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

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Annexes

Appendices

SECTION A. General description of project activity

A.1 Title of the project activity:

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Waste Heat based 7 MW Captive Power Project

Version - 01

Date of document – 24th August 2005.

A.2. Description of the project activity:

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i) Background

Godawari Power and Ispat Ltd. (GPIL) is a sponge iron manufacturing company that belongs to the 'Hira Group of Companies' of Chattisgarh State, India. The Group has over two decades of experience in manufacturing secondary steel products like steel bars, rounds, wires and ferro alloys. The other companies belonging to the Group are Hira Steels Limited and R.R. Ispat Limited [hereinafter referred to as Group Companies].

Godawari Power and Ispat Ltd. [the name of the company Ispat Godawari Ltd (IGL) has been changed to Godawari Power and Ispat Ltd w.e.f. 20th June 2005] came up with its two units - Sponge Iron Division and Mini Steel Plant at a facility in Raipur in the year 2001-02. The company produces around 70,000 tonnes of Sponge Iron and 30,000 tonnes of Steel Billets per annum. In an effort to achieve higher productivity and increased energy efficiency, the company established its own **power plant division.** The division started operations from September 2002 with a 7 MW waste heat recovery based captive power plant (CPP). A year later it undertook expansion with an 11 MW coal based power plant utilizing coal fines and coal rejects from the sponge iron process as fuel.

ii) Project Activity

Of the 18 MW installed capacity of the CPP at GPIL, about 7MW power is generated by utilizing heat content of the waste gases released from Direct Reduction Iron (DRI) kilns of sponge iron process. The heat from the gases is transferred to a Waste Heat Recovery Boiler

(WHRB) to produce steam. Steam thus produced is fed to a common steam header, from where it is finally fed to turbo-generator sets to generate power. The constituent of total power contributed by steam coming from WHRB (calculated thermodynamically) in GPIL's CPP comes under the scope of the term **Project Activity** mentioned henceforth throughout this document.

iii) Purpose of the Project Activity

The purpose of the project activity is to achieve energy efficiency and betterment of the working environment in sponge iron making process. The project activity of GPIL also leads to sustainable economic growth, conservation of natural resources and reduction in Greenhouse Gas (GHG) emission. The electricity produced by the project activity is used to partially meet the power requirement of GPIL plant itself and the surplus power is wheeled[1] through Chattisgarh State Electricity Board (CSEB) transmission & distribution (T&D) lines to meet the power requirement of its Group Companies — Hira Steels Limited located at Rawabhata and R.R. Ispat Limited located at Urla, both in Chattisgarh State. The net result is a reduction in electricity demand from the state grid supply and hence GHG emission reduction.

iv) Salient Features of the project

The main activity of GPIL involves production of Sponge Iron and Steel Billets. Sponge iron is manufactured through rotary kiln of 350 tonnes per day capacity (around 105,000 tonnes per annum) using coal as fuel. The flue gas available at high temperatures of around 950^{o}C from the sponge iron kiln constitutes a significant amount of heat energy. With the WHRB, a modern technology, GPIL has achieved about 75% recovery of waste heat from flue gas of sponge iron kiln and utilization of same heat to produce steam. The steam is further utilized to generate electrical energy. In absence of the waste heat recovery steam generation system (WHRSGS), the same heat energy would have been lost in the atmosphere through stack emission of the flue gases of sponge iron kiln at GPIL's Sponge Iron Division (SID) located within the same premises.

[1] Wheeling refers to the movement of electricity, owned by a power supplier and sold to a retail consumer, over transmission and distribution lines owned by neither one. A fee is charged by the owners of the lines for letting others use them.

The project comprises of a Waste Heat Recovery Boiler (WHRB) and two Steam Turbo Generators with necessary accessories for transfer of Sponge Iron Kiln flue gases and steam. The unit is presently generating around 24 million kWh [or million units] per annum. Around 21 million units (MUs) are available after auxiliary consumption.

Power produced is consumed for in-house operational purposes and surplus is wheeled through the Chattisgarh State Electricity Board (CSEB) grid to the Group Companies. A Power Wheeling Agreement has been signed with CSEB[2] according to which, GPIL can wheel a maximum of 3MW (equivalent to 1.022 MU) power to the group companies through CSEB grid. Power is being wheeled through 33kV transmission grid. All cost for such provision is being borne by GPIL alone. The Group Companies are located within a radius of 10 km of the project site. Because of the proximity of the Group Companies from the project site, the transmission and distribution losses/leakage for wheeling power is considered to be negligible.

The main carbon benefit to the project arises from replacement/displacement of an equivalent amount of electricity from the state grid with high carbon intensity, which comprises of a generation mix primarily from fossil fuel sources. The total emission reductions for the entire crediting period of **10 years** have been calculated to be **221567 tCO_2- equivalent.** The benefits are not just in the form of power produced but also the improvement of local environment and reduction in GHG i.e. CO_2 in global scenario.

Therefore, the project fundamentally achieves the following goals:

- Utilization of heat energy of waste gas.
- Meet the process requirement of power without any T&D losses.
- Helps become self-reliant and be less dependent on grid supply of electricity.
- Technologically upgraded and sustainable industrial growth in the state.
- Conserves natural resources and environment in local as well as global front.
- Reduces the escalating demand and supply disparity of electricity locally.

Project's Contribution to Sustainable Development

Social Benefits: - Project activity has increased small fraction of skilled labour and professionals in the region by providing direct and indirect employment for power plant construction and operation. Also with growing technological advancement the project activity contributes to capacity building in terms of technical knowledge and managerial skills.

A CSEB survey[3] projects Chhattisgarh as a power deficit state in the future. Thus with project activity's ability to reduce an equivalent demand of electricity on the grid is an advantage to the state grid in combating power shortage and making it available for other important purpose.

Economical Benefits: - GPIL wheels about 3 MW per month in total to Group Companies. Hence, the project also brings economic benefits to the state government through power wheeling agreement at a rate of 10% of the total units wheeled. The project shows less dependence of project proponent on grid electricity and better management of waste. This brings in related economic benefits for the company, the local community and the employees.

Environmental Well-being: - In India, coal is the most abundantly available fossil fuel which is mainly used for power generation. Power plants run by state, contribute about 1400 MW[4] of which more than 85% is accounted for by coal based thermal power plants. The waste heat recovery CPP in GPIL has been able to displace/ replace electricity generated by grid-connected power plants in an equivalent amount. Being able to do away with grid power, GPIL has saved further depletion of natural resources – coal, thus increasing its availability to other important processes in future.

Clean Technology: - Waste heat recovery based captive power plant was installed by GPIL as a clean technology to utilize waste flue gases of Sponge Iron process. These gases would otherwise have been emitted to atmosphere leading to air and thermal pollution. Hence, the project activity has contributed to a better quality environment to the employees and the surrounding community. Moreover, the electricity generated from the system has partly

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[2] Power Wheeling Agreement, vide CSEB's memo no. 02-02/SE-I/IGL/142 dated 22.4.03

[3] Refer to http://www.chhattisgarh.nic.in/opportunities/Power.pdf

[4] www.cseb-powerhub.com

substituted the power supplied from grid enabling project proponent to reduce carbon dioxide emission and other associated pollution elsewhere at the thermal power plants; equivalent of which would have been emitted in absence of the project. The total generation is being consumed for its own use as well as the requirement for its group companies. This reduces the technical losses due to transmission and distribution from power generating stations to the respective companies. The wastewater generated from the project activity is reused for sprinkling on roads, fire-fighting purposes and for green belt development. Ash from hoppers of Electrostatic Precipitator (ESP) and Air Pre Heater is collected in Ash Silo and sold to cement industries/ brick manufacturers. Thus the implementation of project activity is a demonstration of a clean technology.

Implementing such modern technologies will lead to sustainable economical and industrial growth in the long run and further conserving natural resources like coal. The detailed references of the above mentioned contributions are provided in Section F – Environmental Impacts.

A.3. Project participants:

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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)
Godawari Power and Ispat Limited (formerly Ispat Godawari Limited)	**Private Entity**	**Yes**
Ministry of Environment & Forests, Govt. of India	**Public Entity**	**No**

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

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India

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

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Chattisgarh

A.4.1.3. City/Town/Community etc:

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Siltara, Raipur District

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

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The project has been implemented within the existing premises of Godawari Power and Ispat Limited, located at Phase I of Siltara Industrial Area on Bilaspur Road, in Raipur District of Chhattisgarh state, India. The geographical location of the site is at 81° 41' E longitude and 21° 23' N latitude. The nearest railway station and airport is at Raipur, the state capital which is at a distance of 17km from the site.

Location advantages:

- Water availability from government supply as well as tube wells.
- Availability of well developed industrial infrastructure [transport, telephone exchange, banks, other civil amenities and housing facilities at nearby Raipur town]
- Abundance of skilled and semi-skilled labour
- Proximity to highways, railways and airport

The geographical location with rail/road connectivity of Raipur is detailed in the maps below.

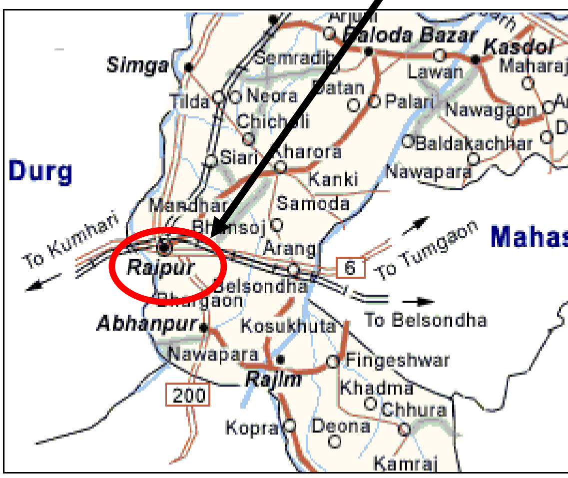

Fig 1: Location of project activity.
(Maps not to scale).

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

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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 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 (Version 3)’ on the UNFCCC website for accreditation of Designated Operational Entities[5].

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

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The Waste Heat Recovery (WHR) based captive power plant at GPIL utilizes the heat content of waste flue gas of sponge iron kiln to generate electricity for its captive requirement.. The sponge iron kiln of 350 TPD capacity currently has an average annual production of around 70,000 tonnes and runs on coal as fuel in the sponge iron kiln. Typical flue gas availability from the sponge iron kiln is 75,000 Nm^3/hr.

The exhausted flue gas of the sponge iron kiln is received at the After-Burning Chamber (ABC) inlet at a temperature of around 900^{o}C. The waste gases are burnt in ABC to remove traces of carbon monoxide. After secondary combustion the hot flue gases leave the ABC at temperatures ranging from 950^{o}C to 1050^{o}C which is finally introduced to the WHRB through a hot gas duct.

The combusted gas is circulated through three passes of WHRB to transfer the sensible heat energy of the waste gas to water and generate steam at a rate of 30 tonnes per hour (tph) at 35kg/cm^2, 410^{0}C. The radiation heat and convection heat component of the hot gas is recovered in first two passes. About 75% of heat is recovered at this point. Finally, the gas is passed through Economiser bundles for optimum recovery of heat from the hot exhaust. After final heat transfer at all heat recovery sections the gas leaves the WHRB chamber at a temperature of around 200^{o}C.

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

The moderate pressure WHRB along with the high efficiency extraction cum condensing type multistage Steam Turbine & Generator (STG) sets of 10 MW is operated to generate power. GPIL operates two STG sets each of 10 MW capacity feeding steam simultaneously or one at a time from the steam generation sources.

Combusted gas after maximum heat transfer in the boiler is led to exhaust stack through Electrostatic Precipitator (ESP) which reduces Suspended Particulate Matter (SPM) load to a large extent. SPM is collected in the hoppers of the ESP. The particulate matter collected in the hoppers is conveyed to existing ash silo by a conveyor belt. The ash from the silo is sold to cement plant and brick manufacturing unit in the vicinity on contractual basis. Bag filters have been installed at all points where there is possibility of any fugitive emission of flue dust.

Other systems required for power plant includes circulating cooling water system, de-mineralization plant, air compressor system etc. Circulating water system is used to condense exhaust steam after passing through turbine rotor. Cooling water enters the condenser and takes away heat available in the exhaust steam. Heat acquired by the cooling water is removed in cooling tower. Only treated water is supplied to the boiler to avoid scale formation in boiler heat transfer tubes and better performance. Total wastewater is recycled and reused after treatment and the blow down water is used for other purposes like plantation.

GPIL's sponge iron plant is usually shut down for a period of about 15 days, at an interval of 6 months. No supplementary fuel is used for firing in WHRB. Therefore, due to unavailability of flue gas (as fuel) power plant will be shutdown during this period. Hence, power plant will operate for 335 days in a year. At present the power plant is annually generating around 21 MUs after auxiliary consumption.

About 4MW electrical energy produced meets the captive requirement and remaining around 3 MW is wheeled through the CSEB grid to its group companies. The technology used to generate electricity is environmentally safe and abides by all legal norms and standards in the field of environment.

Implementation schedule

The project proponent and sponsor, Godawari Power and Ispat Limited launched the project on waste heat recovery based Captive Power generation in the year 2000, with a consolidated project report. The CPP started commercial operation in September 2002. The zero date for

CER calculations and quantification of CO_2 reduced for this project has been considered from 1st September 2002 and will extend till year 2012, for 10 years of crediting period.

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:

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GPIL set-up the CPP with an objective to utilize waste resources available from manufacturing process and use it to generate electrical energy for its own utilization as well as the requirements of its group companies through wheeling.

