power are capital (installation) cost figures and the unit cost of electricity purchased or produced. Table 1 below shows the economic evaluation of the three options:

Baseline Option	Capital Cost Rs. Million / MW	Generation/ Purchase Cost Rs./kWh		Source of Information	Comments	Conclusion
1) Import of Power from Grid	Nil	Year 2003-2004	3.66	SRBSL sources	Continuation of current situation, Low and declining electricity charges, No additional investment, easy government approvals	An economically attractive option
		Year 2004-2005	2.75			
		Year 2005-2006	2.55			
2) Fossil Fuel (Coal) based CPP	42.5 - 45.0	1.78 - 1.92		Indicative prices available in India during project inception stage[5]	High Capital Cost - uneconomical for small sizes, difficulty in accessing bank loans. Government statutory approvals cumbersome because of coal linkage sanctions, air pollution hazards and ash handling problems. Delay in obtaining approvals and regular permissions from the concerned authority will lead to cost overrun.	This option is economically unattractive
4) Fossil fuel (LDO/FO) Based CPP	7.5 – 12.0	3.5-4.6		Indicative prices available in India during project inception stage[4]	Marginal low capital cost but high variable cost mainly due to higher fuel prices. Generally used as backup for supplying power to essential equipments and not for complete grid displacement at such a scale. Moreover, SRBSL anticipated further oil price increase in future.	This option is economically unattractive

Table 1: Evaluation of baseline options based on Economic Attractiveness

[5] Captive Power Plants- Case study of Gujarat India - http://iis-db.stanford.edu/pubs/20454/wp22_cpp_5mar04.pdf

Thus in view of the above points, the Baseline Option 1: 'Import of electricity from the grid' is most likely baseline scenario and has been considered as business as usual scenario for the baseline emission calculations. Further, the following points corroborate that 'import of electricity from grid as the baseline:

- This is a usual practice being followed by the other similar industries in the state (business-as-usual-scenario). Out of 27 sponge iron plants in the state, SRBSL is third plant to implement waste heat recovery for captive power generation.

- The grid's generation mix comprises of power generated through sources such as thermal (coal and gas), hydro and renewable energy. The project activity would therefore displace an equivalent amount of electricity the plants would have drawn from the grid. The Baseline Emission Factor for the grid is more conservative than that of the coal based CPP.

We may therefore conclude that in the absence of project activity, SRBSL would draw power from Eastern Regional Grid and the system boundary would include the grid generation mix. Thus the most appropriate baseline scenario would be 'Import of power from grid'.

Establishing the additionality for the project activity

This step is based on "Tool for the demonstration and assessment of additionality (version 02)" of the twenty second meeting of Executive Board (Annex 8). Information/data related to preliminary screening, identifying alternatives, common industry practice and other financial, regulatory and technology related barriers were used to establish the additionality. Details of establishing additionality are explained in section B.3.

Determining the baseline emissions

This step provides steps for analysis of the selected baseline scenario to calculate the baseline emission factor. Details of baseline emission calculations are shown in Annex 3.

From the step 'Identification of alternative baseline scenarios' it is found that 'Import of Electricity from Grid' is the most appropriate baseline option. The project activity thus displaces equivalent amount of electricity from grid which is predominantly generated from thermal (fossil fuel based) power plants. Further, as per ACM0004 baseline methodology the Baseline Emission Factor (BEF) of chosen grid is calculated as per combined margin method of

ACM0002 in Annex 3. Project emissions are zero as no auxiliary fuel is used for generation startup or supplementary fuel for WHRBs. Finally, annual emission reductions are found as the difference of baseline emissions and project emissions during the given year in tons of CO_2 equivalent. This is shown in detail in Section E.

B.3. 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:

As per the decision 17/cp.7, para 43, a CDM project activity is additional if anthropogenic emissions of green house gases by sources are reduced below those that would have occurred in absence of registered CDM project activity. The methodology requires the project proponent to determine the additionality based on 'Tool for the demonstration and assessment of additionality (version 02)' as per EB-22 meeting.

Step 0. Preliminary screening based on the starting date of the project activity

1. If project participants wish to have the crediting period starting prior to the registration of their project activity, they shall:

(a) *Provide evidence that the starting date of the CDM project activity falls between 1 January 2000 and the date of the registration of a first CDM project activity, bearing in mind that only CDM project activities submitted for registration before 31 December 2005 may claim for a crediting period starting before the date of registration*:

The project proponent and sponsor SRBSL started construction of the project in October 2004.

(b) *Provide evidence that the incentive from the CDM was seriously considered in the decision to proceed with the project activity. This evidence shall be based on (preferably official, legal and/or other corporate) documentation that was available at, or prior to, the start of the project activity.*

Following documents are available as evidence to show that incentive from CDM was seriously considered in the decision to proceed with the project activity:

1) Copy of Loan Agreement of SRBSL with Indian Renewable Energy Development Agency (IREDA) – a Government of India owned financial institution (dated 25th August 2004) where CDM benefits were considered for loan sanction.

2) Extract of Board Meeting minutes showing resolution of the SRBSL Board

Sub-step 1a. Define alternatives to the project activity:
Sub-step 1b. Enforcement of applicable laws and regulations:

The project activity will supply a total of 9.6MW of power to SRBSL plant. As discussed in section B2 above, there were five alternatives available with the project proponent to provide this service among which three were feasible. The feasible alternatives are:

Baseline Option 1: Continuation of current scenario i.e. Import of Power from Grid

Baseline Option 2: Fossil fuel (Coal) based CPP at SRBSL premises

Baseline Option 4: Fossil fuel (Light diesel oil or furnace oil) based CPP at SRBSL premises

These alternatives are in compliance with all applicable legal and regulatory requirements. There is no legal binding on SRBSL to implement the project activity. In India it is not mandatory for sponge iron units to implement waste heat recovery based power generation plants from waste gases of the kilns. Neither are there any planned regulations for sponge iron manufacturing industries that will enforce them to implement project activity in India. The pollution control board does require sponge iron units to operate such that the dust levels of the waste gases to be emitted into the atmosphere should be less than 150mg/Nm^3. These pollution control board norms were being met even in absence of the project. Though this alternative would bring down the SPM levels in the flue gas, there is no mandate by the West Bengal Pollution Control Board to implement the same. From the above we can conclude that the project activity is a voluntary activity on part of the project proponent and is no way mandated by the law or instigated by the promotional policies of the Government. It is a proactive endeavor to improve on energy efficiency by utilization of waste heat energy and reduce greenhouse gas emissions.

Next the project proponent is required to conduct
Step 2. Investment analysis OR
Step 3. Barrier analysis.

SRBSL proceeds to establish project additionality by conducting the Step 3: Barrier Analysis.

The project proponent is required to determine whether the proposed project activity faces barriers that:

(a) Prevent the implementation of this type of proposed project activity; and (b) Do not prevent the implementation of at least one of the alternatives through the following sub-steps:

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

1. Investment Barriers:

SRBSL management fixed the debt equity ratio for funding the captive power plant at 70:30. Hence, a substantial amount of fund was to be raised externally from banks/ financial institutions (FIs) which was a heavy liability for a medium sized start up company like SRBSL. The project proponent approached a number of banks/ FIs like West Bengal Industrial Development Corporation, Indian Overseas Bank (IOB), State Bank of India, UCO bank, West Bengal Financial Corporation and Indian Renewable Energy Development Agency (IREDA). Initially, IOB agreed to partially fund the project at a lending rate of 12.75% subject to SRBSL tying up the remaining portion of term loan with IREDA and other banks[6]. IREDA conducted the financial appraisal of the project as an energy efficiency project and considered the potential revenue under CDM route. In its loan agreement[7], IREDA put a condition that the borrower (SRBSL) shall agree and undertake that in case the borrower enters for any arrangement for selling Carbon Credit/ Certified Emission Reduction (CER) under CDM, IREDA shall be given/provided with first charge on the cash flow from sale such carbon credits and for such purpose the borrower shall execute such deeds in favour of IREDA as IREDA may require. With the potential benefits under CDM for the project as one of the conditions, IREDA agreed to partially fund the project at a competitive lending rate of 10 % (prevailing Prime Lending Rate was around 10.25 – 11.00%[8]). Thereafter, IOB also lowered their interest rate to 9.75%.

Thus from the above discussion we can conclude that CDM was the principal motivator for availing of loans and reducing the interest rates making the debt sourcing for the project affordable.

2. **Technological Barriers**:

[6] Letter dated 28 May 2004 from Indian Overseas Bank to SRBSL
[7] Loan Sanction letter from IREDA dated 25th August 2005.
[8] http://indiabudget.nic.in/es2003-04/chapt2004/chap33.pdf

a. *Operational risks*: As the grid owner has not allowed SRBSL to parallel the captive power generation system with the grid electricity system, the captive power plant will operate in stand alone mode.

- The non-availability of waste gases due to any technical fault in the kilns will prevent power generation in the project activity. If the heat content of the waste gas is not sufficient, the project activity will directly be affected since there are no inbuilt provisions to increase waste gas temperatures through auxiliary fuel firing.
- Cumulative effect of sustained variable frequency operation due to fluctuations in waste gas supply (flow rate & temperature) may have substantial bearing in safe and sustained operation of assets like the power plant equipments.
- Quality of sponge iron plant and other steel products in SRBSL are heavily dependent on the quality of power supply. Poor quality of power supply not only results in reduced life of equipment but also in poor quality of products.

Non-availability of waste gas at the required temperature can also result in a complete closure of the project activity. It has been further stated that resumption of production process takes a long time. Hence the power interruption even for a short spell destabilizes the manufacturing process, besides causing production loss and damage to the sophisticated equipments due to thermal shock.

b. *Air cooled Condenser*: The SRBSL facility is situated on a coal belt in Durgapur, West Bengal. Drawing water from ground is not allowed in the area by the government and industry is required to purchase water from the local authority. Water is thus a scarcity in that region.

To overcome the problem of water shortage for operating the captive power plant, SRBSL proposes to install an air-cooled condensing system instead of water-cooled condensing system. Air-cooled condensing systems are least preferred in India as they have a much higher capital cost, higher operating temperatures, and lower efficiency than wet cooling systems[9]. The air-cooled condensers consist of one or more rectangular bundles of finned tubes arranged in staggered rows and suitably supported on a steel structure. Both ends of the tubes are fixed in tube sheets in channels that have holes opposite to the tubes, or removable covers, for tube rolling and cleaning. Apart from design complexity air-cooled condensing system involves huge space requirement and its weight is also substantial. In spite of such technical barriers the

[9]'Closed Cycle Dry Cooling Systems'
http://www.energymanagertraining.com/power_plants/condenser&cooling_sys.htm

project proponent is willing to continue with the proposed air-cooled condensing system to make the operation of the captive power plant successful.

3. **Other barrier(s) – due to lack of awareness about available technologies, products, financial support; limited dissemination of information on operation know how; limited managerial resources; organizational capacity**

Lack of information on operation know-how

The sponge-iron manufacturing sector belongs to steel industry sector with limited knowledge and exposure of complications associated with production of power. SRBSL personnel lacked the necessary technical background to develop and implement a waste heat recovery based power plant with technological innovation. They had to strengthen their internal capacity by inviting external expertise to implement the project activity. The SRBSL personnel at various levels lacked relevant managerial background for project activity implementation, operation and maintenance. They were provided with training to ensure smooth operation. They had no background strength in the power sector economics and power generation sector.

Sub-step 3b: ***Show that the identified barriers would not prevent a wide spread implementation of at least one of the alternatives (except the proposed project activity).***

This is demonstrated in Table 1 of Section B.2 above. SRBSL's project activity is a WHR based power project utilizing waste heat from sponge iron rotary kiln that uses coal as fuel. SRBSL would not have faced any investment barrier in case it continued to import power from grid as no special investments are required. Further for import of power from grid, SRBSL would not have to face any technological barriers as in the case of generation of waste heat based power. Therefore, it is most likely that in absence of the project activity SRBSL would opt for the business-as-usual scenario, i.e. releasing the waste heat into the atmosphere and importing equivalent electricity from regional grid to cater to the need.

Step 4: Common Practice analysis*:*

Based on the information about activities similar to the proposed project activity, the project proponent is supposed to carry out common practice analysis to complement and reinforce the barrier analysis. The project proponent is required to identify and discuss the existing common practice through the following sub-steps:

Step 4a: Analyze other activities similar to the proposed project activity

In the sponge iron sector of West Bengal with similar socio-economic environment, geographic conditions and technological circumstances there are 27 similar sponge iron plants. Table 2 below summarizes the common practices adopted by sponge iron manufacturing industries to meet their power requirement on a continuous basis – at the start of implementation of project activity in October 2004.

Table2: Common practice analysis for WHR based CPP in Sponge iron plants of West Bengal

Scenario	Number of Sponge Iron Plants in West Bengal
Scenario 1: Import of electricity from grid	24
Scenario 2: Coal based CPP	0
Scenario 4: Diesel/ LDO/ FO based CPP [i.e. DG sets]	0
Project activity: Waste heat recovery based CPP [including project activity] – all under CDM	3
Total number of sponge iron plants	27

Source: Directorate of Industries, Govt. of West Bengal.

As per the above Table, out of 27 sponge iron plants in West Bengal, 24 plants (excluding SRBSL) import electricity from grid. None of the plants have fossil fuel fired CPP supplying power on a continuous basis. Two sponge iron plants which are setting up the WHR based CPP, are doing so under CDM and hence they are excluded from common practice analysis. We may therefore conclude from the assessment of sponge iron units in West Bengal that the there is not a single unit to implement the WHR based CPP without CDM.

Step 4b: Discuss any similar options that are occurring

As mentioned above, only two other sponge iron plants in West Bengal are setting up Waste Heat Recovery based CPP and both are CDM project activities.

This shows that there is poor penetration of this technology and is subject to barriers in West Bengal and implementation of this technology would not have happened in the absence of CDM.

Step 5: Impact of CDM registration

The project activity was started in October 2004 and will be commissioned in November 2006. As referred to in Step 4 above, SRBSL is among the first three waste heat recovery projects in the state of West Bengal and minimize GHG emissions related to import of power from Regional grid.

Due to associated risks mentioned in Step 3, banks were lending SRBSL at a high interest rate. Registering the project activity as CDM project would allow SRBSL to make the project successful and sustainable which could lead to banks lowering interest rates for similar activities to sponge iron industries located in the state. This would act as a precursor for other industries to invest in waste heat recovery based power generation leading to further reduction in anthropogenic GHG emissions.

Successful implementation and running of the project activity on a sustainable basis requires continuous investments in technological up gradation. It also requires manpower training and skill development on a regular basis. The project proponent could get the necessary funding from selling the project related CERs. Apart from these, registration of the project under CDM would enhance its visibility that would aid West Bengal power utilities in appreciating the eco-friendly efforts of the project proponent. This could lead to smoother transactions in future between the project proponent and the utility. Further CDM fund will provide additional coverage to the risk due to failure of project activity; shut down of plant and loss of production in SRBSL.

It is ascertained that the project activity would not have occurred in the absence of the CDM simply because no sufficient financial, policy, or other incentives exist locally to foster its development in West Bengal /India and without the proposed carbon financing for the project the SRBSL would not have taken the investment risks in order to implement the project activity. Therefore the project activity is additional. Also, the impact of CDM registration is significant with respect to continuity of the project activity on a sustainable basis.

B.4.Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

As per ACM0004, the spatial extent of the project boundary comprises the waste heat or gas sources, captive power generating equipment, any equipment used to provide auxiliary heat to the waste heat recovery process, and the power plants connected physically to the electricity grid that the proposed project activity will affect.

For the project activity, the project boundary starts from supply of waste flue gas at the WHR boiler inlet to the point of electricity generated and supplied to end users. The boundary will not include the upstream emissions. Further, no fuel is used for auxiliary firing of the waste gases in the project activity. Thus, the project boundary covers the ABC, Waste Heat Recovery Boilers, turbo generator sets, auxiliary and waste gas disposal equipments, power evacuation system and the end users of SRBSL's facility.

The project is using energy in the waste gas to generate electricity that displaces electricity from Eastern Regional grid. Hence the system boundary extends to the fossil fuel fired power plants connected to Eastern Regional electricity supply system. The actual amount of CO_2 reduction however depends on the baseline emission factor determined as per ACM0002 methodology.

B.5.Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

The baseline scenario for the project activity is Import of Power from Grid. Hence, as required by ACM0004, baseline for the project activity is calculated as per ACM0002 for the chosen grid (i.e. Eastern Regional Grid). The approach used is existing actual or historical emissions. Net baseline emission factor for the grid was found to be 0.823 kg CO_2/ kWh. Please refer to details of baseline calculation in Annex 3 of the PDD.

Date of completing the final draft of this baseline selection: 03/03/2006

Name of person/entity determining the baseline: Mr. A.K. Gulati, Director – Projects of Sri Ramrupai Balaji Steels Limited (as listed in Annex-1 of the PDD).

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:

>>

October 2004

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

>>

20y

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

C.2.1. Renewable crediting period

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

>>

C.2.1.2. Length of the first crediting period:

>>

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

01/11/2006

C.2.2.2. Length:

>>

10y

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

>>

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

Reference: Revised approved consolidated baseline methodology ACM0004/ Version 02, Sectoral Scope: 01, 03 March 2006

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

>>

The approved consolidated monitoring methodology is designed to be used in conjunction with the approved consolidated baseline methodology. The applicability conditions of the monitoring methodology are identical with those for the baseline methodology. The project activity under consideration meets all the applicability conditions of the approved consolidated baseline methodology (refer to Section B.1.1 for details). Hence it is justified to adopt the approved consolidated monitoring methodology for the project activity.

The monitoring methodology requires the project proponent to monitor the electricity generated using the waste gases of the DRI kiln in the WHR based power plant. The project activity's financial benefits under CDM are based on this parameter. The proposed project activity will utilize the heat energy in the waste gas for power generation and thereby displace grid electricity. The amount of electrical energy generated and substituted in the grid is directly controlled by the project proponent and will be under the purview of monitoring plan. Thus a detailed monitoring plan (as described in Annex 4: Monitoring Plan) is developed by SRBSL in line with the approved consolidated monitoring methodology.

Description of Monitoring Methodology

The methodology ACM0004 requires monitoring of the following:

- *Net Electricity Generation from Project Activity* (MWh/year) – This will be calculated as the difference of gross waste heat power generated for a year minus the auxiliary power consumption during that year. The project activity will employ modern and control equipments that will measure, record, report and control various key parameters like total power generated, power used for auxiliary consumption, steam flow rate, temperature and pressure parameters of the steam generated and steam fed to the common header of turbo-generator sets to generate power. The monitoring and controls is part of the Distributed Control System (DCS) of the entire plant. All instruments will be calibrated and marked at regular interval to ensure accuracy.

- *Data needed to calculate carbon dioxide emissions from fossil fuel consumption due to project activity* – The project activity does not use any auxiliary fossil fuel, hence there is no carbon dioxide emissions due to fossil fuel consumption from project activity.

- *Data needed to recalculate the operating margin emission factor, if needed based on the choice of the method to determine the Operating Margin (OM), consistent with "Consolidated baseline methodology for grid connected electricity generation from renewable sources(ACM0002)"* – The Operating Margin Emission Factor for the Eastern Regional grid is calculated as per ACM0002. Data needed to calculate the emission factor are based on information available from authorised government agencies - Central Electricity Authority (CEA) sources. The government authorised agency monitors power generated and supplied to the grid. The grid mix scenario through the entire crediting period will be based on records and reports with CEA. The Grid transmission and distribution network includes monitoring and control facilities at each generation unit level, as well as voltage, substation and consumer level. The power records from the above sources contain all information related to sources and origin of generation like thermal, hydro and renewable energy sources, installed and de-rated capacity, performance of generating unit like actual and expected generation, and planned capacity additions during the year, etc. Hence, the transparency of measurements, recording, monitoring and control of the generation mix of the Eastern Regional grid is ensured all the time. These records can be used for verification of generation mix and emission factor (EF) for baseline calculation for a particular year.

- *Data needed to calculate the build emission factor, if needed, consistent with" Consolidated baseline methodology for grid connected electricity generation from renewable sources (ACM0002)"* – Same as above.

- *Data needed to calculate emission factor for captive power generation* - Not applicable for the project activity

Further, within the SRBSL facility there is negligible amount of T&D losses for electricity distributed and hence the losses are neglected.

GHG Emissions Sources of the Project

There is no direct emission from the project activity as power is generated from the waste gas by utilizing its sensible heat component. The CO_2 content of the waste flue gas remain same throughout the process and should be checked at the waste gas inlet and outlet of the boiler. The project extracts the heat energy from the waste flue gases through principles of heat transfer in the boiler and economiser tubes. Therefore, the direct emission from the project activity is zero and all auxiliaries are run by the power that is generated through the waste heat, no other major on-site emission takes place within the project boundary.

Indirect on-site emissions

The only indirect on site GHG emission source is the consumption of energy and the emission of GHGs during the construction phase of waste heat recovery based power plant. Considering the life cycle of the project and its components and compared to the emissions to be avoided in its life span of 20 years, emissions from the above-mentioned source is negligible.

Direct off site emissions

There is no identified direct off site emissions due to project activity.

In-direct off-site emissions

This includes emissions during the manufacturing process of parts, supplies and machinery required for building the project (i.e. electromechanical equipment, *etc.*). But these emissions are outside the control of the project and hence excluded.

Monitoring Plan Application:

For such industrial energy efficiency projects - waste heat energy to electricity, it is adequate to monitor and verify the amount of electricity produced from the WHRSGS. To produce equal amount of electricity at the regional grid, the grid would have used non-renewable resources like coal, oil, and natural gas, which would have led to GHG emissions. Thus, the captive power produced substitute the regional electricity supply and thereby reduces GHG emissions, which would have occurred in absence of the project.