The project has employed a non-GHG emitting technology - Waste Heat Recovery and Steam Generating System. In the absence of the project, the electricity requirements of equivalent amount would have been met by CSEB grid supply resulting into an equivalent amount of CO_2 emission from the thermal power stations. More than 85% of CSEB grid comprises of thermal power mix (coal, gas). However, due to project activity, project proponent has been able to reduce and replace an equivalent amount of demand on grid electricity, resulting in reduction of corresponding CO_2 emissions at the thermal power plants of the grid.

The project does not contribute to any additional GHG emission. It utilizes only the sensible heat content of the waste gases available at the outlet of the ABC attached to the Sponge Iron kiln located within the premises and connected by hot gas duct with the the WHRB. The chemical composition of the waste gas at the inlet and outlet of the boiler remain same and no other secondary fuel is fired in the boiler.

Taking into consideration the power deficit in India, future demand rise in Chhattisgarh[6] and recent capacity additions to meet the electricity demand in the state, the project activity contributes by reducing this demand by around 21 MU per year. The project activity reduces anthropogenic emissions by sources that would have occurred (due to future generation mixes) or are occurring (due to present generation mixes) to cater to a certain proportion of the

[6] Refer- (power shortage of approximately to 917 MW by the year 2010-11 as reported in the Infrastructure Development Action Plan for Chhattisgarh – Final Report http://www.chhattisgarh.nic.in/opportunities/Power.pdf)

demand. The average estimated total of emission reductions to be achieved by the project is 22156.7 tonnes of CO_2/year and 221567 tonnes of CO_2 for the entire 10 year crediting period.

The Indian Government or Government of Chattisgarh does not require the sponge iron manufacturing units to utilize the heat content of the waste gases generated during their production process. Hence the project proponents do not have any legal binding to implement the proposed project activity. GPIL will be implementing the proposed project activity over and above the national or sectoral requirement. The resulting GHG emission reduction will be additional to those directed by the government policies and regulations.

The project faced a number of regulatory/institutional barriers during granting of permission of the waste heat recovery based CPP with provision for wheeling. The decision to implement the project activity was taken in year 2000 when the rules related to open access[7] in India were not clear. The State Electricity Board(SEB) framed the rules for setting up captive power plants in the state. The SEB made it mandatory for GPIL to first become a High Tension (HT) consumer with a contract demand of 3500kVA as a condition for setting up the CPP. The project proponent further faced a number of barriers for accessing bank loans. Iron and Steel plants were classed as Non Performing Assets by banks and financial institutions in India during project start up stage. Banks were reluctant to fund the project and it took a wait for almost two and a half years to achieve financial closure for the project. The project proponent further had to provide hefty collaterals and bank guarantee against the loans. These factors led to significant time and cost overrun. Later, though the new Electricity Act which was enacted in 2003 liberalised captive power generation and open access came the project proponent still continued to face numerous barriers on a continuous basis. These barriers are further dealt in detail in Section B3.

GPIL decided to implement the project activity by making special efforts towards borrowing funds and to develop technical expertise. GPIL was fully aware of the CDM developments during project decision making stage and decided to invest in project activity taking into consideration the financial assistance which would be made available under CDM. The

[7] Open Access as defined by the Electricity Act 2003 means 'the non-discriminatory provision for the use of transmission lines or distribution system or a associated facilities with such lines or system by any licensee or consumer or a person engaged in generation in accordance with the regulations specified by the Appropriate Commission

financial assistance and the enhanced visibility that CDM would provide helped GPIL overcome the barriers associated with implementation of the project activity.

Hence, in absence of the approval and registration of the project activity as a CDM project activity the associated barriers would prevail and GPIL would eventually resort to business-as-usual scenario which is letting off the waste heat into atmosphere and importing power from grid. The waste heat based power plant is not only justified in view of its capability to affect the generation mix but also lead as an example of eco-friendly power from a sponge iron industry. The project meets the requirement of additionality tests of the 'Tools for demonstration and assessment of Additionality' and its operation has the effect of reducing GHG emissions below the level that would have occurred in its absence (refer section B3 for further details).

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

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Years	Annual Estimation of emission reductions in tonnes of CO_2 e
2002-2003 [Sept-Mar]	20627.7
2003-2004	35099.1
2004-2005	19703.8
2005-2006	19703.8
2006-2007	19703.8
2007-2008	19703.8
2008-2009	19703.8
2009-2010	19703.8
2010-2011	19703.8
2011-2012	19703.8
Apr 2012-Aug 2012	8209.9
Total estimated reductions CO_2 e	221567
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	22156.7

A.4.5. Public funding of the project activity:

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No public funding from parties belonging to Annex – I country is available to 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:

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

Reference: Approved consolidated baseline methodology ACM0004/ Version 01;

Sectoral Scope: 01, 8 July 2005[8]

Approach: Existing actual or historical emissions, as applicable.

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

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Justification concerning choice of Approach

Project activity includes electricity generation by utilizing the heat energy of waste flue gas available from GPIL's Sponge Iron unit through Waste Heat Recovery and Steam Generating system in the CPP of GPIL. The electricity generated partially meets the in-house requirement and surplus power is wheeled to the group companies of GPIL.

In absence of the project (business-as-usual scenario) GPIL would have drawn equivalent amount of electricity from the state grid supply (CSEB) consisting of a generation mix of 87.1% thermal sources (coal, gas); 6.4 % non fossil fuel sources such as nuclear, hydro and renewable and remaining 6.5% from other state grids. (refer to Table 1 below)..

[8] http://cdm.unfccc.int/EB/Meetings/020/eb20repan12.pdf

Table 1: Generation Mix of Chattisgarh State based on power available (in MU) for 2004-05

Source	Power available to CSEB in 2004-05 (MU)	Percentage
Coal	10175.61	85.5
Gas	182.78	1.5
Hydro	382.64	3.2
Nuclear	169.15	1.4
Renewable	211.09	1.8
Other Grids	773.55	6.5
Total	**11894.82**	**100**

Source: Western Regional Electricity Board Annual Report, 2004-05

Moreover, in the absence of the project the waste heat energy in the flue gases would have been lost in the ambient air adding to thermal pollution of the area. Therefore with successful operation of captive power plant, the project is being able to displace/ substitute the equivalent power units from grid mix with an emission factor of 0.943 $kgCO_2/kWh$ (refer Section E). However, since the project has a capacity of 7 MW which is less than 1% of the CSEB grid generation mix of 2034.5 MW, we can assume a marginal effect on the operation of existing power plants. Also in view of the predicted power deficit status of the state in future, a delay effect in future power plants may creep in due to the occurrence of this project although to a limited extent. Thus the project has marginal effect on the operation of the existing power plants and future capacity additions and their associated actual emission. Hence it can be concluded that the most appropriate approach for baseline methodology would be "Existing actual and historical emission" of the power plants connected to the selected grid.

The selected baseline methodology is also based on "Existing actual and historical emission" established upon chosen or identified grid that is most realistic representation of the baseline scenario w.r.t. the project activity.

Justification concerning applicability of the selected methodology

The Consolidated baseline methodology ACM0004 for waste gas and/or heat for power generation applies to project activities that generate electricity from waste heat or the combustion of waste gases in industrial facilities. The methodology is applicable to electricity generation project activities:

A. that displace electricity generation with fossil fuels in the electricity grid or displace captive electricity generation from fossil fuels,

B. Where no fuel switch is done in the process where the waste heat or waste gas is produced after the implementation of project activity

GPIL's project activity is a WHR based power project utilizing waste heat from sponge iron rotary kiln. Coal is used as fuel in the sponge iron kiln. The GPIL plant is connected to the state grid and will be dependent on the same in absence of the project. In the state of Chhattisgarh there are about 17 Sponge Iron plants producing similar products by using similar technology under the similar governed polices, and having similar investment or finance options. Out of these 17 plants only 5 plants (including GPIL) have WHRB technology for captive generation of electricity. It is most likely that in absence of the project activity GPIL would opt for the business-as-usual scenario, i.e. letting off the waste heat into the atmosphere and import of equivalent electricity from state grid to cater to the need. Moreover, the sponge iron kiln of GPIL continues to use coal as fuel and no fuel switch is planned during the crediting period. The project activity thus meets both the applicability criteria set forth in the methodology.

The non-project option is "import of electricity from the grid". Since the baseline scenario (established in Section B2) is grid connected and the selected approach is 'existing actual and historical emission", the data of actual emission of the power plants connected to the grid has been collected from CSEB and Central Electricity Authority (CEA) information sources and used in calculation to determine the carbon intensity of the grid (emission factor). Data is generally available in the form of total electricity supplied annually to CSEB by the power generation units.

As per the Kyoto Protocol (KP) baseline should be in accordance with the additionality criteria of article 12, paragraph 5(c), which states that a CDM project activity must reduce anthropogenic emissions of greenhouse gases that are additional to any that would have occurred in the absence of the registered CDM project activity. The project additionality is established as per latest version of "Tool for the demonstration and assessment of additionality" which is described in Section B3.

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

The project activity involves setting up of 7MW WHR based CPP by GPIL to meet a part of its own requirement and wheel the surplus power to its Group Companies. The methodology is applied in the context of the project activity as follows:

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 checked 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.

As mentioned above, the project activity requires supplying a total of 7 MW of power to the end users - GPIL and its group companies. Five plausible alternative scenarios were available with the project proponent which was discussed during project inception stage:

Alternative 1: Import of power from grid for end users – continuation of current scenario

The end users would continue to purchase required power from Chattisgarh State Electricity Board (CSEB). An equivalent amount of CO_2 emissions would take place at the thermal power plants supplying power to CSEB grid. This alternative is in compliance with all applicable legal and regulatory requirements and can be a part of baseline option.

Alternative 2: 7 MW Coal based CPP at GPIL

The project proponent may generate the same amount electricity (7 MW) from coal based CPP at its existing sponge iron plant. The power generated would partially meet GPIL's own demand and the surplus power would be wheeled to its Group Companies through CSEB grid. An equivalent amount of CO_2 emissions would be released at the CPP end. This alternative is in compliance with all applicable legal and regulatory requirements and can be a part of baseline option.

Alternative 3: 7 MW Gas based CPP at GPIL

GPIL may generate its own power using natural gas based captive power plant and an equivalent amount of carbon dioxide would be generated at the power plant end. 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 distribution network in Chattisgarh[9]. Therefore, alternative 3 may be excluded from baseline scenario.

Alternative 4: 7 MW light diesel oil or furnace oil based CPP at GPIL

GPIL may set up 7 MW light diesel oil (LDO) or furnace oil (FO) based CPP at its existing sponge iron plant. The power generated would partially meet GPIL's own demand and the remaining power would be wheeled to its Group Companies through CSEB grid. An equivalent amount of CO_2 emissions would be released at the CPP end. This alternative is in compliance with all applicable legal and regulatory requirements and can be a part of baseline option.

Alternative 5: Implementation of project activity without CDM benefits

GPIL may set up a 7 MW waste heat recovery based CPP at its existing sponge iron plant. The power generated would partially meet GPIL's own demand and the remaining power would be wheeled to its group companies. This alternative is in compliance with all applicable legal and regulatory requirements. The heat energy of the kiln flue gases would be utilized and for the total power supplied, GPIL would reduce an equivalent amount of CO_2 emissions at the thermal power plants feeding to the CSEB grid. However, for this alternative the project proponent faced a number of regulatory, investment and technological barriers (as detailed in Section B3 below) and hence this option is not a part of baseline scenario.

Evaluation of the alternatives on economic attractiveness:

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

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

Table 2: Evaluation of Alternatives based on Economic Attractiveness

Alternative	Capital Cost (Rs. Million / MW)	Generation/ Purchase Cost (Rs./kWh)		Source of Information	Comments	Conclusion
1) Import of Power from Grid	Nil	Year 1999-2000	3.92	Values from Hira Steels Annual Report 2000-01 and 2001-02 (as GPIL started import only from 2001-02)	Continuation of current situation, annual expenses in the form of tariff is low, no additional investment, easy government approvals,	An economically attractive option
		Year 2000-2001	3.52			
		Year 2001-2002	3.66			
2) Coal based CPP	42.5 - 45.0	1.78 - 1.92		Indicative prices available in India during project conception stage[10]	High Capital Cost - uneconomical for small sizes, difficulty in accessing bank loans, government clearances cumbersome.	This option is economically unattractive
4) LDO/FO Based CPP	7.5 -12.0	3.5 - 4.6		Indicative prices available in India during project conception stage[10]	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, GPIL expected further oil price hike in future.	This option is economically unattractive

[10] Captive Power Plabnts- 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 Alternative 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 is the baseline:

- This is a usual practice being followed by the other similar industries in the state-ie.business-as-usual-scenario. Only 5 sponge iron plants [including GPIL] out of 17 (refer Step 4 in section B3 of Tools for demonstration and assessment for Additionality) for details) in the state have waste heat recovery based captive power generation.

- No power generation risk involved

- The GPIL plant is connected to the state grid and will be dependent on the same in absence of the project.

- The grid's generation mix comprises of power generated through sources such as thermal (coal and gas), hydro and nuclear power plants 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 of the grid is more conservative than that of the coal based CPP.

We may therefore conclude that in the absence of project activity, the end users would draw power from CSEB, and the system boundary would include the grid's generation mix. It may also be noted that in the pre-project scenario the GPIL and the group companies drew power from CSEB. This further reaffirms that the grid as baseline will be the most appropriate baseline.

Establishing the additionality for the project activity

This step is based on Annex I to EB 16 Report and follows the "Tool for demonstration and assessment of additionality". 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 B3.