Monitoring for baseline emission calculation has also been included within the monitoring plan. For baseline emission factor data shall be collected from CEA sources. (Refer to Annex 3 of PDD for details of baseline calculation). To monitor the actual amount of energy used and total electricity produced from project, flow meters and power meters should be installed at specific points. Power meters should be installed at the outlet of the turbine and other transmission points to calculate the total electricity produced. This can be further categorized into the auxiliary consumption and electricity transmitted/distributed to the steel complex of SRBSL. Flow rate of steam generated in the WHRB and fed to the turbine, steam temperature and pressure should be measured for calculation of total electricity produced from the project activity.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data type	Data Variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data to be kept	Comment

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

For the project activity, there is no provision for auxiliary fuel firing before the Waste Heat Recovery Boilers. Hence, there are no project emissions due to auxiliary fuel firing which means that no data needs to be monitored for this purpose.

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.

For Electricity Generated by Project Activity

ID No.	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	For how long is archived data to be kept?	Comments
1. EG_{GEN}	Quanti tative	Total Electricity Generated	MWh /year	Calculated[10]	Continuously	100%	Electronic/ paper	Credit Period + 2 years	MONITORING LOCATION: The data will be measured by meters at plant and DCS. Manager In-charge would be responsible for calibration of the meters. See Annexe 4 for details
2. EG_{AUX}	Quanti tative	Auxiliary consumption of Electricity[11]	MWh /year	Calculated[12]	Continuously	100%	Electronic/paper	Credit period + 2 years	MONITORING LOCATION: The data will be measured by meters at plant and DCS. Manager In-charge would be responsible for regular calibration. See Annexe 4 for details
3. EG_y	Quanti tative	Net Electricity supplied	MWh /year	Calculated (EG_{gen}- EG_{aux})	Continuously	100%	Electronic/paper	Credit Period + 2 years	Calculated from the above measured parameters. Algorithm for project emissions given in baseline methodology

[10] Power generated due to waste heat recovery project will be calculated on the basis of total enthalpy of steam (enthalpy per unit steam x steam flow) from WHRBs as a percentage of total enthalpy of steam fed to common header of the CPP

[11] This will include electrical energy utilized by the power generating equipment in the project boundary.

[12] Auxiliary consumption of electricity due to the project activity will be calculated as percentage of total auxiliary consumption in the same manner as mentioned above.

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

Not Applicable

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

ID No.	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	For which baseline method(s) must this element be included	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	For how long is archived data to be kept?	Comments
4. EF_y	Emission factor	CO_2 emission factor of the grid	tCO_2/ MWh	Calculated	Simple OM, BM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated as weighted sum of OM and BM emission factors
5. $EF_{OM,y}$	Emission factor	CO_2 operating margin emission factor of the grid	tCO_2/ MWh	Calculated	Simple OM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated as indicated in the relevant OM baseline method above
6. $EF_{BM,y}$	Emission factor	CO_2 Build Margin emission factor of the grid	tCO_2/ MWh	Calculated	BM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated as [∑I Fi,y*COEFi]/ [∑mGENm,y] over recently built power plants defined in

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :										
ID No.	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	For which baseline method(s) must this element be included	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	For how long is archived data to be kept?	Comments
										the baseline methodology
7. $F_{i,j,y}$	Fuel Quantity	Amount of each fossil fuel consumed by each power source/ plant	t or m^3/year	measured	Simple OM BM	Yearly	100%	Electronic	During the crediting period and two years after	Obtained from authorised latest local statistics
8. $COEF_{i,k}$	Emission factor coefficient	CO_2 emission coefficient of each fuel type and each power source/plant	tCO_2/ t or m^3	calculated	Simple OM BM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated based on the IPCC default value of the Emission Factor, Net Calorific Value and Oxidation Factor of the fuel used by the power plants feeding Eastern Regional grid.
9. $GEN_{j,y}$	Electricity quantity	Electricity generation of each power source/plant	MWh/ year	measured	Simple OM BM	Yearly	100%	Electronic	During the crediting period and two years after	Obtained from authorised latest local statistics

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

Emission Factor of the Grid (EF_{Grid})

Electricity baseline emission factor of Eastern regional grid (EF_y) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors according to the following three steps. Calculations for this combined margin must be based on data from an official source (where available) and made publicly available.

STEP1: Calculate the Operating Margin emission factor

The Simple OM emission factor ($EF_{OM,simple,y}$) for Eastern Regional grid is calculated as the weighted average emissions (in t CO_2equ/MWh) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation.

$$EF_{OM,simple,y} = \frac{\sum_{i,j} F_{i,j,y} \, x \, COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$

where,

$COEF_{i,j}$ is the CO_2 emission coefficient of fuel i (t CO_2 / mass or volume unit of the fuel), calculated as given below and

$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j

$F_{i,j,y}$ is the amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y , calculated as given below

j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports from other grid

The Fuel Consumption $F_{i,j,y}$ (tonnes) is obtained as

$$\sum_i F_{i,j,y} = \left(\sum_j GEN_{j,y} \otimes 860 \Big/ NCV_i \otimes E_{i,j} \right)$$

where,

$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j

NCV_i is the net calorific value per mass (kCal/kg) or volume unit of a fuel i

$E_{i,j}$ is the efficiency (%) of the power plants by source j

The factor 860 (=3600/4.18) is a conversion factor to convert kWh to kCal.

The CO_2 emission coefficient $COEF_i$ is obtained as

$$COEF_i = NCV_i \otimes EF_{CO2,i} \otimes OXID_i$$

Where,

NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel i

$EF_{CO2,i}$ is the CO_2 emission factor per unit of energy of the fuel i

$OXID_i$ is the oxidation factor of the fuel

The Simple OM emission factor ($EF_{OM,simple,y}$) is calculated separately for the most recent three years (2002-2003, 2003-2004 & 2004-2005) and an average value has been considered as the OM emission factor for the baseline ($EF_{OM,y}$).

$$EF_{OM,y} = \sum_y EF_{OM,simple,y} / 3$$

where y represents the years 2002-2003, 2003-2004 and 2004-2005

STEP 2. Calculate the Build Margin emission factor

The Build Margin emission factor ($EF_{BM,y}$) has been calculated as the generation-weighted average emission factor (t CO_2/MWh) of a sample of power plants m of Eastern Regional grid. The sample group *m* consists of either

• the five power plants that have been built most recently, or

• the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

Project proponent should use from these two options that sample group that comprises the larger annual generation. The calculation for Build Margin emission factor is furnished below:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \, x \, COEF_{i,m}}{\sum_{m} GEN_{m,y}}$$

where,

$F_{i,m,y}$, $COEF_{i,m}$ and $GEN_{m,y}$ - Are analogous to the variables described for the simple OM method above for plants m.

STEP 3. Calculate the Emission Factor of the Grid (EF_{Grid})

The electricity baseline emission factor of Eastern Regional Grid, EF_y is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

$$EF_y = W_{OM} \otimes EF_{OM,y} \oplus W_{BM} \otimes EF_{BM,y}$$

where the weights w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM} = w_{BM} = 0.5$), and $EF_{OM,y}$ and $EF_{BM,y}$ are calculated as described in Steps 1 and 2 above and are expressed in t CO_2/MWh.

(Please refer to “Annex 3: Baseline Information” for further details on grid analysis)

Baseline Emission Calculations

Net units of electricity substituted in the grid (EG_y) = (Total electricity generated-Auxiliary Consumption)

$$= (EG_{GEN} - EG_{AUX})$$

EG_y is calculated as mentioned above in the Table D.2.1.3

Therefore the Baseline Emission is calculated as,

$$BE_y = EG_y \otimes EF_y$$

where,

BE_y = Baseline Emissions due to displacement of electricity during the year y (in tons of CO_2)

EG_y = Net units of electricity substituted in the grid during the year y (in MWh)

EF_y = Emission Factor of the grid (in tCO_2/ MWh) and

y is any year within the crediting period of the project activity

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

Not applicable

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
There are no potential sources of leakage which can be attributed to the project activity. Hence no data is required to be monitored for this purpose.								

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Not Applicable

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

$ER_y = BE_y – PE_y$

Where
ER_y = emission reductions for the project activity in tonnes of CO_2 e
BE_y = Baseline emissions estimated in D.2.1.4 in tonnes of CO_2 e
PE_y = Project emissions = 0

Please refer to Section E.5 of this document.

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored			
Data *(Indicate table and ID number e.g. 1. , -14.)*	Uncertainty level of data (High/Medium/Low)	Are QA/QC procedures planned for these data?	Outline explanation why QA/QC procedures are or are not being planned.
1.,-3.	Low	Yes	This data will be used for calculation of project electricity generation.
4.,-6.	Low	No	This data is calculated, so does not need QA procedures
7., - 9.	Low	No	This data will be required for the calculation of baseline emissions (from grid electricity) and will be obtained through published and official sources.

Note on QA/QC: The parameters related to the performance of the project will be monitored using meters and standard testing equipment, which will be regularly calibrated following standard industry practices.

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

>>

The Plant Manager is responsible for monitoring and archiving of data required for estimating the emission reductions. He would be supported by the shift in-charge who would continuously monitor the data logging and would generate daily, monthly reports

D.5 Name of person/entity determining the monitoring methodology:

>>

Mr. A.K. Gulati, Director – Projects of Sri Ramrupai Balaji Steels Limited (as listed in Annex-1 of the PDD).

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>>

The project activity utilizes the heat content of the waste gas available from the Sponge Iron kilns as its fuel source. Since the composition of the waste gas at the boiler inlet and the boiler outlet is identical and there are no other fuel source within the project boundary the project activity itself leads to zero net GHG on-site emissions.

E.2. Estimated leakage:

>>

There is no leakage activity, which contributes to the GHG emissions outside the project boundary.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

>>

A net emission by project activity (E1+E2) is zero tonnes of CO_2 per kWh of power generation.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

>>

Sl. No.	Operating Years	Baseline Emission Factor (kg CO_2 / kWh)	Baseline Emissions (tonnes of CO_2)
1.	November 2006 - March 2007	0.823	21460
2.	2007-2008	0.823	51504
3.	2008-2009	0.823	51504
4.	2009-2010	0.823	51504
5.	2010-2011	0.823	51504
6.	2011-2012	0.823	51504
7.	2012-2013	0.823	51504

Sl. No.	Operating Years	Baseline Emission Factor (kg CO_2 / kWh)	Baseline Emissions (tonnes of CO_2)
8.	2013-2014	0.823	51504
9.	2014-2015	0.823	51504
10.	2015-2016	0.823	51504
11.	April 2016 – October 2016	0.823	30044

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

>>

Sl. No.	Operating Years	Baseline Emissions (tonnes of CO_2)	Project Emission (tonnes of CO_2)	CO_2 Emission Reductions (tonnes of CO_2)
1.	November 2006 - March 2007	21460	0	21460
2.	2007-2008	51504	0	51504
3.	2008-2009	51504	0	51504
4.	2009-2010	51504	0	51504
5.	2010-2011	51504	0	51504
6.	2011-2012	51504	0	51504
7.	2012-2013	51504	0	51504
8.	2013-2014	51504	0	51504
9.	2014-2015	51504	0	51504
10.	2015-2016	51504	0	51504
11.	April 2016 – October 2016	30044	0	30044

Total estimated Emission Reductions: **515040 tonnes of CO_2 equivalent** over 10 year crediting period

E.6. Table providing values obtained when applying formulae above:

>>

Years	Estimation of project activity Emissions (tonnes of CO2 e)	Estimation of baseline Emissions (tonnes of CO2 e)	Estimation of leakage (tonnes of CO2 e)	Annual estimation of emission reductions in tonnes of CO_2 e
November 2006 - March 2007	0	21460	0	21460
2007-2008	0	51504	0	51504
2008-2009	0	51504	0	51504
2009-2010	0	51504	0	51504
2010-2011	0	51504	0	51504
2011-2012	0	51504	0	51504
2012-2013	0	51504	0	51504
2013-2014	0	51504	0	51504
2014-2015	0	51504	0	51504
2015-2016	0	51504	0	51504
April 2016 – October 2016	0	30044	0	30044
Total (tonnes of CO2 e)	**0**	**515040**	**0**	**515040**

SECTION F. Environmental impacts

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

>>

Article 12 of the Kyoto Protocol requires that a CDM project activity contribute to the sustainable development of the host country. Assessing the project's positive and negative impacts on the local environment and on society is thus a key element for each CDM project. SRBSL proposes to implement the CDM project activity because of their commitment to ensured maximum global and local benefits in relation to certain environmental and social issues and was a major step towards sustainable development. With regard to the local environment the project has positive effects on local air and water quality. The new waste gas treatment technology adopted is better one.

By displacing electricity demand on the grid, the project will reduce emissions related to coal-fired power production, which include carbon dioxide, sulphur oxides, nitrogen oxides and particulates. It will also conserve the non-renewable natural resource – coal and reduced the adverse impacts related to transportation of coal and coal mining that would have been required to meet the additional capacity requirement of thermal power plants. These aspects contribute to the regional and global benefits.

Environmental Impact Analysis

The heat recovery based captive power project would cause an impact on Environment in three distinct phases:

- During Construction Phase
- During Operational Phase and
- Maintenance Phase

The impacts envisaged during construction of the project activity were:

- Impact on Soil Quality
- Impact on Air quality
- Impact on Noise Levels

The environmental impact during the construction phase is regarded as temporary or short term and hence does not affect the environment significantly.

The nature of the impacts that are evident during the operational and maintenance phase are discussed below:

Conservation of coal:

By displacing SRBSL Plant's electricity demand on the grid, the project activity will reduce an equivalent amount of coal consumption of the thermal power plants.

Ambient Air Quality (AAQ):

SRBSL being a Sponge Iron (DRI) making company will generate hot dusty gas from rotary kiln. The company already has an elaborate gas-cleaning tower inclusive of multi field Electrostatic Precipitator (ESP), ID fan, Stack etc. Instead of Gas Cooling Tower there will be Waste Heat Recovery Boiler for power generation. After implementation of the project activity exit gas temperature in atmosphere will be reduced without any change in the gas cleaning system. The project will not create any additional pollutant in the exit gas of the stack since it will be driven by an unfired Waste Heat Recovery Boiler. The ESP is designed to limit the dust concentration below 150 mg/ Nm^3 at the outlet of ESP.

The ambient air quality in and around the SRBSL's factory will expected to be found well within the statutory limits. (as per the design). There will be no variations in the AAQ data after the project execution and the SPM values too will be well within the limits. All other ambient air quality parameters i.e. SO_2, NOx, CO and hydrocarbon concentrations will also remain below the West Bengal Pollution Control Board standards.

The project activity will also reduce the adverse impacts on air quality related to transportation of coal and coal mining that would have been required to meet the additional capacity requirement of thermal power plants.

Impact on water:

For implementing the project activity air cooled condensing system will be installed to reduce the requirement of make-up water. The effluents from the Reverse Osmosis water treatment plant will be led into a properly sized impervious, neutralization pit. Normally these effluents are self neutralizing but provision will be made for dosing lime into the neutralization pit to ensure a sufficiently high pH value before these effluents get disposed. Waste water treatment for the plant will be based on discharge of various wastewaters to ponds for clarification and filtration. Oily water will be treated separately to remove oil/ grease before discharge into effluent ponds.

Solid waste generation:

Fly ash collected from the ESP hoppers and the air heater hoppers and the ash collected from the furnace bottom hoppers, which is also dry, will be used for land filling, cement or brick manufacturing.

Noise:

The equipments used in the project will be designed and other noise abatement measures will seriously be taken in such a way so as to keep the noise level below 85 to 90 db(A) as per the requirement of Occupational Safety and Health Administration (OSHA) Standards.

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

Host party regulations do not require an Environmental Impact Assessment for the project activity. This project activity in turn has positive environmental impacts and the environmental clearance has been received. The Heat Recovery Based Power Plant with ESP is a cleaner and more energy efficient air pollution control measure as compared to the Gas Conditioning Tower technology. The project activity is not polluting and the impacts associated with the project activity are insignificant. Environmental Clearance documents from relevant Government Departments are available with the project proponent and that can be shown on request.

SECTION G. Stakeholders' comments

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

SRBSL proposes to implement a 9.6 MW waste heat recovery based power plant at their sponge iron factory premise in Durgapur in West Bengal.

The stakeholders identified for the project are as under:

- Non-Governmental Organisations (NGOs)
- Environment Department, Government of West Bengal
- Ministry of Non Conventional Energy Sources (MNES)
- Elected body of representatives administering the local area (village *Panchayat*)
- Shareholders of SRBSL
- Consultants
- Equipment Suppliers
- Durgapur Projects Limited (DPL) and Damodar Valley Corporation (DVC)
- West Bengal Electricity Regulatory Commission (WBERC)
- Indian Overseas Bank (IOB)
- West Bengal Pollution Control Board (WBPCB)

Stakeholders list includes the government and non-government parties, which are involved in the project at various stages. For implementing the project activity SRBSL communicated to the relevant stakeholders. The stakeholders' responses have been both verbal and/or documented.

SRBSL also maintains a continuous consultation process with the local governing and non-governing body and considers their opinions and suggestion that come from the local community.

G.2. Summary of the comments received:

Stakeholders Involvement

Local population comprises of the local people in and around the project area. The local people are the beneficiaries of the project. In addition to this, it will also include local manpower working at the plant site. Since, the project results in environmental benefits and will provide good direct employment opportunities the local populous expresses positive opinions about the project.

The project will not cause any major displacement of the local population. The project will be set up on a barren land near the factory premises. Thus, the project will not cause any adverse social impacts on local population rather will help in improvising their quality of life.

West Bengal Pollution Control Board (WBPCB) and Environment Department of Government of West Bengal have prescribed standards of environmental compliance and monitor the adherence to the standards. The project has received the Consent to Establish (or No Objection Certificate (NOC)) from WBPCB.

The government of India, through Ministry of Non-conventional Energy Sources (MNES), has been encouraging energy conservation, demand side management and viable renewable energy projects.

Project consultants were involved in the project to take care of various pre contract and post contract project activities like preparation of Detailed Project Report (DPR), preparation of basic and detailed engineering documents, preparation of tender documents, selection of vendors / suppliers, supervision of project implementation, successful commissioning and trial runs.

Equipment suppliers, one of the stakeholders have supplied the equipments as per the specifications finalized for the project and are responsible for successful erection & commissioning of the same at the site.

Stakeholders' Comments

SRBSL will shortly receive the major necessary approvals and consents from various authorities, required for project implementation like West Bengal Electricity Regulatory Commission and West Bengal Pollution Control Board. SRBSL has also received a positive response from the Village Panchayat and NGOs for the project activity.

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

The relevant comments and important clauses mentioned in the project documents/clearances like Detailed Project Report (DPR), environmental clearances, local clearance etc. were considered while preparation of CDM project development document.

The SRBSL representatives met with the various stakeholders for appraisal and support. They were commended for their voluntary action toward environmental development and energy efficient measures undertaken in this project involving generation of electricity by utilising process waste gases with associated energy efficiency and positive environmental effects.

As per UNFCCC requirement this Project Design Document (PDD) will be published at the validator's web site for public comments.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Sri Ramrupai Balaji Steel Limited
Street/P.O.Box:	5, Bentinck Street
Building:	-
City:	Kolkata
State/Region:	West Bengal
Postfix/ZIP:	700001
Country:	India
Telephone:	+91-33-2242 6263
FAX:	-
E-Mail:	-
URL:	-
Represented by:	
Title:	Director (Projects)
Salutation:	Mr.
Last Name:	Gulati
Middle Name:	K
First Name:	A
Department:	Projects
Mobile:	-
Direct FAX:	-
Direct tel:	+91-33-2242 6263
Personal E-Mail:	-

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Till now funding from any Annex I country is not available.

Annex 3

BASELINE INFORMATION

For the project activity the baseline scenario was determined as 'Import of power from grid' as described in Section B.2 above. As per ACM0004 methodology, for grid power supply as baseline scenario the Emission Factor for the displaced electricity system is calculated as per ACM0002 baseline methodology. The project proponent proceeds to determine the Emission Factor for the electricity system it imports power from.

A) Choice of the grid that will be affected by the project activity

Indian power grid system (or the National Grid) is divided into five regional grids namely Northern, North Eastern, Eastern, Southern and Western Region Grids. These regional grids have independent state Load Dispatch Centres (LDCs) that manage the flow of power in their jurisdiction. Power generated by state owned generation units and private owned generation units is consumed by the respective states. The power generated by central sector generation plants is shared by all states forming part of the grid in a fixed proportion.

The project activity hosting plant SRBSL is connected to Durgapur Projects Limited (DPL) and Damodar Valley Corporation (DVC), both government Generation cum Distribution companies belonging to the Eastern Regional Grid. The Eastern Regional Grid consists of state grids of Bihar, Jharkhand, Orissa (GRIDCO), West Bengal (including DPL), and Sikkim; central generating stations of Damodar Valley Corporation (DVC) and National Thermal Power Corporation (NTPC) and private sector grids of CESC and DPSCL[13].

[13] Eastern Region Load Despatch Centre (ERLDC) Annual Report- http://www.erldc.org/report/AR_03-04.pdf

The DPL generation system consists of six coal based power generation systems of total 401 MW installed capacity. After fulfilling total requirement of its command area customers, DPL surplus power goes to the West Bengal State Electricity Board (WBSEB). [14].

DVC, jointly owned by Government of India, Government of West Bengal and Government of Bihar is a multipurpose river valley project set up under Act No. XIV of 1948, for the unified development of Damodar valley area. The generation mix of DVC consists of 2535 MW-coal, 82.5MW – gas and 144 MW-hydro. DVC supplies bulk power at 33 KV, 132 KV and 220 KV at 122 different locations to a number of industries and distributing licensees[15]

Since the project activity displaces an equivalent amount of power drawn from DPL and DVC generating stations of the Eastern Regional grid which have significant inter grid transfers, the project proponent will be required to use the carbon intensity of the entire Eastern Regional grid as the baseline emission factor for baseline emission calculations over the proposed project activity's crediting period.