Determining the baseline emissions

This step provides steps for analysis of the selected baseline scenario to calculate the baseline emission factor. Details of baseline emissions 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 WHRB. 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:

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As per the decision 17/cp.7, para 43, a CDM project activity is additional if anthropogenic emissions of greenhouse 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 demonstration and assessment of additionality' as per EB 16 meeting. The flowchart in Fig 2 below provides a step-wise approach to establish additionality of the project activity.

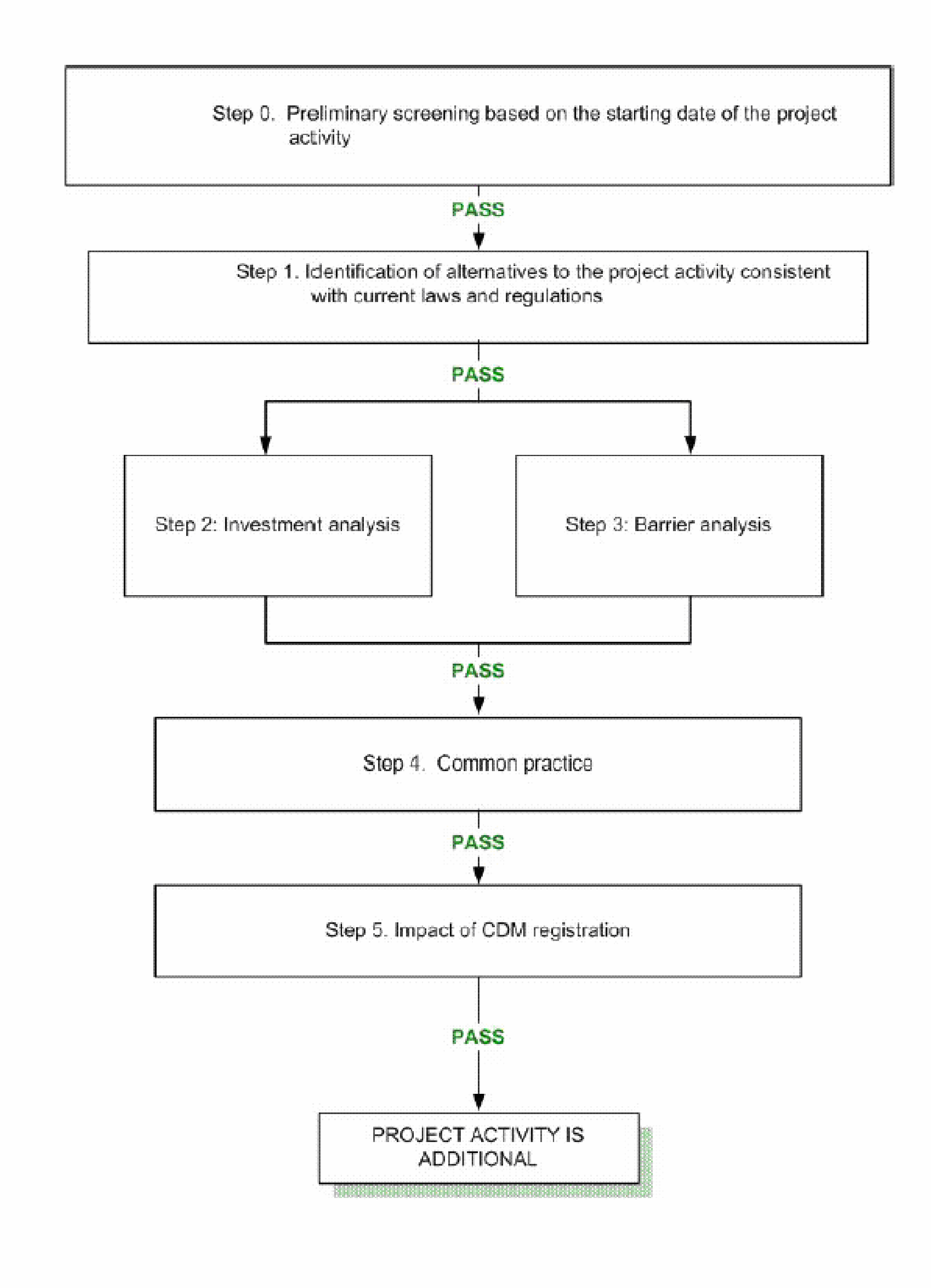

Fig 2: Flow chart for establishing additionality

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 Godawari Ispat and Power Limited launched the project on waste heat recovery based captive power generation starting construction in July 2002. The CPP started commercial operation in September 2002. Hence, the project activity lies between 1st January 2000 and the 18 November 2004 i.e. date of registration of first CDM project activity. GPIL would provide sufficient evidences to establish the same. GPIL proposes to get the project activity registered with UNFCCC before December 31, 2005.

(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 to third parties at, or prior to, the start of the project activity.*

As a responsible corporate citizen, GPIL is committed for business growth keeping in mind the environmental protection aspects both locally as well as globally. GPIL is aware that the emergence of the concept of sustainable development in the recent years has brought in the general realization that environmental issues are inexorably linked with its development objectives and polices. All activities undertaken by GPIL take into consideration the environmental, health and social assessment. Consequently, climate change issues are very much a part of GPIL decision making covering all its proposed activities. GPIL was aware of the number of investment and regulatory barriers it would face for entering into a domain of power generation which is not coming under its expertise. Despite these barriers, the Board Members of GPIL in its meeting on 5th Jan 2000 decided to take up the project activity in view of the risk mitigation cover CDM would provide[11]. The Board also decided to bear the costs for CDM documentation, registration and for adhering with the M&V protocol. Adequate evidence is available which shows that CDM benefits were seriously considered to proceed with project activity. The documentation will be made available to the Designated Operational Entity (DOE) during validation.

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

The project activity requires supplying a total of 7 MW of power to the end users - GPIL and its group companies. As discussed in section B2 above, there were five plausible alternatives available with the project proponent to provide this service among which three were feasible. They are:

Alternative 1: Import of power from grid for end users – continuation of current scenario
Alternative 2: 7 MW Coal based CPP at GPIL
Alternative 4: 7 MW light diesel oil or furnace oil based CPP at GPIL
These alternatives are in compliance with all applicable legal and regulatory requirements. There is no legal binding on GPIL 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 Chattisgarh Pollution Control Board to implement the same.

Next the project proponent is required to conduct

Step 2. Investment analysis OR
Step 3. Barrier analysis.

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

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[11] Minutes of Meeting of Board of Directors of GPIL held on 5th June 2000.

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

The project activity had its associated barriers to successful implementation, which have been overcome by GPIL to bring about additional greenhouse gas reductions. The barriers are detailed below:

1. Regulatory/Institutional barriers:

During inception of the project in 2000, the prevailing statute for setting up captive power plants in India was governed by the old law of Electricity Supply (Act) that was enforced way back in 1948. All the powers for setting up CPPs were conferred with SEB under the Act and obtaining approvals for project activity implementation were cumbersome and time consuming. Regulatory barriers faced by GPIL (the project proponent) are detailed below:

a. The agricultural and domestic consumers are heavily cross subsidized by the industrial and commercial consumers in India[12]. However, billing and collection is much more efficient for high tension (H.T) industrial consumers[13]. The trend of developing captive power stations would reduce the revenues of state utilities from HT industrial consumers like GPIL that would in turn lead to reduction in cross subsidy to the domestic and agricultural sector. With the trend of HT consumers setting up CPPs the problems of the SEBs in India would continue to worsen[14]. In fact, one of the major reasons SEBs introduced policies which discourage setting up captive power plants was the fact that their most profitable and regular paying customer had moved away from them in the past. In view of the dismal financial state of most SEBs in India, the SEBs were unwilling to give up the industrial segment and hence framed policies which did not encourage captive power plants. Such an

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[12] Power Trading, http://www.electricityindia.com/powertrading.html

[13] Captive Power Scenario in India, Infrastructure Development Action Plan for Chattisgarh-Final Report, http://chhattisgarh.nic.in/opportunities/Annexure%203.2.pdf

[14] ‘Problems and prospects of privatisation and regulation in India’s Power Sector’, Energy for sustainable development, Pg. 75, Volume III No. 6, March 1997, www.ieiglobal.org/ESDVol3No6/**india**.pdf -

approach (dissuading setting up of captive power plants by disallowing excess sale to the Grid/ third party, making it mandatory for industries to buy from the SEB, very high wheeling charges, etc.) was inhibiting the introduction of new energy efficient technologies such as the WHRBs in GPIL's case.

b. Besides, another concern as mentioned by Orissa Electricity Regulatory Commission in one of its orders was that the industrial consumers provide continuous high load factor and act as base loads during off peak hours for power plants feeding to the grid. Setting up of CPPs by HT consumers would affect the off peak operations of such thermal power plants[15]. This factor was also one of the reasons why SEBs in India dissuaded industrial consumers like GPIL from setting up their own CPP.

c. Further, in particular case of project proponent, it was made mandatory by the Madhya Pradesh Electricity Board (MPEB) in its communication (during the period 1999 - 2000) that GPIL should become an HT consumer first for setting up the CPP with a phase wise increase of contract demand up to 3500 kVA at the time of commissioning of plant[16]. Even till date GPIL has a contract demand of 3500 kVA . This implied that GPIL had to bear fixed demand charges on a continuous basis even though it was not interested in being connected to the grid and wheeling option was ruled out.

d. The permission to setup the CPP was given by CSEB in August 2001 on the condition that CPP would be run in isolation of Board's grid and for wheeling to its group companies, GPIL was again asked to apply separately. This caused further delay and cost overruns in project activity[17].

e. There were a number of complex issues such as transition risks, settlement of imbalances in power injected and drawals, effective metering, efficient pricing of transmission, management of congestion etc. on which the Board was to decide that led to additional delay. The permission to wheel power and to operate in parallel with state grid was

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15 'OERC Orders', Section 6.40.10.2 - http://www.wescoorissa.com/cinfo/a39.htm#6.37

16 Letters dated 26th Nov 1999 and 3rd Jan 2000 from Madhya Pradesh Electricity Board (Chattisgarh state was carved from Madhya Pradesh on Nov.1 2000)

17 Letter dated. 28th August 2001 from CSEB to M/s IGL.

provided only on 22nd April 2003 after the new Chattisgarh Government framed the policy for establishing CPPs on 27th January 2003[18].

f. Even for wheeling of power there were inadequacies of wheeling infrastructure facilities. Under the power wheeling agreement[2] with CSEB, GPIL had to bear all the expenses of connectivity for wheeling. The Board (CSEB) stated that it shall not be liable for any loss incurred due to failure in grid due to reasons of emergency.

g. According to the agreement, whenever there is an emergency in the Board power system and the Board is required to resort to load shedding, no separate consideration will be given to the CPP and the group companies. Board claimed that it shall not be liable for any loss or consequences arising therefrom. The load shedding from the Board is frequent in the area affecting the CPP operations as CPP operates in parallel with the grid.

The detailed correspondences between GPIL and MPEB/CSEB that highlights the obstacles of setting up of CPP and fixing of wheeling charges from project conceptualisation to final wheeling agreement are available with the project proponent which can be shown on request.

The above mentioned regulatory barriers were one of the major obstacles to project activity implementation. A new Electricity Act was enacted in India only in June 2003 making major changes in power generation and transmission (including open access) of power[19]. However, this was three years after the decision of the project proponent to invest in project activity and almost a year after the project started commercial operation. The level of impact of the Act is still quite limited and the constraints for enhancing the same are the relative lack of commercial awareness with SEBs, lack of proper market mechanism (absence of tariff structure to encourage trading of power), inadequate transmission capacity, lack of statutory provisions for direct sale by CPPs/ Licensees, grid indiscipline and financial viability of State Utilities.

[18] Letter dated. 11th Feb 2003 from CSEB to M/s IGL

[19] http://www.powermin.nic.in/JSP_SERVLETS/internal.jsp

2. Investment barrier(s)

The project activity had a high initial capital cost compared to no additional investment for the baseline option of import of electricity from the grid.
GPIL was conceived during 1999 to manufacture sponge iron using DRI kilns and also steel using the ibnduction furnaces. This period was a recessionary period for steel industry in India as the demand price of steel products were at an all time low & many secondary steel producers had already closed shops. The state run steel plants were registering heavy losses and a number of steel producing units were classed as Non – Performing Assets in the parlance of Banks & Financial Institutions. In view of this, Banks were not very willing to patronise any project in iron & steel sector.

It is in this backdrop the WHR project was formulated by GPIL. The promoters had full conviction in the revival of steel sector and they could convince at least one Bank, namely Canara Bank (an Indian Public Sector Bank) to lend support to this project. The Bank agreed to finance the project partly in consortium with one another Bank, but on the condition that promoters furnish a number of collateral securities and personal guarantees and borrow money at higher effective interest rate. The prevailing interest rate (Prime Lending Rate) of public sector banks during project inception stage was about 12 to 12.5%[20]. Typically, the lending rates by a bank for a project are based on the macroeconomic outlook for sector, the promoters' credentials, penetration of technology and regulatory risks. For GPIL's project activity the macroeconomic outlook for steel sector then was negative, promoters though experienced were not highly reputed, technological penetration of waste heat recovery based CPP was low (as shown in step 4 of section B3 of Tool for demonstration and assessment of Additionality) and the regulatory decisions were slow to come by. As a result of the above risks that it envisaged, the bank was partly funding GPIL at a higher lending rate of 14%.

Even after Canara Bank sanctioned the credit limits with higher interest rate for the project during the year 2000, it was exceedingly difficult to locate the second Bank. In the intervening period the project proponent had to stretch all resources at its command & resorted to high cost market borrowing for completing the project. Finally, in the March 2002, the other consortium bank i.e State Bank of India agreed to fund the remaining debt again at a minimum of 14.25% per annum. A significant time and cost over run were the corollary of such impediments for the WHR based CPP project.