Furthermore, the as per ACM0002 (Version 5, dated 03 March 2006), *"In large countries with layered dispatch systems (e.g. state/provincial/regional/national) the regional grid definition should be used. A state/provincial grid definition may indeed in many cases be too narrow given significant electricity trade among states/provinces that might be affected, directly or indirectly, by a CDM project activity."*

Taking into consideration both the points mentioned above (i.e. the relevant grid displaced by the project activity and the guidelines for selection of the appropriate grid in large countries with layered dispatch systems like India as given in ACM0002), the Eastern Regional Grid has been considered as the most representative system boundary (i.e. project electricity system) where an equivalent amount of electricity would be replaced by the implementation of the proposed project activity. The carbon intensity of the Eastern Regional Grid would be determined to arrive at the baseline emission factor for baseline emission calculations for the project activity's crediting period.

B) Determination of the Carbon Intensity of the chosen Grid

Complete analysis of the system boundary's electricity generation mix has been carried out for calculating the emission factor of Eastern Regional Grid as follows:

---

[14] http://www.thedurgapurprojectsltd.com/production/index.html

Combined Margin

The approved consolidated baseline methodology suggests that the proposed project activity would have an effect on both the operating margin (*i.e.* the present power generation sources of the grid, weighted according to the actual participation in the grid mix) and the build margin (*i.e.* weighted average emissions of recent capacity additions) of the selected Eastern Regional Grid and the net baseline emission factor would therefore incorporate an average of both these elements.

Step 1: Calculation of Operating Margin

As mentioned above the proposed project activity would have some effect on the Operating Margin (OM) of the Eastern Regional Grid. The approved consolidated baseline methodology-ACM0004 requires the project proponent to calculate the Operating Margin (OM) emission factor following the guidelines in ACM0002 (Consolidated methodology for grid-connected electricity generation from renewable sources).

As per Step 1 of ACM0002, the Operating Margin emission factor(s) ($EF_{OM,y}$) is calculated based on one of the four following methods:

a) Simple OM, or
b) Simple adjusted OM, or
c) Dispatch Data Analysis OM, or
d) Average OM.

As per the methodology 'Dispatch Data Analysis' (1c) should be the first methodological choice. However, this method is not selected for OM emission factor calculations due to non-availability of activity data.

'Simple OM' (1a) method is applicable to project activity connected to the project electricity system (grid) where the low-cost/must run[16] resources constitute less than 50% of the total grid generation in

1) average of the five most recent years, or

2) based on long-term normal for hydroelectricity production.

The Simple adjusted OM (1b) and Average OM (1d) methods are applicable to project activity connected to the project electricity system (grid) where the low-cost/must run resources constitute more than 50% of the total grid generation.

---

[15] http://www.dvcindia.org/power/plants.htm

[16] The low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation.

To select the appropriate methodology for determining the Operating Margin emission factor ($EF_{OM,y}$) for the proposed project activity, SRBSL conducted a baseline study wherein the power generation data for all power sources in the project electricity system (i.e. Eastern Regional Grid) have been collected from government/non-government organisations and authentic sources. The power generation mix of Eastern Regional Grid comprises of coal, gas and diesel based thermal power generation and hydro power generation. The actual generation data of entire Eastern Regional Grid is analysed for the years 2000-2001, 2001-2002, 2002-2003, 2003-2004 and 2004-2005 to arrive at the contribution of the thermal power plants and the low-cost and must run power generation sources in the Eastern Regional Grid mix (Refer to Table 3 given below). It was found that the average share of the low cost and must run power generation sources over most recent years was lower than 50% of the total electricity generation in the grid.

Table 3: Power Generation Mix of Eastern Regional Grid for five most recent years[17]

Energy Source	2000-01	2001-02	2002-03	2003-04	2004-05
Total Power Available – MkWh	60073	64180	60912.42	72908.52	80778.58
Low Cost (Hydro and Wind) power available – MkWh	7481	9497	6585.37	9908.02	9958.32
Thermal (Coal and Gas) Power available – MkWh	52592	54683	53996.30	62603.88	69677.42
Purchase from other grids – MkWh	-	-	330.75	396.32	1142.84
% Low Cost Power out of Total power available	12.45	14.80	10.81	13.59	12.33
% Thermal Power out of Total power available	87.55	85.20	88.65	85.86	86.26
% Purchase from other grids out of total power available	-	-	0.54	0.54	1.41
Low Cost Power % out of Total grid generation - Average of the five most recent years – 12.79%					

[17] Source of data for the years 2000-2001 and 2001-2002: EREB-Annual Administrative Report (2004-2005) - http://cea.nic.in/god/reb/ereb/Chapters in English/chapter-2.doc

Source of data for the years 2002-2003, 2003-2004: CEA-General Review (2002-2003) a 2005 (Contains data for 2003-2004)

Source of data for the year 2004-2005:
http://cea.nic.in/god/opm/Monthly_Generation_Report/18col_05_03.pdf,
http://cea.nic.in/god/reb/ereb/Chapters in English/chapter-2.doc and
http://cea.nic.in/god/reb/ereb/Annexures(E)/Annexure-VIII.xls.

SRBSL has therefore adopted the 'Simple OM' (1a) method, amongst the 'Simple OM' (1a), 'Simple adjusted OM' (1b) and 'Average OM' (1d) methods to calculate the Baseline Emission Factor of the chosen grid.

The Simple OM emission factor ($EF_{OM,simple,y}$) is calculated as the generation-weighted average emissions per electricity unit (tCO_2/MkWh) taking into consideration the present power generation mix excluding low cost must run hydro and wind power projects of the selected grid, the design efficiency of the thermal power plants in the grid mix and the IPCC emission factors.

The Simple OM emission factor can be calculated using either of the two following data vintages for years(s) *y*:

• A 3-year average, based on the most recent statistics available at the time of PDD submission, or

• The year in which project generation occurs, if $EF_{OM,y}$ is updated based on ex-post monitoring.

SRBSL has calculated the OM emission factor as per the 3-year average of Simple OM calculated based on the most recent statistics available at the time of PDD submission.

Present Power Generation Mix

Eastern Regional Grid gets a mix of power from various sources like coal, gas, diesel, waste heat, hydro, wind and nuclear. The actual generation data of the entire Eastern Regional Grid for the years 2002–2003, 2003-2004 and 2004-2005 is presented in this document which includes generation from state owned plants, purchase from central sector power plants and purchase from private sector power plants.

Table 4: Power Generation Mix of Eastern Regional Grid for the year 2002-2003[18]

Generation Details in the Eastern Region for the year 2002-2003				
Generation Sources	Fuel	Gross MkWh Generated	Auxiliary Consumption (MkWh)	Net MkWh Generated (/Imported)
		2002-2003	2002-2003	2002-2003
Generation of SEBs, Electricity Dept., Govt. Undertakings, Municipalities, Private Generating Stations, Self-generating Industries				
Total Thermal	Coal	37104.36	3840.89	33263.47

[18] Source: CEA General Review (2002-2003)

Total Thermal	Diesel	0.89	0.00	0.89
Total Thermal (Gas Turbine)	Diesel	8.52	1.00	7.52
Total Hydro	Hydro	4244.03	73.47	4170.56
Total Wind	Wind	0.32	0.00	0.32
Total Nuclear	Nuclear	0.00	0.00	0.00
Total from Non-Utilities	Low Cost (Assumed for conservative estimate)			542.88
Generation of Central Sector Power Plants located in Eastern Region				
Total Thermal	Coal	22638.67	1915.96	20722.71
Total Thermal	Diesel	0	0	0
Total Thermal (Gas Turbine)	Diesel	0	0	0
Total Hydro	Hydro	352.84	0.81	352.03
Total Wind	Wind	0	0	0
Total Nuclear	Nuclear	0	0	0
Import from Central Sector Power Plants located in other Regions				
Total Thermal	Coal			1.23
Total Thermal	Diesel			0
Total Thermal	Gas			0.48
Total Hydro	Hydro			0
Total Wind	Wind			0
Total Nuclear	Nuclear			0
Import from other Regions				
North Eastern				229.95
Southern				100.8
Northern				0
Import from other Countries				**1519.58**

Summary of Generation Details in the Eastern Region for the year 2002-2003				
Total Thermal Generation in ER	Coal			53987.41
Total Thermal Generation in ER	Diesel			8.41
Total Thermal Generation in ER	Gas			0.48
Total Hydro Generation in ER	Hydro			4522.59
Total Wind Generation in ER	Wind			0.32
Total Nuclear Generation in ER	Nuclear			0
Total Generation from Non-Utilities in ER	Low Cost (Assumed for conservative estimate)			542.88
Total Import from other Regions in ER	Low Cost (Assumed for conservative estimate)			330.75
Total Import from other Countries				1519.58
Total Generation from all sources in ER				**60912.42**

Table 5: Power Generation Mix of Eastern Regional Grid for the year 2003-2004[19]

Generation Details in the Eastern Region for the year 2003-2004				
		Gross MkWh Generated	**Auxiliary Consumption (MkWh)**	**Net MkWh Generated (/Imported)**
Generation Sources	**Fuel**	**2003-2004**	**2003-2004**	**2003-2004**
Generation of SEBs, Electricity				

[19] Source: CEA General Review 2005 (Contains data for 2003-2004)

Dept., Govt. Undertakings, Municipalities, Private Generating Stations, Self-generating Industries				
Total Thermal	Coal	40370.84	4492.73	35878.11
Total Thermal	Diesel	0.58	0	0.58
Total Thermal (Gas Turbine)	Diesel	6.61	0.94	5.67
Total Hydro	Hydro	7186.25	34.44	7151.81
Total Wind	Wind	0.47	0	0.47
Total Nuclear	Nuclear	0	0	0
Total from Non-Utilities	Low Cost (Assumed for conservative estimate)			663.76
Generation of Central Sector Power Plants located in Eastern Region				
Total Thermal	Coal	29183.16	2463.64	26719.52
Total Thermal	Diesel	0	0	0
Total Thermal (Gas Turbine)	Diesel	0	0	0
Total Hydro	Hydro	344.26	0.68	343.58
Total Wind	Wind	0	0	0
Total Nuclear	Nuclear	0	0	0
Import from Central Sector Power Plants located in other Regions				

Total Thermal	Coal			0
Total Thermal	Diesel			0
Total Thermal	Gas			0
Total Hydro	Hydro			0
Total Wind	Wind			0
Total Nuclear	Nuclear			0
Import from other Regions				
North Eastern				335
Southern				52.61
Northern				9.01
Import from other Countries				**1748.4**
Summary of Generation Details in the Eastern Region for the year 2003-2004				
Total Thermal Generation in ER	Coal			62597.63
Total Thermal Generation in ER	Diesel			6.25
Total Thermal Generation in ER	Gas			0
Total Hydro Generation in ER	Hydro			7495.39
Total Wind Generation in ER	Wind			0.47
Total Nuclear Generation in ER	Nuclear			0
Total Generation from Non-Utilities in ER	Low Cost (Assumed for conservative estimate)			663.76
Total Import from other Regions in ER				396.62

This template shall not be altered. It shall be completed without modifying/adding headings or logo, format or font.