With the goal of obtaining carbon revenues from the avoidance of grid-based greenhouse gas (GHG) emissions, GPIL management took the decision of taking the investment risks and secure financing partially from bank funding and partially through equity so as to invest in the CDM project activity after computing the proposed carbon financing. Besides the direct financing risk, GPIL is also shouldering the additional transaction costs such as preparing documents, supporting CDM initiatives and developing and maintaining M&V protocol to fulfil CDM requirements. GPIL is shouldering a significant market or financial risk and taking a pro-active approach by showing confidence in the Kyoto Protocol/CDM system.

3. Technological barriers:

The power generation from the waste heat recovery based system in GPIL is a function of availability flue gas at required temperature from sponge iron kiln. Any technical failure of sponge iron kiln and or inconsistent flow of flue gases from the kiln will directly affect the operation and electricity generation of power plant. GPIL had to overcome such barrier by streamlining the operation of the Sponge Iron Kiln with the power plant.

Hence, operation of the sponge iron kiln has to be monitored in order to keep co-ordination between the two units as well as to ensure the minimum availability of flue gas at required temperature to run the power plant efficiently and thereby meet the requirement of the manufacturing processes.

GPIL had to develop connectivity between the outlet of ABC attached to sponge iron kiln and the WHRB for efficient and effective utilization of heat content of the waste gases. It was to be ensured that no leakages took place through the pipeline system that could result in loss of energy into the atmosphere. The same is being monitored under project monitoring and verification plan.

The WHRB and the economiser are able to extract about 75% of the total sensible heat available of the flue gases. About 75,000 Nm^3/hr of flue gases is available at the boiler inlet at gas temperature of 950°C.

Further, for arresting SPM from the exhaust gas stream, project activity has installed Electro-Static Precipitator (ESP) instead of Venturi Scrubber to avoid handling of slurry and risk of ground water and soil pollution due to seepage from slurry storage space. ESP's are relatively 99% efficient. GPIL has achieved SPM reduction to the level of 126 mg/Nm^3 against the statutory limit of 150mg/ Nm^3.

[20] http://www.indiainfoline.com/infr/sebs/gseb/news.html

As mentioned earlier GPIL is the second organization among the 17 sponge iron plants in Chattisgarh, who undertook wheeling of power. Synchronization of a waste heat recovery based power project activity has its associated technical and operational risks which were discussed in the GPIL management meeting before the project activity received approval. GPIL undertook this operational risk so as to utilize the energy content of waste gases to maximum extent and minimize GHG emissions. The operational risks are detailed below.

(a) Special Problems with Paralleling Applications: As per the wheeling agreement, Board (i.e CSEB) has clearly stated that it shall not be held responsible for any damage, whatsoever, that may be caused to the generating sets or any other equipment installed in CPP on account of parallel operation with CSEB grid and CSEB shall not be responsible to pay any compensation for any such damage. The protection systems will have to be provided at the cost of company to ensure no damage is done due to paralleling of CPP. Relays at Board's substation would be tested at interval of six months and results would be furnished to the company. The repair/replacement/maintenance of such protection equipments shall be at the cost of company.

(b) Other Operational barrier(s)

Besides all these risks and barriers regarding grid connectivity and stand alone operations, the project activity had to face operational risks related to the waste gas generation and its heat content, which effect the successful implementation of the project activity.

- The non-availability of waste gases due to any technical fault in the kiln 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 & temp) may have substantial bearing in safe and sustained operation of assets like the power plant equipments.

  Quality of products of a number of processes in the industry like steel billets and sponge iron is 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.

- Moreover if the waste gas temperatures are greater than 1000^0C, the erosive nature of the waste gases increase manifolds and it would have a detrimental effect on the boiler tubes designed for waste gases between 950-1000^{o}C. The project activity has inbuilt controls to ensure the waste gas temperatures do not exceed 1000^{o}C, however in case of any failure of such controls the sponge iron kiln would have to be shut down immediately, or else it would cause damage to the boiler.

(c) Lack of relevant technical background

The Board (ie. CSEB) in its power purchase agreement had clearly stated that '*the Company (GPIL) should abide by grid discipline so as to not have any adverse effect on the Operation of Board's Grid System. In case of any violation in abiding with the grid discipline, the Board shall be free to isolate Company's power supply in grid system without any liability to the Board. Moreover, if the export meter records net import of reactive power then the same will be billed by the Board to GPIL at the rate of 0.27 per kVARH. This rate will be subject to changes from time to time*'.

As a result of the above mentioned critical factors, GPIL's management had to take a cautious decision of undertaking wheeling that involves supplying power to the grid. Energy generation is not a core business of potential users - the project participant belongs to the Hira Group of Industries which has never before taken up a power generation project. The Group is engaged mainly in the manufacturing sponge iron and steel billets. The waste heat recovery based power project is a steep diversification from the core business fields to power generation where the project proponent had to meet challenges of captive power policies, delivery/non-delivery of power, wheeling of power and techno-commercial problems associated with electricity boards. The facility had to invite external parties to implement the project activity. Skilled professionals had to be employed and the employees of GPIL were also required to develop expertise on design, construction and operation of heat recovery based power plant.

(d) Lack of infrastructure facilities for implementation of technology:

As mentioned earlier for wheeling of power there were inadequacies of infrastructure facilities. Under the power wheeling agreement with CSEB, GPIL had to bear all the expenses of connectivity for wheeling. GPIL had to setup the Siltara Grid Substation which is at a distance of 3km from the project site.

Moreover, as per the power purchase agreement, for proper and prompt co-ordination and efficient load management, the Board had envisaged to maintain a two way power line carrier communication (PLCC) link between CPP and substation at Siltara. This system would be provided at the cost of GPIL alone. Alternatively, the Board may provide any other suitable communication again at GPIL's cost. The Board stated that it shall not be liable for any loss incurred due to failure in grid due to reasons of emergency.

4. 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

The sponge-iron manufacturing sector belongs to steel industry sector with limited knowledge and exposure of complications associated with production of power. GPIL 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 GPIL 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 already considered in Step 3a).***

This is demonstrated in Table 2 of Section B.2 above. GPIL's project activity is a waste heat recovery based power project utilizing waste heat from sponge iron rotary kiln that uses coal as fuel. GPIL would not face any regulatory barrier in case it opted for import of power from grid since before project activity GPIL was connected to the grid for power and it still imports power from the grid on a continuous basis. In this scenario it would not face the investment barrier as no special investments are required to meet the demand. Finally GPIL would not face any technological barriers associated with generation and synchronization of waste heat based power. Therefore, it is most likely that in absence of the project activity GPIL would opt for the business-as-usual scenario, i.e. letting off the waste heat into the atmosphere and importing equivalent amount of electricity from state grid to cater to its 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 Chattisgarh State with similar socio economic, environment, geographic conditions and technological circumstances there were 17 similar plants (ie.sponge iron manufacturing units) operating when the project was in implementation stage (year 2002). Of the 17 plants only five plants (including GPIL) had set-up waste heat recovery based CPPs. Among them two plants (namely Prakash Industries Ltd. and Monnet Ispat Ltd.) generated power to meet their in-house consumption alone thus not undertaking additional risks associated with exporting/ wheeling power to grid. GPIL's project activity would be the third sponge iron plant in the state to set up WHR based CPP with a provision for feeding power to the grid.

These plants have been categorised as per Table 3 summarizing the common practices adopted by sponge iron manufacturing plants located in Chattisgarh state to meet their power requirements.

Table 3: Common Practise analysis

Alternatives	Description	No. of sponge iron plants
Scenario 1	Import of Power from Grid	12
Scenario 2	Waste heat recovery based CPP for in-house consumption	02
Similar Project Activity	Waste heat recovery based CPP feeding to grid (including GPIL)	03
Total no. of Sponge Iron plants in Chattisgarh		**17**

Source: GPIL and Sponge Iron Manufacturers Association (SIMA) of India

Step 4b: Discuss any similar options that are occurring

WHR based power generation feeding power to grid took place only at Jindal Steel and Power Limited (JSPL)[21] and HEG Ltd.[22] other than the project activity at GPIL. JSPL was exporting surplus power to the

[21] JSPL Annual Report 2001-02

state grid while HEG Ltd. wheeled the surplus to the company's graphite plant at Mandideep near Bhopal in Madhya Pradesh. This substantiates the fact that the project activity is not a widely observed and commonly carried out practice.

Thus GPIL is the second sponge iron plant that is undertaking wheeling of power in state of Chattisgarh.

Step 5: Impact of CDM registration

The project activity was started in July 2002 and was commissioned in Sept 2002. As mentioned in Step 4, GPIL was the second waste heat recovery power project in the state of Chattisgarh that was undertaking wheeling of power to other companies to maximize the waste heat recovery potential and minimize the GHG emission due to import of power. Though the Electricity Act 2003 (passed in the next year after commissioning) provided for freeing of license to generate captive power and enable wheeling, a number of regulatory/institutional problems are still being faced by project proponent on a continuous basis like paying monthly charges for the high Contract Demand to utility. Project activity getting registered as CDM project would give instant visibility among the state utilities power ministries/departments, environment ministries/departments of the local and global benefits of the project, enabling GPIL to face lesser governmental hurdles in future.

Due to associated risks mentioned in Step 3, banks were lending GPIL at a higher interest rate of 14%. Again, registering the project activity as CDM project would allow GPIL to make the project successful and sustainable which would lead to banks lowering interest rates for similar activities to other sponge iron industries located in the state. This would act as a precursor for other sponge iron industries in India to invest in waste heat recovery based power generation leading to additional reduction in GHG emission reduction overall.

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.

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[22] http://www.hegltd.com/heg_power.html

Apart from these, registration of the project under CDM would enhance the visibility and would aid CSEB in appreciating the GHG emission reduction efforts of the project proponent. This could lead to smoother wheeling transactions in future between the project proponent and utility. Further CDM fund will provide additional coverage to the risk due to regular and breakdown maintenance of WHR systems, failure of project activity due to shut down of plant and loss of production in GPIL.

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 Chattisgarh/India and without the proposed carbon financing for the project the GPIL 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 run 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:

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According to UNFCCC guidelines under simplified M&P for small scale CDM project, the project boundary is the physical, geographical site of the industrial facility, process or equipment that are affected by the project activities.

This CDM project covers the activities carried on for production of electricity at GPIL facility from their waste heat based CPP. The activities include recovery and utilization of waste flues gases of Sponge Iron kiln of GPIL after complete combustion, generation of steam, feeding of this steam to the common header of the CPP, generating power in turbo generator sets and finally with evacuation of power from the power plant. The produced electricity by CPP is used as in-house consumption of total facility and surplus power is wheeled to the group companies through state grid.

There is no auxiliary fuel used in the waste heat recovery steam generation system.

Hence, drawing boundary line across the periphery of the above mentioned activities (those components affected by project activities) should be the project boundary for this waste heat recovery based CPP. Figure 3 shows graphical representation of the physical boundary of this Project.

The boundary comprises of the WHRB unit, Economiser, Steam Turbine Generators (TG1 and TG2), ESP, and Ash Removal System.

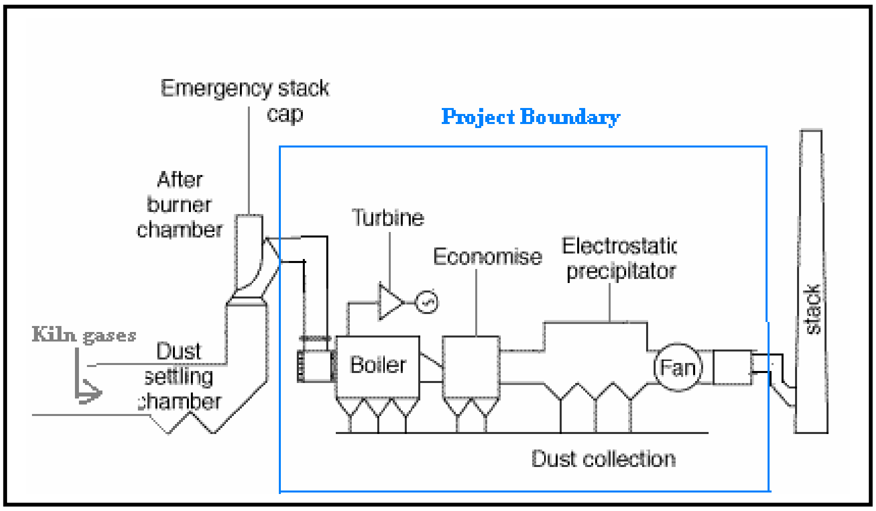

Figure 3: Project Boundary for GPIL's Waste Heat based Power Project.

The project boundary starts from supply of waste flue gas at the boiler inlet to the point of evacuation of power either to the GPIL facility itself or feeding surplus power to grid..

Further, for the purpose of calculation of baseline emission, CSEB grid has been considered within the system boundary. Estimation of baseline emissions has been done based on data and information available from CSEB and CEA sources as applicable.

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:

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As required by the Option 2 of ACM0004 methodology i.e. 'If baseline scenario is grid power imports', the Baseline Emission Factor (BEF) of displaced electricity is calculated as per ACM0002. The electricity system considered for the project was the state grid of CSEB. Net BEF was calculated accordingly for CSEB grid and found to be 0.943 kg CO_2/ kWh. Please refer to details in Annex 3 of this document for detailed calculations.

Date of completing the final draft of this baseline section *(DD/MM/YYYY)*: 24/08/2005

Name of person/entity determining the baseline: Experts and consultants of GPIL

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:

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July, 2002.[construction start date]

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

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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:

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C.2.1.2. Length of the first crediting period:

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C.2.2. Fixed crediting period:

C.2.2.1. Starting date DD/MM/YYYY:

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01/09/2002

C.2.2.2. Length:

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SECTION D. Application of a monitoring methodology and plan

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

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Title: Consolidated monitoring methodology for waste gas and/ or heat for power generation

Reference: Approved consolidated monitoring methodology ACM0004/ Version 01,
Sectoral Scope: 01, 8 July 2005[6]

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

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The monitoring plan has been prepared in accordance with in ACM0004.

The project activity being a waste heat recovery based power generation one, there are no/negligible project emissions generated during operation of the project activity.

The monitoring methodology will essentially aim at measuring and recording through devices, which will enable verification of the emission reductions achieved by the project activity that qualifies as Certified Emission Reductions (CERs). The generation of power units, auxiliary consumption, steam generation, steam characteristics [temperature and pressure], flue gas quantity and quality are the essential parameters to be monitored. The methods of monitoring adopted should also qualify as economical, transparent, accurate and reliable.

Applicability Criteria:

This methodology applies to project activities that generate electricity from waste heat or the combustion of waste gases in industrial facilities.

The methodology applies to electricity generation project activities

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

GPIL's project activity is a waste heat recovery based power project utilizing waste heat from sponge iron rotary kiln. The project activity displaces electricity of equivalent amount from CSEB grid having a generation mix of thermal (coal, gas) hydro and nuclear sources. Coal was used as fuel in the sponge iron kiln prior to project activity. The kiln will continue to use coal as fuel and no fuel switch is planned during the crediting period. The applicability criteria of ACM0004 meet the principle of the project activity and therefore the monitoring procedure for the project is developed as per that methodology.

Description of Monitoring Methodology

The methodology ACM004 requires monitoring of the following:

- *Net Electricity Generation from Project Activity* (MWh / year)– This is calculated as the difference of gross waste heat power generated for a year minus the auxiliary power consumption during that year. The project activity has employed state of the art monitoring 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 are calibrated and marked at regular interval to ensure accuracy. CSEB also monitors the quantum of electricity that is fed to grid from generator sets and hence the monitoring of the amount of power wheeled from the CSEB meters..

- *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 chosen 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 (www.cea.nic.in), Western Regional Electricity Board (www. wreb.gov.in) - a subsidiary of CEA and the Chattisgarh State Electricity Board (www.cseb-powerhub.com) sources. The government authorised agencies monitor power generated and supplied to state grid. The grid mix scenario through the entire crediting period will be based on records and reports with CEA and CSEB. CEA and CSEB monitor the performance of all power generation unit connected to its grid under their own monitoring schedule monthly/ annually. The state 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 State Grid 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 State 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, downstream to the project boundary, the project proponent does not have any control over the Transmission and Distribution (T&D) losses in state grid which may occur due to wheeling of power to the other Group companies. Within the GPIL facility, there is no or negligible amount of T&D losses of electricity distributed and hence neglected.

GHG Sources of the Project for Leakage Identification

Direct on-site emissions

There is no direct emission from the project activity as power is generated from the waste gas by utilizing its sensible heat component and without any change in chemical composition. The CO_2 content of the waste flue gas remain same through out the process and should be checked at the waste gas inlet and outlet of the boiler. The project extracts the heat energy form 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 25 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 theses emissions are outside the control of the project and hence excluded.

<u>Monitoring Plan Application – Please see Annex 4 for details</u>

For industrial energy efficiency project like GPIL - waste flue gas to steam to common header to electricity, it is important to monitor and verify the steam parameters and amount of electricity produced from turbo generator sets. To produce equal amount of electricity at the state grid, the grid would have used non-renewable resources like coal, oil, and natural gas, which would have led to GHG emission. Thus, the captive power produced substitute the State electricity supply and thereby reduces GHG emission, which would have occurred in absence of the project.

Electricity generation from waste flue gas is completed in two complementary steps: -

- Recovery of heat energy from waste flue gas from Sponge iron kiln after complete combustion in ABC
- Utilization of recovered heat to produce steam, which is fed to common header of the CPP and finally to turbo generator sets.

Electricity transferred after auxiliary consumption by the system is used for in-house consumption of GPIL facility and surplus power is wheeled to group companies through the State grid. The substituted electricity includes thermal, hydro and other renewable energy power plant. The actual – emission reductions generated by the project are estimated based on the thermal power share in the state grid. Therefore, monitoring plan should cover processes and procedures to conduct monitoring according to a schedule to record the actual measured figures as well as verified with the calculated figures of steam fed and electricity generated by the facility as well as the auxiliary consumption.

Monitoring for baseline emission calculation has also been included within the monitoring plan. For baseline emission factor data shall be collected from CSEB and CEA sources.

To monitor the actual amount of energy used and total electricity produced from project, flow meters and power meters are at specific points. Power meters are 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, in-house consumption and net electricity exported to the grid.

Flow rate of steam generated in the WHRB and fed to the two turbines, steam temperature and pressure would 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
1. Qi	Quantitative	Volume of auxiliary fuel used by project	Tonnes of m^3	Not applicable					
2. NCV_f	Quantitative	Net calorific Value of fuel	TJ per m^3						
3.EF_i	Quantitative	Carbon Emissions factor of fuel	tC/ TJ						

As per the methodology, project emission is applicable only if any treatment is given to waste gases for additional heat gain and as a result there is additional emission of CO_2 due to project activity. The additional heat gain can take place due to any of the two following reasons:

1. Auxiliary firing using other fuels in After Burning Chamber (ABC)
   There is no provision for auxiliary fuel firing in the ABC. Hence there are no project emissions due to auxiliary fuel firing in the ABC.
2. Improved Technology which results in improved combustion and additional heat gain:
   No technological up-gradation has been implemented in the ABC. Hence there are no associated project emissions.

Since project emissions in the project activity are almost negligible, no data need to be monitored for this purpose.

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
4. EG_{gen}	Quantitative	Total WHR Electricity Generated	MWh /year	Calculated[23]	Continuously	100%	Electronic/ paper	Credit Period + 2 years	MONITORING LOCATION: The data will be calculated after collecting data from meters at plant and DCS. Manager In-charge would be responsible for calibration of the meters See Annex 4 for details
5. EG_{aux}	Quantitative	Auxiliary consumption of Electricity from WHR sources	MWh /year	Calculated[24]	Continuously	100%	Electronic/paper	Credit period + 2 years	MONITORING LOCATION: The data will be calculated after collecting data from meters at plant and DCS. Manager In-charge would be responsible for regular calibration. See Annex 4 for details
6. EG_y	Quantitative	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.

[23] 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 (from where steam is finally fed to the turbo-generator sets) of the CPP.

[24] 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.

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
7. EF_y	Emission factor	CO2 emission factor of the grid	tCO2/ 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
8. $EF_{OM,y}$	Emission factor	CO2 operating margin emission factor of the grid	tCO2/ 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
9. $EF_{BM,y}$	Emission factor	CO2 Build Margin emission factor of the	tCO2/ 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

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
		grid								plants defined in the baseline methodology
10. $F_{i,j,y}$	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
11. $COEF_{i,k}$	Emission factor coefficient	CO2 emission coefficient of each fuel type and each power source/plant	tCO2/ t or m^3	Measured	Simple OM, BM	Yearly	100%	Electronic	During the crediting period and two years after	Country and region specific values are taken to calculate COEF
12. $GEN_{j,y}$	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 CSEB (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.

STEP 1. Calculate the Operating Margin emission factor

The Simple OM emission factor ($EF_{OM,simple,y}$) for CSEB 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 $F_{i,j,y}$ 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 (energy content) per mass or volume unit of a fuel i

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

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 CSEB. 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.

Considered calculations for the Build Margin emission factor $EF_{BM,y}$ is updated annually ex post for the year in which actual project generation and associated emissions reductions occur. The sample group m for the most recent year consists of the 16 power plants that have been built most recently, since it comprises of larger annual power generation.

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

The electricity baseline emission factor of CSEB, 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 due to waste heat (WHR) power in the grid (EG_y)

= (Electricity generated -Auxiliary Consumption) $_{WHR}$

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

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 due to WHR 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

Not applicable

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

>>

The leakage emissions due to project activity are emissions arising due to activities such as "power plant construction and associated activities" and "transportation of equipment to the site". As per the methodology these emissions may be considered as very negligible as compared to the baseline scenario and occur only during the setting up of the project infrastructure.

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.)

>>

CO_2 Emission Reduction Calculations				
Step 1	**:**	Baseline Emissions	-	Project Emissions

See 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., -2.	Low	Yes	It is a critical parameter that would affect the GHG reductions claims.
4.,-6.	Low	Yes	This data will be used for calculation of project electricity generation.
7.,-9.	Low	No	This data is calculated, so does not need QA procedures
10., - 12.	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 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:

>>
Experts and consultants of GPIL.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

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The project activity utilizes the heat content of the waste gas available from the Sponge Iron kiln Unit 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 CO2 / kWh)	Baseline Emissions (tonnes of CO_2)
1.	2002-2003 [Sept-Mar]	0.943	20627.7
2.	2003-2004	0.943	35099.1
3.	2004-2005	0.943	19703.8
4.	2005-2006	0.943	19703.8
5.	2006-2007	0.943	19703.8
6.	2007-2008	0.943	19703.8
7.	2008-2009	0.943	19703.8
8.	2009-2010	0.943	19703.8
9.	2010-2011	0.943	19703.8
10.	2011-2012	0.943	19703.8
11	2012-13 [Apr-Aug]	0.943	8209.9

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.	2002-2003 [Sept-Mar]	20627.7	0	20627.7
2.	2003-2004	35099.1	0	35099.1
3.	2004-2005	19703.8	0	19703.8
4.	2005-2006	19703.8	0	19703.8
5.	2006-2007	19703.8	0	19703.8
6.	2007-2008	19703.8	0	19703.8
7.	2008-2009	19703.8	0	19703.8
8.	2009-2010	19703.8	0	19703.8
9.	2010-2011	19703.8	0	19703.8
10.	2011-2012	19703.8	0	19703.8
11	2012-13 [Apr-Aug]	8209.9	0	8209.9

Total Estimated Emission Reductions: **221567 t CO2 equivalent** over the 10 year crediting period.

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

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Formulae have been provided in Section D. The table above in Section E.5 presents the values obtained applying the said formulae. For detailed estimation of baseline emission factor and emission reductions please refer to Appendix III for Details

SECTION F. Environmental impacts

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

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The emergence of the concept of sustainable development in the recent years has brought in the general realization that environmental issues are inexorably linked with development objectives and polices. Any project activity can cause impacts on environment either positive or negative depending on the type of the activity, throughout the project lifetime. Therefore, it is important to discuss such aspects. To predict the cause-condition-effect-relationship of the activities on the environment, the GPIL facility has conduct an Environmental Impact Assessment (EIA) study. EIA study helps in justifying a project's sustainability plus provides with mitigation and management plan to abet the negative impact and enhance the positive ones. Thus EIA study is obligatory under Indian government policy under the Environmental (Protection) Act 1986 promulgated a notification on 27 January 1994 (amended on 04/05/1994, 10/04/1997, 27/1/2000 and 13/12/2000). GPIL also submits Environmental Statement for every financial year by 31st September as per provision of Environmental Protection Rule 1989.

It should also be noted that the facility has been constructed in an industrial area where other types of industry also exist and thereby it is very difficult to account for the exact magnitude of the impacts due to operation of the project activity on the environment. Also, it is difficult to quantify all impacts, as some of them are intangible like social issues.

After conducting the EIA study it was found that the project returns benefits to the local, regional and global environment in various ways.

- Reduced additional GHG emission related to thermal power production, which includes a huge emission in percentage including carbon dioxide, sulphur dioxide, oxides of nitrogen, and particulate matter, which would have occurred in absence of this project in BAU case.

- Reduced adverse impacts related to air emission at coal mines, transportation of coal that would have been required to meet the additional capacity requirement of thermal power stations.

- It has also successfully conserved the non-renewable natural resource such as coal, oil and natural gas by reducing power demand by 21 MU annually on local grid.

- Project activity has also enable GPIL to save energy loss by utilizing waste heat energy of the flue gas of sponge iron kiln.

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:

>>

Please provide conclusions and all references to support documentation of an environmental impact assessment that has been undertaken in accordance with the procedures as required by the host Party.

The EIA study was conducted in two stages, viz. environmental status before and after the project development. Area within 10 km radius from centre of the project site was covered during the study. All environmental parameters observed during the study period before project commissioning was found to be well under permissible limits.

The activity from the project has caused impact in the following phases of project implementation:

⇒ During Construction Phase

⇒ During Operational Phase

⇒ During Maintenance Phase

<u>During Construction Phase</u>

The main area of concern during construction phase was: -

⇒ Air Environment- Air Pollution and Noise Pollution

⇒ Land Environment- Soil Pollution

⇒ Water Environment- Water Pollution

Taking into consideration the project life cycle, the magnitude of the impacts during construction phase is negligible and exists for a temporary period of time till the end of construction phase. Therefore, it does not affect the environment considerably.

During Operational and Maintenance Phase

Following facts about project activities, its impact on the environment, local, regional and global during operational and maintenance phase and structured Environmental Management Plan (EMP) has been noted as follows: -

Impact on Air Environment

➢ Ambient Air Quality

Project activity shows no negative impact on the ambient air quality of the project site. Analysis of data on air quality monitoring data after 24 hour indicates that the ground level concentration (GLC) of the air pollutants are well under permissible limits for industrial area, and has improved after implementation of Environment Management Plan (EMP) of GPIL envisages periodical monitoring and recording of the emission from the stack and at ground level within the premises once in every month on regular basis.