Total Import from other Countries				1748.4
Total Generation from all sources in ER				**72908.52**

Table 6: Power Generation Mix of Eastern Regional Grid for the year 2004-2005[20]

Generation Details in the Eastern Region for the year 2004-2005				
		Gross MkWh Generated	**Auxiliary Consumption (MkWh)**	**Net MkWh Generated (/Imported)**
Generation Sources	**Fuel**	**2004-2005**	**2004-2005**	**2004-2005**
Generation of SEBs, Electricity Dept., Govt. Undertakings, Municipalities, Private Generating Stations, Self-generating Industries				
Total Thermal	Coal	42189.37	4218.937	37970.43
Total Thermal	Diesel	0.17	0.004913	0.17
Total Thermal (Gas Turbine)	Diesel	0	0	0
Total Hydro	Hydro	7892.96	37.096912	7855.86
Total Wind	Wind	0	0	0
Total Nuclear	Nuclear	0	0	0
Generation in Central Sector Power Plants located in Eastern Region				
Total Thermal	Coal	35229.8	3522.98	31706.82
Total Thermal	Diesel	0	0	0
Total Thermal (Gas Turbine)	Diesel	0	0	0
Total Hydro	Hydro	369.64	1.74	367.9
Total Wind	Wind	0	0	0

[20]Source:http://cea.nic.in/god/opm/Monthly_Generation_Report/18col_05_03.pdf, http://cea.nic.in/god/reb/ereb/Chapters in English/chapter-2.doc, http://cea.nic.in/god/reb/ereb/Annexures(E)/Annexure-VIII.xls and CEA General Review (2005)

Total Nuclear	Nuclear	0	0	0
Import from Central Sector Power Plants located in other Regions				
Total Thermal	Coal			0
Total Thermal	Diesel			0
Total Thermal	Gas			0
Total Hydro	Hydro			0
Total Wind	Wind			0
Total Nuclear	Nuclear			0
Import from other Regions				
North Eastern				1142.84
Southern				0
Northern				0
Import from other Countries				**1734.55**
Summary of Generation Details in the Eastern Region for the year 2004-2005				
Total Thermal Generation in ER	Coal			69677.25
Total Thermal Generation in ER	Diesel			0.17
Total Thermal Generation in ER	Gas			0
Total Hydro Generation in ER	Hydro			8223.77
Total Wind Generation in ER	Wind			0
Total Nuclear Generation in ER	Nuclear			0
Total Import from other Regions in ER				1142.84
Total Import from other Countries in ER				1734.55
Total Generation from all sources in ER				**80778.58**

The following table gives a step by step approach for calculating the Simple Operating Margin emission factor for Eastern Regional Grid for the most recent 3 years at the time of PDD submission i.e.2002-2003, 2003-2004 & 2004-2005.

Table 7: Data used for Simple OM emission factor										
$COEF_{i,j\,y}$- is the CO_2 emission coefficient of fuel i (tCO_2 / mass or volume unit of the fuel), taking into account the Net Calorific Value (energy content) per mass or volume unit of a fuel i (NCV_i), the CO_2 emission factor per unit of energy of the fuel i($EF_{CO2,i}$), and the oxidation factor of the fuel i ($OXID_i$).										
Parameters	**2002-2003**			**2003-2004**			**2004-2005**			**Source**
	Coal	**Gas**	**Diesel**	**Coal**	**Gas**	**Diesel**	**Coal**	**Gas**	**Diesel**	
NCV_i (kcal/kg)	4171	11942	9760	3820	11942	10186	3820	11942	10186	Coal: CEA-General Review 2002-2003 & 2005 Gas: IPCC-Good Practice Guidance Diesel: CEA-General Review 2002-2003 & 2005
$EF_{CO2,i}$ (tonne CO_2/TJ)	96.1	56.1	74.1	96.1	56.1	74.1	96.1	56.1	74.1	IPCC 1996 Revised Guidelines and the IPCC Good Practice Guidance
$OXID_i$	0.98	0.995	0.99	0.98	0.995	0.99	0.98	0.995	0.99	Page 1.29 in the 1996 Revised IPCC Guidelines
***$COEF_{i,j\,y}$*(tonne of CO_2/ton of fuel)**	**1.645**	**2.791**	**2.998**	**1.506**	**2.791**	**3.129**	**1.506**	**2.791**	**3.129**	**Calculated as per Equation (2) of ACM0002**
$F_{i\,,j,\,y}$ - Fuel Consumption – is the amount of fuel consumed by relevant power sources j (where j – power sources delivering electricity to the grid, not including low-operating cost and must-run power plants and including imports from the grid). The Fuel Consumption is calculated based on total generation of the relevant power sources (j) ($\Sigma_j GEN_{j,y}$) , efficiency of power generation with fuel source i (Ei,j)and the Net Calorific Value (energy content) per mass or volume unit of a fuel i (NCV_i).										
$GEN_{j,y}$ is the electricity (MkWh) delivered to the grid by source j, j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports from the grid. The j power sources would also include electricity imports from the Central Generating Stations since the net imports from CGS exceed 20% of the total generation in the project electricity system – Eastern Regional Grid.										

Parameters	2002-2003			2003-2004			2004-2005			Source
	Coal	Gas	Diesel	Coal	Gas	Diesel	Coal	Gas	Diesel	
$\Sigma_j GEN_{j,y}$ (MkWh)	53987.41	0.48	8.41	62597.63	0.00	6.25	69677.25	0.00	0.17	Refer to Tables 4,5 and 6: Power Generation Data of Annex 3:Baseline Information.
Efficiency of power generation with fuel source in % (Ei,j) -The most important parameter in calculating the 'Fuel consumption' by relevant power sources is the thermal efficiency of the power plant with fuel source i. The methodology requires the project proponent to use technology provider's nameplate power plant efficiency or the anticipated energy efficiency documented in official sources. The design efficiency is expected to be a conservative estimate, because under actual operating conditions plants usually have lower efficiencies and higher emissions than the nameplate performance would imply. The efficiency of power generation with fuel source is calculated using the most conservative Design Station Heat Rate Value.										
Parameters	2002-2003			2003-2004			2004-2005			Source
	Coal	Gas	Diesel	Coal	Gas	Diesel	Coal	Gas	Diesel	
Station Heat Rate (Design Values)	2368.03	1911	2062	2373.82	1911	2062	2365	1911	2062	Coal -Performance Review of Thermal Power Stations 2002-03, 2003-04 & 2004-05 - Section 13 Gas- Petition No. 22/99; IA No.27/1999 AND IA No.18/2000 Diesel – http://mnes.nic.in/baselinepdfs/annexure2c.pdf
Ei,j (%)	36.317	45	41.707	36.229	45	41.707	36.364	45	41.707	Calculated using Station Heat Rate Values
NCV_i (kcal/kg)	4171	11942	9760	3820	11942	10186	3820	11942	10186	Coal: CEA-General Review 2002-2003 & 2005 Gas: IPCC-Good Practice Guidance Diesel: CEA-General Review 2002-2003 & 2005
$F_{i,j,y}$ is the amount of fuel i (in a mass or volume unit, here tons/yr) consumed by relevant power sources j in year(s) y										

Parameters	2002-2003			2003-2004			2004-2005			Source
	Coal	Gas	Diesel	Coal	Gas	Diesel	Coal	Gas	Diesel	
$F_{i,j,y}$ (tons/yr)	30650637	77	1777	38899347	0	1265	43137880	0	33	Calculated
$\Sigma_i GEN_{i,y}$ (MkWh)	53996.30			62603.88			69677.42			Refer to Tables 4, 5 and 6: Power Generation Data of Annex 3:Baseline Information.
Parameters	**2002-2003**			**2003-2004**			**2004-2005**			**Source**
EF (excluding electricity imports from other grids) (ton ofCO_2/MkWh)	**933.72**			**936.02**			**932.57**			Calculated
There are some electricity transfers from the connected electricity systems (NEREB,SREB and NREB) to the project electricity system- Eastern Regional Grid.										
Import from NEREB (MkWh)	229.95			335.00			1142.84			Refer to Tables 4, 5 and 6: Power Generation Data of Annex 3: Baseline Information.
Import from SREB (MkWh)	100.80			52.61			0.00			Refer to Tables 4, 5 and 6: Power Generation Data of Annex 3:Baseline Information.
Import from NREB (MkWh)	0.00			9.01			0.00			Refer to Tables 4, 5 and 6: Power Generation Data of Annex 3:Baseline Information.
As per ACM0002 the CO_2 emission factor for the net electricity imports from the connected electricity system may be determined as the average emission rate of the exporting grid, if and only if net imports do not exceed 20% of total generation in the project electricity system. The Emission Factor of the North Eastern Grid has been used as the emission factor for imports from NEREB (North Eastern Regional Electricity Board). The Emission Factor of the Southern Grid has been used as the emission factor for imports from SREB (Southern Regional Electricity Board). The Emission Factor of the Northern Grid has been used as the emission factor for imports from NREB (Northern Regional Electricity Board).										
EF (NEREB) (ton ofCO_2/MkWh)	**380.00**			**390.00**			**390.00**			http://mnes.nic.in/baselinepdfs/chapter2.pdf (EF of North Eastern Grid has

				been considered)
EF (SREB) (ton ofCO_2/MkWh)	**770.00**	**760.00**	**740.00**	http://mnes.nic.in/baselinepdfs/chapter2.pdf (EF of Southern Grid has been considered)
EF (NREB) (ton ofCO_2/MkWh)	**790.00**	**740.00**	**730.00**	http://mnes.nic.in/baselinepdfs/chapter2.pdf (EF of Northern Grid has been considered)
There are some electricity transfers from other countries to the project electricity system- Eastern Regional Grid.				
Import from Other Countries (MkWh)	1519.58	1748.40	1734.55	Refer to Tables 4, 5 and 6: Power Generation Data of Annex 3: Baseline Information.
As per ACM0002, for imports from connected electricity system located in another country, the emission factor is 0 tons CO_2 per MWh.				
EF (for imports from other countries) (ton of CO_2/MkWh)	**0.00**	**0.00**	**0.00**	As per ACM0002
Net $EF_{OM,simple,y}$ is then calculated as the weighted average of the EF (excluding electricity imports from other grids), EF (NEREB), EF (SREB), EF (NREB) and EF (for imports from other countries).				
$\Sigma_j GEN_{j,y}$ (MkWh)	**55846.63**	**64748.90**	**72554.81**	Refer to Tables 4, 5 and 6: Power Generation Data of Annex 3: Baseline Information.
$EF_{OM,simple,y}$ (tCO_2/MkWh)	905.736	907.752	901.733	Calculated as per Equation (1) of ACM0002
$EF_{OM,y}$ (tCO_2/MkWh)	**905.074**			Average of the most recent three years' Simple OM

Step 2: Calculation of Build Margin

As mentioned above the project activity would have some effect on the Build Margin (BM) of the Eastern Regional Grid. The approved consolidated baseline methodology-ACM0004 requires the project proponent to calculate the Build Margin (BM) emission factor following the guidelines in ACM0002 (Consolidated methodology for grid-connected electricity generation from renewable sources).

As per Step 2 of ACM0002, the Build Margin emission factor ($EF_{BM,y}$) is calculated as the generation-weighted average emission factor (tCO_2/MkWh) of a sample of power plants. The methodology suggests the project proponent to choose one of the two options available to calculate the Build Margin emission factor $EF_{BM,y}$

Option 1:

Calculate the Build Margin emission factor $EF_{BM,y}$ *ex ante* based on the most recent information available on plants already built for sample group *m* at the time of PDD submission. The sample group *m* consists of either:

(a) The five power plants that have been built most recently, or
(b) The power plants capacity additions in the electricity system that comprise 20% of the system generation (in MkWh) and that have been built most recently.

Project participants should use from these two options that sample group that comprises the larger annual generation.

Option 2:

For the first crediting period, the Build Margin emission factor $EF_{BM,y}$ must be updated annually ex post for the year in which actual project generation and associated emission reductions occur. For subsequent crediting periods, $EF_{BM,y}$ should be calculated ex-ante, as described in Option 1 above. The sample group m consists of either

(a) the five power plants that have been built most recently, or
(b) the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MkWh) and that have been built most recently.

Project participants should use from these two options that sample group that comprises the larger annual generation.

SRBSL has adopted Option 1, which requires the project participant to calculate the Build Margin emission factor $EF_{BM,y}$ ex ante based on the most recent information available on plants already built for sample group m at the time of PDD submission. The sample group m should consist of either (a) the five power plants that have been built most recently, or (b) the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MkWh) and that have been built most recently. Project participants are required to use from these two options that sample group that comprises the larger annual generation. As per the baseline information data the option (b) comprises the larger annual generation. Therefore for SRBSL project activity the sample group m consists of (b) the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MkWh) and that have been built most recently. Power plant capacity additions registered as CDM project activities are excluded from the sample group.

The following Table 8 presents the key information and data used to determine the BM emission factor.

Table 8: Power Generation data for sample of power plants considered for BM calculation[21]

Sr.No.	Power plant name / location	State	Year of Commissioning	Fuel Type	Capacity of the new addition (MW)	Total Capacity (MW)	Generation of the Unit in 2004-2005 (MKWh)
1	Small Hydro	Sikkim		Hydro		8.9	9.41
2	Massanjore	West Bengal		Hydro		4	0.00
3	DVC Mejia U-4	Central (West Bengal)	Feb 2005	Coal	210	840	178.18
4	Subarnarekha-I	Jharkhand	2004	Hydro	65	130	230.91
5	Subarnarekha-II	Jharkhand	2004	Hydro	65	130	
6	NTPC Talcher STPS, Kahina (Stage-II) Unit-IV	Central (Orissa)	Oct 2003	Coal	500	2000	3655.67
7	Chandil-II	Jharkhand	March 2003	Hydro	4	8	0.00
8	NTPC Talcher STPS, Kahina (Stage-II) Unit-III	Central (Orissa)	Jan 2003	Coal	500	2000	3655.67
9	Chandil-I	Jharkhand	Dec 2002	Hydro	4	8	0.00
10	Bakreswar U-3	West Bengal	2001	Coal	210	630	1252.91
11	Bakreswar U-2	West Bengal	2001	Coal	210	630	1252.91
12	Indravati P.H. U-4	Orissa	2001	Hydro	150	600	709.47
13	Indravati P.H. U-3	Orissa	2000	Hydro	150	600	709.47
14	Jojobera-II	Jharkhand	2000	Coal	120	240	365.14
15	Bakreswar U-1	West Bengal	2000	Coal	210	630	1252.91
16	NHPC Rangeet Unit-I	Central	1999	Hydro	20	60	367.90
17	NHPC Rangeet Unit-II	Central	1999	Hydro	20	60	
18	NHPC Rangeet Unit-III	Central	1999	Hydro	20	60	
19	Indravati P.H. U-2	Orissa	1999	Hydro	150	600	709.47
20	Indravati P.H. U-1	Orissa	1999	Hydro	150	600	709.47
21	DVC Mejia U-3	Central (West Bengal)	Sep 1999	Coal	210	840	1069.09
22	Tenughat (TVNL) II	Jharkhand	March 1998	Coal	210	420	596.48
				Total			**16725.06**

[21] Source –Please refer to Enclosure-I for details.

20% of Gross generation in the most recent year i.e. 2004-2005			**16155.72**
Coal			**13278.95**
Hydro			**3446.12**

The following table gives a step by step approach for calculating the Build Margin emission factor for Eastern Regional Grid for the most recent year at the time of PDD submission i.e.2004-2005.

Table 9: Data used for BM emission factor				
Parameters	**2004-2005**			**Source**
	Coal	**Gas**	**Diesel**	
$COEF_{i,m}$- is the CO_2 emission coefficient of fuel i (tCO_2 / mass or volume unit of the fuel), taking into account the Net Calorific Value (energy content) per mass or volume unit of a fuel i (NCV_i), the CO_2 emission factor per unit of energy of the fuel i ($EFCO_{2,i}$), and the oxidation factor of the fuel i ($OXID_i$).				
NCV_i (kcal/kg)	3820	11942	10186	Coal & Diesel: CEA-General Review 2005 Gas: IPCC-Good Practice Guidance
$EF_{CO2,i}$ *(tonne CO_2/TJ)*	96.1	56.1	74.1	IPCC 1996 Revised Guidelines and the IPCC Good Practice Guidance
$OXID_i$	0.98	0.995	0.99	Page 1.29 in the 1996 Revised IPCC Guidelines
$COEF_{i,m}$ (tonne of CO_2/ton of fuel)	**1.506**	**2.791**	**3.129**	**Calculated as per Equation (2) of ACM0002**
Where NCV_i ,$EFCO_{2,i}$ $OXID_i$, $COEF_{i,m}$ are analogous to the variables described for the simple OM method above for plants in the sample group m.				
Parameters	**2004-2005**			**Source**
	Coal	**Gas**	**Diesel**	
$F_{i,m,y}$ - Fuel Consumption – is the amount of fuel consumed by relevant power sources m (where m – power sources which are a part of the sample group m delivering electricity to the grid). The Fuel Consumption is calculated based on total generation of the relevant power sources (m) ($\Sigma_m GEN_{m,y}$) , efficiency of power generation with fuel source i (Ei,m)and the Net Calorific Value (energy content) per mass or volume unit of a fuel i (NCVi).				
$\Sigma GEN_{m,y}$ *(MKWh)*	13278.95	0.00	0.00	Refer to Table 8: Power Generation Data for sample of power plants considered for Built Margin Calculation of Annex 3-Baseline Information.
Station Heat Rate (Design Values)	2365	1911	2062	Coal: CEA-Performance Review of Thermal Power Stations 2004-05 Section 13 Gas: Petition No. 22/99; IA No.27/1999 AND IA No.18/2000 Diesel: http://mnes.nic.in/baselinepdfs/annexure2c.pdf

Avg. efficiency of power generation with fuel source as (in %)	36.364	45	41.707	Calculated using Design Station Heat Rate Values
NCVi (kcal/kg)	3820	11942	10186	Coal & Diesel: CEA-General Review 2005 Gas: IPCC-Good Practice Guidance
$F_{i,m,y}$ (tons/yr)	**8221129**	**0**	**0**	**Calculated**
Where $GEN_{m,y}$ *(MKWh)* , NCVi ,*Fi,m,y*, are analogous to the variables described for the simple OM method above for plants in the sample group m.				

Parameters	**2004-2005**	**Source**
ΣGENm,y (MkWh)	**16725.06**	Refer to Table 8: Power Generation Data for sample of power plants considered for Built Margin Calculation of Annex 3-Baseline Information.
Where *GENm,y* is analogous to the variables described for the simple OM method above for plants in the sample group m.		
$EF_{BM,y}$ (ton of CO_2/MkWh)	**740.422**	Calculated as per Equation (8) of ACM0002

STEP 3. Calculate the Electricity Baseline Emission Factor (EF_y)

As per Step 3, the baseline emission factor EF_y is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$), where the weights w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM} = w_{BM} = 0.5$), and $EF_{OM,y}$ and $EF_{BM,y}$ are calculated as described in Steps 1 and 2 above and are expressed in tCO_2/MkWh. The most recent 3-years (2002-2003, 2003-2004 & 2004-2005) average of the Simple OM and the BM of the base year i.e. 2004-2005 are considered. This is presented in the table below.

Table 10: Data used for Baseline Emission Factor

Parameters	**Values (ton of CO_2/MkWh)**	**Remarks**
OM, $EF_{OM,y}$	905.074	Average of most recent 3-years (2002-2003, 2003-2004 & 2004-2005) values
BM, $EF_{BM,y}$ (ton of CO_2/MkWh)	740.422	Value of the base year i.e. 2004-2005
Baseline Emission Factor, EF_y (ton of CO_2/MkWh)	**822.748**	Calculated

C) Leakage

There is no considerable leakage potential identified from the project activity. There is no requirement to procure additional fuel and therefore no transportation liabilities faced. The project operates solely on waste heat recovery from the sponge kiln flue gases. Indirect GHG emissions outside the project boundary only arise from transportation related to operation of the project. The same is negligible compared to the emission reductions that accrue from the project activity. The project utilizes the waste heat energy of flue gas available from Sponge Iron kilns of SRBSL facility. Other infrastructure requirements for the project are also met from the SRBSL facility.

D) Baseline Emissions

In absence of the project activity there will be emission as per the carbon intensity of the grid (0.823 kg CO_2/ kWh) from which the project activity would have drawn electricity to satisfy its total requirement of power. Based on the Combined Margin Method detailed above, (see section E for calculations) the project activity will reduce 515040 tonnes of CO_2 equivalent in the entire 10 year crediting period.

Annex 4

MONITORING PLAN

Introduction: SRBSL's 50 MW Captive Power Plant will consist of 4 nos. of 10 tph Waste Heat Recovery Boilers which utilize waste heat from the four sponge iron kilns as energy source; 1x 170 tph and 1 x 85 tph Circulating Fluidised Bed Combustion (CFBC) Boilers which will use waste coal (coal char and coal fines) from sponge iron process as fuel, a common steam header and 2 nos. of 25MW turbo generator (TG) sets as shown in Fig. 3 below. SRBSL will install WHRBs to improve the energy efficiency of the manufacturing process and FBCs will be installed to avoid pollution problems associated with disposal of waste coal as required by pollution control norms. The entire CPP will be commissioned in November 2006.