Fugitive emission in the work place is suppressed by occasional water sprinkling in and around the area. Bag filters with ducts, extraction fan and air vents of appropriate height has been install at transverse points to capture flue dust from the process. The plant and process area has been designed such a way that the work environment will have dust loading of 500µg/m3 at a distance of 8 to 10 meters from the process equipment, thereby maintaining safe work place.

➢ **Air Emission**

The CPP is utilizing the waste gas of the kiln generated at the rate of 75,000 Nm3/ hr, thereby by reducing air pollution that would have occurred in absence of WHRB. An effective stack height of 70 m is being maintained which is well above the required height as stipulated under Air (Pollution) Act, 1981 for power plants. Further, before dispersing flue gas into the environment, it is passed through ESP with a designed emission outlet of 100 mg/Nm^3. Recent monitoring data on stack emission shows 126mg/Nm^3 of SPM count against the legal requirement of 150 mg/Nm^3 issued by the state govt. There is no additional air emission from the project activity.

The Consent to Establish under Section 21 of Air (Prevention & Control of Pollution) Act, 1981 for augmentation of off-gas cleaning system and Consent to Operate under Air Act, 1981 were received before the commissioning of project.

- **Thermal Pollution**

In absence of the project activity there would have been considerable amount of thermal pollution in the vicinity or additional cooling system needed to be incorporated with Sponge Iron kiln. CPP primarily utilizes the heat content of the waste flue gas and thereby takes care of thermal pollution. The flue gas of temperature 950^{o}C enters the boiler system and comes out with the temperature at 200^{o} C. With reduction of temperature the corrosiveness of flue gas also reduces, thus protecting ESP from early wear and tear and increasing its lifetime. Work environment pollution due to thermal radiation is not significant.

Unit does not need to procure any material from outside the GPIL boundary thus benefiting the local as well as regional environment by reducing mobile emission.

- **Air Pollution during Maintenance Phase**

During the maintenance phase the CPP is cut-off from the line, the flue gas from ABC is diverted to the emergency stack connected to ABC. The flue gas is cooled at Gas Conditioning Tower before routing through the ESP and then discharged into the environment. The emission during maintenance phase is not considered as project emission as this would have any way occurred in absence of the project.

- **Noise Generation**

Noise contour monitoring was conducted in and around the site and surrounding villages and it was found that the noise levels are within the norms for industrial area. Some devices, which generate high dB noise during operation, have been provided with silencers to attenuate the high pitched noise. Signboards have been provided at all high noise zone for employee's notification to take personal protection before entering into the zone. A routine check up of noise level with Sound Pressure Level Meter is being followed.

Impact on Water Environment

CPP consumes about 2600 KL of water per day for cooling purposes. Out of this 96% is lost as evaporation loss and rest 4% is blow down water. The blow down water is utilized for plantation within the facility. Project is a zero discharge unit. The monitoring data generated with respect to quality of water indicates that most of the parameters monitored are well within limit.

The main sources of wastewater in GPIL facility as whole are DM Plant and blow down water of Cooling Tower. The wastewater outlet of the DM plant has been provided with acid linings to avoid corrosion and is neutralized before treatment. The treated DM Plant wastewater from the ETP is reutilized for sprinkling on pathways, fire fighting and green belt development. Therefore eliminating stress on the availability of fresh water in the region. The ETP monitoring data results shows that pH, BOD and COD levels (crucial parameters) are within the limits stipulated by state government.

Solid Waste Management

Slurry waste generation has been avoided by avoiding installation of Venturi Scrubber. Ash collected from the bottom of the hopper of ESPs is transported by dense phased pneumatic conveying system to Ash Silo equipped with bag filters to ensure clean air. The ash thus collected is then sold to Cement plants/ brick manufacturers on contract as a feed in their production process.

Safety Management

For ensuring safety of the workmen all moving parts of all machinery and exposed parts of machines has been provided with guards and hoods and all the surfaces likely to attain high temperatures would be dully insulated. The other important aspects of checking up and maintaining all the machineries properly and continuously have already been ensured by the facility. Maintenance personnel would undertake such responsibility. Production dose not involves generation, and handling of any hazardous by-products.

The facility has also developed Disaster Management Plan to handle crisis situations and its aftermath.

Ecology

There were no endangered species located in and around the plant area. Therefore, there needn't be any concern for loss of important germ-plasma that needs conservation.

Green Belt Development

Green Belt is another way of attenuating fugitive emission, noise pollution and thermal pollution. It also enhances aesthetic beauty of the surroundings. The efficiency of green belt in pollution abetment depends mainly on the width of green belt, height of trees, distance from source of pollutants. About 74681 sq. meter of area is maintained as Green Belt at the premises.

Social

The social status has improved due to increase in employment opportunities, income structure, transportation, medical facilities, housing and other ancillary business in the area.

Conclusion

The net impact under environmental pollution category is positive as all necessary and best abatement measures have been adopted and are periodically monitored. Overall positive impacts have been observed in land and aquatic environment. The human interest parameters will show encouraging positive impacts due to increased job opportunities at the facility as well as other ancillary unit coming up due to development of the place, transportation, medical facilities, housing, etc.

SECTION G. Stakeholders' comments

>>

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

>>

Identification of Stakeholders

GPIL facility has incorporated the Power Plant Division with objective to recover and utilize heat content of waste flue gas from its own Sponge Iron kiln and generate steam to produce electricity.

The stakeholders identified for the project are as under.

- Local Authority
- Local community at Silatara and Raipur
- Chattisgarh State Electricity Board (CSEB)
- Chattisgarh Electricity Regulatory Commission (CERC)
- Chattisgarh State Renewable Energy Development Agency (CSREDA)
- Chattisgarh Environment Conservation Board
- Environment Department, Govt. of Chattisgarh
- Ministry of Environment and Forest (MoEF), Govt. of India
- Ministry of Non-conventional Energy Sources (MNES)
- Ground water Department
- Non-Governmental Organizations (NGOs)
- Consultants
- Equipment Suppliers

Stakeholders list includes the government and non-government parties, which are involved in the project at various stages. GPIL has not only communicated with the relevant stakeholders under statutory obligations but also have engaged the other stakeholders in a proactive manner in expressing and accounting their opinions on the project.

G.2. Summary of the comments received:

>>

The village Panchayat / Local elected body of representatives administrating the local area is a true representative of the local population in a democracy like India. Hence, their comments / permission/views to set up and operate the project are very necessary.

The local community mainly comprises of the local people in and around the project area. The roles of the local people are as a beneficiary of the project. Their contribution includes local manpower working at the plant site. Since, the project will provide direct and indirect employment opportunities to local populace thus encouraging the project.

The project does not require any displacement of the local population. The project is located in a barren land of the industrial area. In addition to the above, the local population is also an indirect consumer of the power that is generated electricity from the power plant substitutes grid supply thus improves the power reliability and stability in the local electricity network. The installation of transmission lines does not create any inconvenience to the local population. Thus, it implies that the project will not cause any adverse social impacts on the local population but helps in improving the quality of life for them.

State Pollution Control Board and Environment Department of the Government of Chattisgarh have prescribed standards of environmental compliance and monitor the adherence to the standards. Water requirements of the project are met through deep tube wells. Study conducted to assess environmental impact suggests that the project is located in a plain terrain with gentle undulations here and there. The unit is a zero discharge unit.

Chhattisgarh State Renewable Energy Development Agency (CREDA) is one who implements policies in respect of non-conventional renewable power projects in the state of Chhattisgarh. CREDA has accorded its support for the project. Further, State's apex body of power is CSEB and they have already issued consent for the installation and operation of the waste heat based power plant of 7 MW capacity under section 44 of the Electricity (Supply) Act, 1948.

As a buyer (for wheeling) of the power, the CSEB is a major stakeholder in the project. They hold the key of the commercial success of the project. CSEB has already cleared the project and GPIL has signed the Power Wheeling Agreement with CSEB.

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

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 clearance, Wheeling of Power Agreement, local clearances *etc.* were considered while preparing the CDM Project Design Document.

The GPIL representative met with the local NGOs and apprised them about the project and sought their support for the project. As per UNFCCC requirement the PDD will be published at the validator's web site for public comments.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Godawari Power and Ispat Ltd.
Street/P.O.Box:	-
Building:	G-9, Hira Arcade,
City:	Pandari, Raipur
State/Region:	Chhattisgarh
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E-Mail:	lkp46@sify.com
URL:	-
Represented by:	
Title:	Executive Director
Salutation:	Mr.
Last Name:	Prasad
Middle Name:	
First Name:	L.
Department:	Raw Materials
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Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

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

Annex 3

BASELINE INFORMATION

DETERMINATION OF BASELINE EMISSIONS

For the project activity the baseline scenario was determined as import of power from grid as shown in Section B2 above. As per ACM0004 methodology, if the baseline scenario is grid power supply the Emission Factor for the displaced electricity is calculated as in 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

The Indian Power grid system is unique in itself. Under this system there are different load dispatch centers at state, regional and central levels. These load dispatch centres manage the flow of power in their jurisdiction. At present, the interregional flows of power are quite low. Hence, each region may be considered as an island due to which the power generated at each region is distributed in their jurisdiction only[25]. Furthermore as project generates only about 21 MU annually [excluding auxiliary consumption] which is comparatively very small in size, it is less likely to considerably affect any regional power scenario. Hence, the state grid, Chattisgarh State Electricity Board (CSEB) is the realistic grid representation w.r.t. the project activity. Also GPIL is connected to CSEB for the extra units required to satisfy their need in addition to the generation of their own CPP. In absence of the project the CSEB would have catered the total electricity requirement of GPIL facility (business-as-usual case). Hence, it can be concluded that CSEB grid is the most representative baseline system boundary for the project activity and would be considered for determination of the carbon intensity to arrive at the baseline emission factor for the project activity.

Chhattisgarh State Grid Scenario – the grid mix:

Strategically located in central India, Chhattisgarh has good connectivity for easy transmission to any of India's four grids. Chhattisgarh is in the chronically deficit western grid, and is linked to the southern and northern grids. A special high-tension line is being laid between Raipur and Rourkela, in the Eastern grid. Chhattisgarh has excellent power evacuation infrastructure. It can transport and sell power to deficit areas in any part of India.

[25] http://www.uppcl.org; *UPPCL Statistics at a Glance-March 2002 and other available UPPCL documents*

Each state has their own power generation plants (State Government owned) managed by respective State Electricity Boards / Corporations. The institutional structure of the power sector in Chhattisgarh is a single vertically integrated entity i.e. Chhattisgarh State Electricity Board (CSEB).

State of Chhattisgarh came in existence on 01.11.2002. State Government constituted separate State Electricity Board vide notification No. 18 & 22/E. Dept/2000 dated 12.11.2000. C.S.E.B. became functional w.e.f. 01.12.2000 and governs all the segments (Generation, Transmission and Distribution) of the state sector.

In addition to the state government owned power generation plants, there are privately owned power generation plants and central government (Government of India) owned power generation plants managed by Government of India Enterprises like National Thermal Power Corporation Ltd., Nuclear Power Corporation Ltd., *etc.* exporting power to CSEB. Power generated by all generation units is being fed to the grid (Western Grid), which is accessible to all states forming part of the western grid. The grid supply mix comprise of thermal, hydro, wind, renewable and nuclear.

Power generated by state owned generation units and privately owned generation units is consumed totally by respective states. But the power generated by central sector generation plants is shared by all states forming part of the grid in fixed proportion.

- *State's own generation*

CSEB is responsible for the operation and maintenance of all the power generating stations in the state. CSEB has 1,360 MW of installed capacity of which more than 85% is accounted for by thermal power (coal) and the balance is hydro power.

- *Central share to CSEB*

CSEB get power from central government owed power plants such as NTPC Korba, Vindyachal, (Coal Based); Kawas, Gandhar (Gas Based); Kakrapara (Nuclear based) with total share of 498 MW out of which thermal mix is of 475 MW and rest is nuclear of 23 MW. Thus thermal has a percentage share of about 95% out of the total share central share allocated for Chattisgarh.

- *Independent Power Plant (IPP)*

There are very few private power plants in the state contributing to the CSEB grid. Jindal Steel and Power Limited (JSPL) is the major private supplier to the State Grid. Power is sold from its 205MW captive based power plant that uses both coal (equivalent to 80%) and waste heat (remaining 20%) for power generation. A small amount of power is also supplied by private producers using renewable sources of energy (mainly rice husk based power plants)

B) Determination of the carbon intensity of the chosen grid

As per ACM0004 methodology, if the baseline scenario is grid power supply the Emission Factor for the displaced electricity is calculated as in ACM0002 baseline methodology. Complete analysis of the system boundary's electricity generation mix has been carried out for calculating the emission factor of CSEB as follows:

Combined Margin

The approved consolidated baseline methodology suggests that the 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 state grid mix) and the build margin (*i.e.* weighted average emissions of recent capacity additions) of the selected CSEB 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 project activity would have some effect on the Operating Margin (OM) of the Orissa State 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[26] 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.

To select the appropriate methodology for determining the Operating Margin emission factor ($EF_{OM,y}$) for the project activity, GPIL conducted a baseline study wherein the power generation data for all power sources in the project electricity system (i.e. CSEB) were collected from government/non-government organisations and authentic sources. The power generation mix of CSEB comprises of coal, gas, nuclear and hydro power generation as well as imports from other grids as shown in Table 4 below.

Table 4 - Power generation Mix of Chattisgarh for last five years

Energy Source	2000-01*	2001-02*	2002-03	2003-04	2004-05
Total Power Generation (MU)	7354.54	8159.69	11214.45	10881.85	11894.82
Total Low Cost Power Generation (MU)	215.38	403.25	821.84	625.96	1025.62
Total Thermal Power Generation (MU)	7139.16	7756.44	10392.61	10157.24	10358.39
Other Grids (MU)	-----	----	0.00	98.65	510.81
Low cost % of Total grid generation	2.92	4.94	7.33	5.75	8.62
Other Grid % of total	------	----	0.00	0.91	4.29
Thermal % of Total grid generation	97.07	95.05	92.67	93.34	87.09
Low Cost % of Total grid generation - Average of the three most recent years – 5.91%					

*Based on State generation figures only as information on Central share was not available for 1999-2000 and 2000 -2001. However, hydro power share for the state is usually accounted by the state generating plants itself which is represented for these years, hence there is no major change in low cost % of CSEB for the two years even if Central Share is accounted.

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

GPIL 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/MU) taking into consideration the present power generation mix excluding low cost must run hydro-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.

GPIL 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.

Table 5 shows the power generation mix of CSEB grid for 2002-03 under different jurisdiction such as State, Central and Private power plants respectively. The identified plants have been categorically differentiated on the basis of their fuel source used for generation.

Table 5: Power Generation Mix of CSEB grid from the Own Generating Stations and Purchase from Central and Private Generating Stations for 2002-03

Name of the Power Plant	Capacity Generation (MW)	OwnGeneration / Purchase MU s 2002-03
COAL		
Coal Based State (CSEB)		
Korba East II (4x40)	160	6858.22
Korba East III (2 x 120)	240	
Korba West (4 x 210)	840	
Subtotal State (Coal)	**1240**	**6858.22**
Coal Based (Central)		
NTPC – Korba TPP	308	2855.93
NTPC- Vindhyachal TPP	106	
Subtotal Central (Coal)	**414**	**2855.93**
Coal Based Private		
Jindal Steel and Power Ltd	110	410.89
Subtotal Private (Coal)	**110**	**410.89**
Total Coal Based Thermal Power Plants		**10125.04**
GAS		
Gas Based (Central)		
NTPC- Kawas Gas based Combined Cycle	33	215.29
NTPC-Jhanor-Gandhar Gas based Combined Cycle	28	52.28
Subtotal Central (Gas)	**61**	**267.57**
HYDRO		
Hydro State (CSEB)		
Hasdeo Bango (3x40)	120	276.48
Subtotal (HYDRO)	**120**	**276.48**
NUCLEAR		
Nuclear Central		
Kakrapara Atomic Power Station	23	290.00
Subtotal (Nuclear)	**23**	**290.00**
RENEWABLE ENERGY / WASTE HEAT POWER		
Jindal Steel and Power Ltd (Waste heat based CPP)	40	149.41
Others		105.95
Subtotal Renewable / Waste Heat Power		**255.36**
GRAND TOTAL		**11214.45**

Table 6 shows the power generation mix of CSEB grid for 2003-04 and 2004-05 under different jurisdiction such as State, Central and Private power plants respectively. The identified plants have been categorically differentiated on the basis of their fuel source used for generation. Power was also imported from other grids during this period that have been shown as a separate category.

Table 6: Power Generation Mix of CSEB grid from the Own Generating Stations and Purchase from other State, Central and Private Generating Stations for 2003-04 and 2004-05.

Name of the Power Plant	Own Generation / Purchase MUs 2003-04	Own Generation / Purchase MUs 2004-05
COAL		
Coal Based State (CSEB)		
Korba East II (4x40)	6868.09	7142.16
Korba East III (2 x 120)		
Korba West (4 x 210)		
Subtotal State (Coal)	**6868.09**	**7142.16**
Coal Based (Central)		
NTPC – Korba TPP	2655.73	2172.96
NTPC- Vindhyachal TPP		
Eastern Region – NTPC	0.00	93.44
Subtotal Central (Coal)	**2655.73**	**2266.40**
Coal Based Private		
Jindal Steel and Power Ltd (110 MW in 2003-04 increased to 165 MW in 2004-05)	434.24	767.05
Subtotal Private (Coal)	**434.24**	**767.05**
Total Coal Based Thermal Power Plants	**9958.06**	**10175.61**
GAS		
Gas Based (Central)		
NTPC- Kawas Gas based Combined Cycle	199.18	182.78
NTPC-Jhanor-Gandhar Gas based Combined Cycle	0.00	
Subtotal Central (Gas)	**199.18**	**182.78**
HYDRO		
Hydro State (CSEB)		
Hasdeo Bango (3x40)	298.94	375.12

Gangarel (2.5x10)	0.00	7.52
Hydro (Inter state)*		
Interstate Generating Station	0.00	262.74
Subtotal (HYDRO)	**298.94**	**644.64**
NUCLEAR		
Nuclear Central		
Kakrapara Atomic Power Station	147.00	169.15
Subtotal (Nuclear)	**147.00**	**169.15**
OTHER GRIDS		
WBPDC	70.98	59.85
GRIDCO	0.00	287.50
DVC	0.00	40.05
Gujarat SEB	0.00	9.43
Assam	0.00	4.13
Tripura	0.00	5.67
APTRANSCO	0.00	104.18
Delhi Transco Limited	27.67	0.00
Subtotal Other grids	**98.65**	**510.81**
RENEWABLE ENERGY / WASTE HEAT POWER		
Jindal Steel and Power Ltd (Waste heat based CPP)	157.91	185.95
Others	22.12	25.14
Subtotal Renewable / Waste Heat Power	**180.03**	**211.09**
GRAND TOTAL	**10881.85**	**11894.82**

** Since the exact source of Interstate Generating station (ISGS) is not known for 2004-05, the source of power available from ISGS is taken to be completely coming from hydro for conservative estimates*

Calculation of Operating Margin Emission Factor

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

Table 7: Calculation of Simple Operating Margin

Parameter	2002--03	2003-04	2004-05
Total generation (MU)	11214.45	10881.85	11894.82
Net generation excluding Hydro, Nuclear, CPP & RE plants (MU)	10392.61	10157.24	10358.39
% of generation by coal out of total gen.excl. Hydro, Nuclear & RE plants (MU)	10125.04	9958.06	10175.61
% of generation by gas out of total gen.exl. Hydro, Nuclear, & RE plants(MU)	267.57	199.18	182.78
Simple Operating Margin			
Fuel 1: Coal			
Avg. efficiency of power generation with coal as a fuel, %	36.310	36.570	36.570
Avg. calorific value of coal used, kCal/kg	4171.000	3820.000	3750.000
Estimated coal consumption, tonnes/yr	5749482.55	6130344.301	6381204.703
Emission factor for Coal (IPCC),tonne CO2/TJ	96.10	96.100	96.100
Oxidation factor of coal (IPCC standard value)	0.98	0.980	0.980
COEF of coal (tonneCO2/tonne of coal)	1.642	1.503	1.476
Fuel 2: Gas			
Avg. efficiency of power generation with gas as a fuel, %	45.00	45.000	45.000
Avg. calorific value of gas used, kCal/kg	10000.00	10000.000	10000.000
Estimated gas consumption, tonnes/yr	51135.60	38065.511	34931.289
Emission factor for Gas (as per standard IPCC value)	56.10	56.100	56.100
Oxidation factor of gas (IPCC standard value)	0.995	0.995	0.995
COEF of gas(tonneCO2/tonne of gas)	2.333	2.333	2.333
EF (OM Simple, excluding imports from other grids), tCO2/MU	919.646	916.133	917.075
EF (EREB) tCO2/MU	1190.000	1190.000	1180.000
EF (WREB) tCO2/MU	910.000	910.000	910.000
EF (SREB) tCO2/MU	770.000	760.000	740.000
EF (NREB) tCO2/MU	790.000	740.000	730.000
EF(North Eastern REB) tCO2/MU	380.000	390.000	390.000
EF (OM Simple), tCO2/MU	**919.646**	**917.553**	**924.268**
Average Simple OM, tCO2/MU	**920.489**		
Simple OM (kg CO2 / kWh)	**0.920**		

Step 2: Calculation of Build Margin

The project activity would have some effect on the Build Margin (BM) of the Chattisgarh State Electricity Board 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/MU) 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 MU) 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 MU) and that have been built most recently.

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

GPIL 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 MU) 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 GPIL project activity the sample group m consists of (b) the power plants capacity additions in the electricity system for 2004-05 that comprise 20% of the system generation (in MU) and that have been built most recently.

The following Table presents the key information and data used to determine the BM emission factor for the most recent year 2004-05.

Table 8: Most recent capacity additions in CSEB for 2004-05 that comprise minimum 20% of gross generation for that year.

Sl.No.	Year of addition	Generating Station / Purchasing grid	Source	Own Generation/Purchase for 2004-05 (MU)
1	2004	WREB	Grid	9.43
2	2004	Interstate generating Station	Hydro	262.74
3	2004	SREB	Grid	104.18
4	2004	ER-NTPC	Coal	93.44
5	2004	North Eastern REB	Grid	9.80
6	2004	Gangarel Hydro	Hydro	7.52
7	2004	JSPL expansion	Coal	255.68
8	2003	EREB	Grid	387.40
9	2001	JSPL expansion	Coal	255.68
10	2000	NTPC Vindhyachal UnitVIII	Coal	498.39
11	1999	NTPC Vindhyachal UnitVII	Coal	
12	1999	JSPL expansion	Coal	255.68
13	1995	Kakrapara Nuclear Unit II	Nuclear	84.575
14	1995	Hasdeo Bango Unit III	Hydro	250.08
15	1994	Hasdeo Bango Unit III	Hydro	
Total Generation Considered				**2474.599**
Gross Generation				**11894.820**
20% of Gross power available				**2378.964**
Coal based				**1358.874**
Gas Based				**0.000**
Hydro based				**520.340**
Nuclear Based				**84.575**
% of generation by coal out of total				**54.913**
% of generation by gas out of total				**0.000**
% of generation by hydro out of total				**21.027**
% of generation by nuclear out of total				**3.418**

Built Margin Emission Factor is calculated as shown in Table 9.

Table 9: Built Margin Emission Factor Calculation

Parameter	2004-05
Generation considered (MU)	2474.599
Power generation from coal (MU)	1358.874
Power generation from Gas (MU)	0.00
Fuel : Coal	
Avg. efficiency of power generation with coal as a fuel, %	36.570
Avg. calorific value of coal used in kCal/kg	3750.000
Estimated coal consumption, tons/yr	852163.523
Emission factor for Coal (IPCC),tonne CO2/TJ	96.100
Oxidation factor of coal (IPCC standard value)	0.980
COEF of coal (tonneCO2/ton of coal)	1.476
EF (excluding imports from other grids), tCO2/MU	925.540
EF (EREB) tCO2/MU	1180.000
EF (WREB) tCO2/MU	910.000
EF (SREB) tCO2/MU	740.000
EF (NREB) tCO2/MU	390.000
BM EF (tCO2 / MU) **BM EF (kg CO2 / kWh)**	**965.041** **0.965**

Step 3: Combined Margin

Therefore the NET BASELINE EMISSION FACTOR as per COMBINED MARGIN (OM + BM)/2 = 0.943 kg CO_2/kWh

C) Leakages

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. Waste heat energy of flue gas available from Sponge Iron kiln of GPIL facility situated beside the project unit is utilized. Other infrastructure requirements for the project are also met from the GPIL facility.

D) Baseline Emission

In absence of the project activity there will be emission as per the carbon intensity of the grid (0.943 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 221567 tonnes of CO_2 in the entire 10 year crediting period.

Data Source for grid emission factor calculation :

- Generation Figures: CEA General Review (2002-03 and 2003-04), WREB Annual Report (2004-05) and CSEB (www.cseb-powerhub.com)
- Regional Grid Emission Factor : MNES baseline data
- Avg. Coal Calorific Value – CEA General Review (2002-03 and 2003-04) and CEA Report on Fuels - http://cea.nic.in/Rep_fuels_gen.pdf (2004-05)
- Efficiency Value of Coal based Thermal Power Plants from Regional Design Heat Rate Values for 2002-03 and 2003-04. For 2004-05 the conservative value of previous years is considered.
- Efficiency of Combined Cycle Gas Based Power Plants: http://www.cercind.org/pet22002407.html
- IPCC 1996 Revised Guidelines and the IPCC Good Practice Guidance
- JSPL Annual Report 2002-03 and 2003-04 and Financial results 2004-05 www.jindalsteelpower.com

Detail Calculation in CER Calculation Sheet is given in Appendix III

Annex 4

MONITORING PLAN

Introduction: GPIL's 18 MW Captive Power Plant consists of a 30 TPH Waste Heat Recovery Boiler that utilizes waste heat from sponge iron kilns as energy source, a 70 TPH Fluidised Bed Combustion (FBC) Boiler that uses coal rejects (coal char and coal fines) from sponge iron process as fuel, a common steam header and 2 x 10 MW turbo generator (TG) sets as shown in Fig.4 below. WHRB was installed by GPIL to improve the energy efficiency of the production process and FBC was installed to avoid the pollution problems associated with disposal of coal rejects as required by pollution control norms. The WHRB was commissioned in September 2002 along with the TG sets and FBC boiler was commissioned later in September 2003.