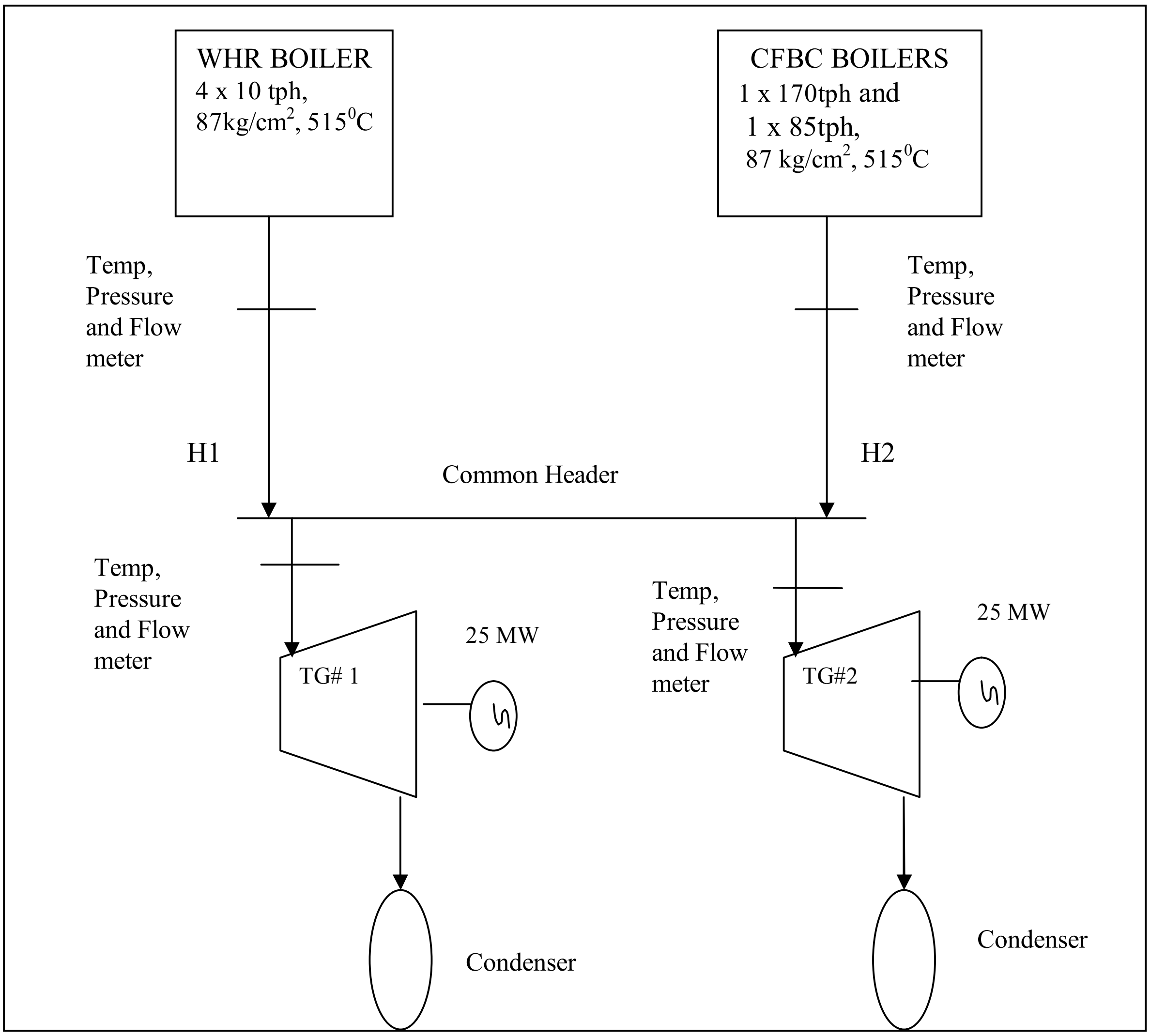


Fig 3: Schematic Diagram of SRBSL's CPP

The working parameters of various equipments and location of Steam Flow meters, pressure and temperature gauges are as indicated in the diagram. The pressure and temperature parameters for both WHR and FBC steam are the same i.e. 87 kg/cm^2 and 515^{0}C. As working steam parameters of pressure and temperature are identical for both the boilers, the only dependent variable for calculation of waste heat power would be the steam flow from respective boilers. However, to maintain transparency in calculating WHR power following monitoring methodology is used.

Calculation of Waste Heat Power: The waste heat power generated is calculated thermodynamically on the basis of Total Enthalpy (steam enthalpy per unit x steam flow) of WHR steam as a percentage of Total Enthalpy of Steam fed to the common header from both WHR and FBC.

The calculation is shown as follows:

A.) Total Enthalpy of Steam from WHR in kCal (H_1)

= (Enthalpy of steam at boiler outlet in kCal/kg) x (Total WHR steam flow in tonnes per day)

= h_1 x S_1

The enthalpy of steam is calculated based on average temperature and pressure readings for the day and WHR steam flow per day is measured by flow meter.

B) Similarly Total Enthalpy of Steam from FBC in kCal (H_2)

= Enthalpy of steam at boiler outlet in kCal/kg x steam flow in tonnes per day

= h_2 x S_2

The enthalpy of steam is calculated based on average temperature and pressure readings for the day and steam flow from the FBC steam flow meter.

C) If $EG_{GEN\ CPP}$ is the Total Power generated by the CPP per day (in MWh) then Power Generated by Waste heat Recovery Boiler (EG_{GEN}) would be calculated as

$$EG_{GEN}\ (MWh) = \frac{EG_{GEN\ CPP} \times (H_1)}{(H_1 + H_2)} \qquad \ldots\ldots\ldots\ldots 1$$

Again, if Auxiliary Consumption for the CPP per day is $EG_{AUX\ CPP}$ (in MWh), then WHR Auxiliary Consumption (EG_{AUX}) will calculated in the same ratio as

$$EG_{AUX}\ (MWh) = \frac{EG_{AUX\ CPP} \times (H_1)}{(H_1 + H_2)} \quad \ldots\ldots\ldots.2$$

Therefore Net Generation from Waste heat Recovery ie. project activity (1 – 2)

$$EG_y\ (MWh) = (EG_{GEN} - EG_{AUX}) \quad \ldots\ldots\ldots\ldots.3$$

Table An.4.1 – Total Enthalpy from WHRB steam									
ID No.	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	For how long is archived data to be kept?	Comments
1. T_1	Quantitative	Avg. Temperature of WHR steam before Common header	^{0}C	Online Measurement	Continuously	100%	Electronic/ paper	Credit Period + 2 years	MONITORING LOCATION: The data will be monitored from meters at plant and DCS. Manager In-charge would be responsible for calibration of the meters
2. P_1	Quantitative	Avg. Pressure of WHR steam before Common header	kg/ cm^2	Online measurement	Continuously	100%	Electronic/paper	Credit period + 2 years	MONITORING LOCATION: The data will be monitored from meters at plant and DCS. Manager In-charge would be responsible for regular calibration
3. h_1	Quantitative	Enthalpy of steam from WHR boiler	kCal/kg	Calculated	Daily	100%	Electronic/ paper	Credit period + 2 years	Noted from standard Steam table/ Mollier Diagram from the avg. temperature and pressure for the day.
4. S_1	Quantitative	Flow of WHR Steam to Common header	tonnes per day	Online measurement	Daily	100%	Electronic /paper	Credit period + 2 years	MONITORING LOCATION: The data will be monitored from meters at plant and DCS. Manager In-charge would be responsible for regular calibration
5. H_1	Quantitative	Total enthalpy of WHR Steam	kCal	Calculated (h_1 x S_1)	Daily	100%	Electronic/paper	Credit Period + 2 years	Calculated on a daily basis

Table An. 4.2 – Total Enthalpy of Steam from FBC Boiler									
ID No.	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	For how long is archived data to be kept?	Comments
6. T_2	Quantitative	Avg. Temperature of FBC steam before Common header	^0C	Online measurement	Continuously	100%	Electronic/ paper	Credit Period + 2 years	MONITORING LOCATION: The data will be monitored from meters at plant and DCS. Manager In-charge would be responsible for calibration of the meters
7. P_2	Quantitative	Avg. Pressure of FBC steam before Common header	kg/ cm^2	Online measurement	Continuously	100%	Electronic/paper	Credit period + 2 years	MONITORING LOCATION: The data will be monitored from meters at plant and DCS. Manager In-charge would be responsible for regular calibration
8. h_2	Quantitative	Enthalpy of steam from FBC boiler	kCal/ kg	Calculated	Daily	100%	Electronic/ paper	Credit period + 2 years	Noted from standard Steam table/ Mollier Diagram from the avg. temperature and pressure for the day
9. S_2	Quantitative	Flow of Steam to Common header	tonnes per day	Online measurement	Continuously	100%	Electronic /paper	Credit period + 2 years	MONITORING LOCATION: The data will be monitored from meters at plant and DCS. Manager In-charge would be responsible for regular calibration
10. H_2	Quantitative	Total enthalpy of FBC Steam	kCal	Calculated (h_2 x S_2)	Daily	100%	Electronic/paper	Credit Period + 2 years	Calculated on a daily basis

Table An.4.3 – WHR Power generated									
ID No.	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	For how long is archived data to be kept?	Comments
11. $EG_{GEN\ CPP}$	Quantitative	Total Electricity Generated by the CPP	MWh / day	Online measurement	Continuously	100%	Electronic/ paper	Credit Period + 2 years	MONITORING LOCATION: The data will be monitored from meters at plant and DCS. Manager In-charge would be responsible for calibration of the meters
12 $EG_{AUX\ CPP}$	Quantitaive	Total Auxiliary Consumption of the CPP	MWh /day	Online measurement	Continuously	100%	Electronic / paper	Credit Period + 2 years	MONITORING LOCATION: The data will be monitored from meters at plant and DCS. Manager In-charge would be responsible for calibration of the meters
13. EG_{GEN}	Quantitative	Waste Heat Recovery Based Power	MWh /day	Calculated	Continuously	100%	Electronic/paper	Credit period + 2 years	Calculated based on the Enthalpy Ratio H1/ (H1+H2), values taken from Tables An. 4.1 and 4.2
14. EG_{AUX}	Quantitative	Auxiliary Electric Consumption	MWh /day	Calculated	Continuously	100%	Electronic/ paper	Credit period + 2 years	Calculated based on the Enthalpy Ratio H1/ (H1+H2), values taken from Tables An. 4.1 and 4.2

Table An. 4.4 Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored			
Data *(Indicate table and ID number e.g. 1. , -14.)*	Uncertainty level of data (High/Medium/Low)	Are QA/QC procedures planned for these data?	Outline explanation why QA/QC procedures are or are not being planned.
1., -5.	Low	Yes	This data will be used for calculation of WHR steam parameters.
6.,-10.	Low	Yes	This data will be used for calculation of FBC steam parameters.
11.,-14.	Low	Yes	This data is used for calculating power contributed from waste heat recovery steam generation system in the CPP.

- - - - - -