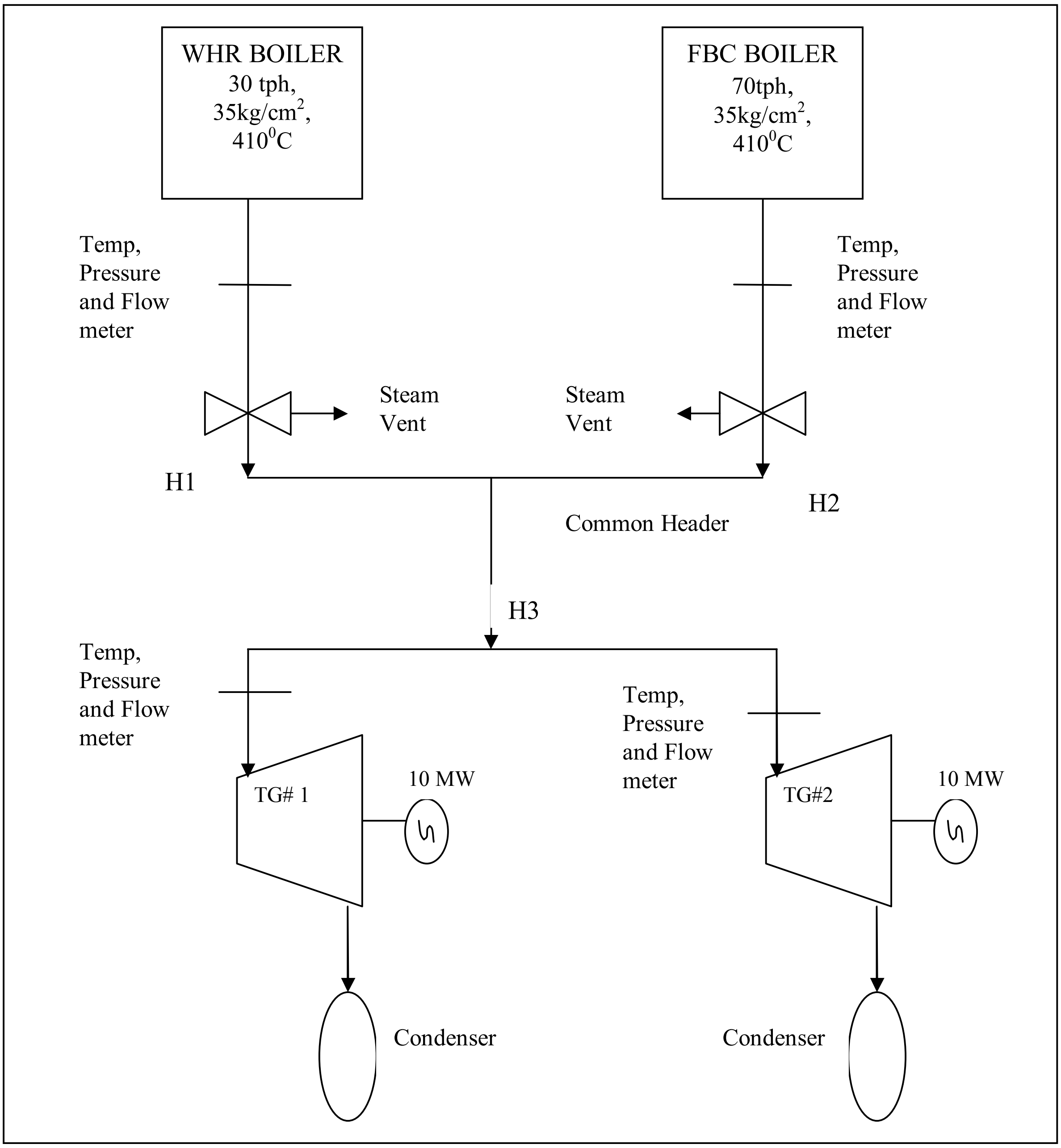

Fig 4 ; Schematic Diagram of GPIL's CPP

The Steam parameters of pressure and temperature from both WHR and FBC boilers are the same i.e. 35 kg/cm^2 and 410^{0}C. The working parameters of various equipments and location of Steam Flow meters, pressure and temperature gauges are as indicated in the figure. 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.

1. Vent Steam: To maintain the design pressure (35kg/cm^2) in the common header, some quantity of steam generated from both WHR and FBC is vented (or dumped) out intermittently.

Vent position is after the location of flow meters in the steam mains pipes from boilers (see figure). Since the quantity of vent steam from respective boilers is not measured in the site, to arrive at a conservative estimate for project purpose it is assumed to be entirely coming from WHR boiler alone (most conservative estimate). The total vent steam is calculated as the difference of total steam generated (from both WHR and FBC) and the total steam consumed in the TG sets. The total vent steam quantity in tonnes per day is subtracted from WHR steam to get the value of **Effective WHR steam.**

i.e S_{vent} = (Total steam generated in both WHR and FBC) – (Total Steam Consumed in TG#1 and TG#2)

2. 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 Effective 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:

Total Enthalpy of Steam from WHRB in kCal (H_1)

= (Enthalpy of steam at boiler outlet in kCal/kg) x (Effective 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 Effective WHR steam flow per day is calculated as mentioned in section 1 of Annexe 4 above.

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 outlet steam flow meter.

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

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

Again, if Auxiliary Consumption for the CPP per day is $EG_{AUX\ CPP}$ (in MWh), then WHRB Auxiliary Consumption (EG_{AUX}) will also 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)

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

Table A4(1) – Calculation of Effective WHR steam flow per day									
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. Sgen	Quantitative	Total Steam generated from both WHR and FBC boiler	tonnes per day	Online measurement	Daily	100%	Electronic/ paper	Credit Period + 2 years	MONITORING LOCATION: The data will be monitored from flow meters at plant and DCS. Manager In-charge would be responsible for calibration of the meters
2. S cons.	Quantitative	Total Steam Consumed by both TG # 1 and TG # 2.	tonnes per day	Online measurement	Daily	100%	Electronic/paper	Credit period + 2 years	MONITORING LOCATION: The data will be monitored from flow meters at plant and DCS. Manager In-charge would be responsible for regular calibration
3. Svent	Quantitative	Total Steam vented in the CPP	tonnes	Calculated (Sgen – Scons)	Daily	100%	Electronic/ paper	Credit period + 2 years	Calculated on a daily basis
4. S_{WHR}	Quantitative	Flow of WHR Steam from 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. S_1	Quantitative	Effective WHR Steam	tonnes per dayr	Calculated (S_{WHR} –Svent)	Daily	100%	Electronic/paper	Credit Period + 2 years	Calculated on a daily basis

Table A4(2) – Total Enthalpy from Effective WHR 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
6. T_1	Quantitative	Avg. Temperature of WHR 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_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
8. h_1	Quantitative	Enthalpy	kCal/kg	Calculated	Daily	100%	Electronic/ paper	Credit period + 2 years	Calculated from Steam tables/ Mollier Diagram
9. S_1	Quantitative	Flow of Effective WHR Steam from Common header	tonnes per day	Calculated	Daily	100%	Electronic /paper	Credit period + 2 years	As per Table A4(1)
10. H_1	Quantitative	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 A4(3) – 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
11. T_2	Quantitative	Avg. Temperature of WHR 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
12. P_2	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
13. h_2	Quantitative	Enthalpy	kCal/kg	Calculated	Daily	100%	Electronic/ paper	Credit period + 2 years	Calculated from Steam tables/ Mollier Diagram
14. S_2	Quantitative	Flow of Steam from 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
15. H_2	Quantitative	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 A4(4) – 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
16. $EG_{GEN\ CPP}$	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
17 $EG_{AUX\ CPP}$	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
18. EG_{GEN}	Quantitative	Waste Heat Recovery Based Power	MWh /day	Calculated	Continuously	100%	Electronic/paper	Credit period + 2 years	Calculated based on the ratio of Enthalpy values in Table A4(2) and A4(3) as H1/ (H1+H2)
19. EG_{AUX}	Quantitative	Auxiliary Electric Consumption	MWh /day	Calculated	Continuously	100%	Electronic/ paper	Credit period + 2 years	Calculated based on the ratio of Enthalpy values in Table A4(2) and A4(3) as H1/ (H1+H2)

Table A4(5) 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	It is a critical parameter that would used to calculate the net / effective WHR steam
6 - 10	Low	Yes	This data will be used for calculation of WHR steam parameters.
11 - 15	Low	Yes	This data will be used for calculation of FBC steam parameters.
16.,- 19.	Low	Yes	This data is used for calculating power contributed from waste heat recovery steam generation system of the CPP.

Appendix I: Abbreviations

GPIL	Godawari Power and Ispat Limited.
IGL	Ispat Godawari Limited. The name of the company has been changed from Ispat Godawari Limited to Godawari Power and Ispat Limited with effect from 20th June 2005.
WHRSGS	Waste Heat Recovery Steam Generation System
T&D	Transmission and Distribution
SID	Sponge Iron Division
MU	Million Units
KV	Kilo Volt
Km	Kilometer
GWh	Giga Watt-hour
CM	Combined Margin
ABC	After Burning Chamber
BAU	Business as Usual
^{o}C	Degree Celsius
CDM	Clean Development Mechanism
CECB	Chattisgarh Environment Conservation Board
CER	Certified Emission Reduction
Cm	Centimeter
CO	Carbon Mono-oxide
CO_2	Carbon di-oxide
CP	Crediting period
CPCB	Central Pollution Control Board
CPP	Captive Power Plant
CREDA	Chattisgarh Renewable Energy Development Agency
CSEB	Chattisgarh State Electricity Board
CSERC	Chattisgarh State Electricity Regulatory Commission
DCS	Distributed Control System
DM	De-mineralised
DPR	Detailed Project Report
DRI	Direct Reduction Iron
EB	Executive Board
EF	Emission Factor
EIA	Environmental Impact Assessment
Equ	Equivalent
ESP	Electro Static Precipitator
EREB	Eastern Regional Electricity Board
GHG	Greenhouse Gas
GWh	Giga watt-hour

IEA	International Energy Agency
IPCC	Inter Governmental Panel on Climate change
Kg	Kilogram
KP	Kyoto Protocol
kVA	Kilo Volt Ampere
kVARH	kilo Volt Ampere Reactive Hour
KW	Kilo-watt
kWh	Kilo-watt hour
M&P	Modalities and Procedures
M&V	Monitoring and Verification
MNES	Ministry of Non-conventional Energy Sources
MU	Million Units (1 MU = 1 Million kWh)
MVA	Million Volt Ampere
MW	Mega-watt
MWh	Mega-watt hour
NGO	Non-governmental Organization
Nm^3	Normal meter cube
NOx	Oxides of Nitrogen
NREB	Northern Regional Electricity Board
NEREB	North Eastern Regional Electricity Board
OECD	Organization for Economic Co-operation and Development
PDD	Project Design Document
SEB	State Electricity Board
SI	Sponge Iron
SIMA	Sponge Iron Manufacturers Association (India)
Sox	Oxides of Sulphur
SPM	Suspended Particulate Matter
SREB	Southern Regional Electricity Board
STG	Steam Turbine Generator
Tph	Tonnes per hour
UNFCCC	United Nations Framework Convention on Climate Change
WHRB	Waste Heat Recovery Boiler
WREB	Western Regional Electricity Board

Appendix II: List of References

Sl. No.	Particulars of the references
1.	Kyoto Protocol to the United Nations Framework Convention on Climate Change
2.	Website of United Nations Framework Convention on Climate Change (UNFCCC), **http://unfccc.int**
3.	UNFCCC Decision 17/CP.7: Modalities and procedures for a clean development mechanism as defined in article 12 of the Kyoto Protocol.
4.	UNFCCC, Clean Development Mechanism Simplified Project Design Document For Small Scale Project Activities (SSC-PDD) *[Version 01 : 21 January, 2003]*
5.	UNFCCC document: Annex B to attachment 3 Indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories *[Version 02: 2 December, 2003]*
6	Practical Baseline Recommendations for Green House Gas Mitigation Projects in the Electric Power Sector, OECD and IEA Information
7	Various project related information / documents / data received from Godawari Power and Ispat Ltd.
8	EIA report of GPIL
9	Website of Central Electricity Authority (CEA), Ministry of Power, Govt. of India -**www.cea.nic.in**
10	Website of Ministry of Power (MoP), Govt. of India: **www.powermin.nic.in**
11	A paper on Anthropogenic Emissions from Energy Activities in India: Generation and Source Characterisation by Moti L. Mittal and C. Sharma.
12	Website of Indian Renewable Energy Development Agency (IREDA), **www.ireda.nic.in**
13	www.infraline.com
14	Website of Sponge Iron Manufacturers' Association (SIMA): http://www.simaindia.org/
15	SIMA Members' List
16	http://www.cseb-powerhub.com/
17	http://www.chattisgarh.nic.in/opportunities/Power/
18	http://www.osc.edu/research/pcrm/emissions/
19	Power Trading, http://www.electricityindia.com/powertrading.html
20	Problems and prospects of privatisation and regulation in India's Power Sector', Energy for sustainable development, Pg. 75, Volume III No. 6, March 1997, www.ieiglobal.org/ESDVol3No6/india.pdf -
21	'Captive Power Plants- Case study of Gujarat India' Source : http://iis-db.stanford.edu/pubs/20454/wp22_cpp_5mar04.pdf

Sl. No.	Particulars of the references
22	Electricity Act 2003, Ministry of Power , Govt. of India http://www.powermin.nic.in/JSP_SERVLETS/internal.jsp
23	Jindal Steel and Power : www.jindalsteelpower.com
24	WREB Annual Report 2004-05 : http://www.wreb.gov.in/anrpt0405.pdf
25	JSPL power plants commissioning dates: http://steelworld.com/cffeb02.htm
26	Prime Lending Rate during 2000-01: http://www.indiainfoline.com/infr/sebs/gseb/news.html

Appendix III: Baseline and CER calculations

The calculation sheet is enclosed along with this document

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