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

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Annexes

Appendices

A. General description of project activity

A.1 Title of the project activity:

Waste heat recovery based captive power generation at Chhattisgarh Electricity Company Limited

Version: 01

Date: 20th October 2005

A.2. Description of the project activity:

Background

Chhattisgarh Electricity Company Limited (CECL), incorporated on 23rd January 1998, is a public limited company. The company has put up a Captive Power Plant (CPP) and a Ferro Alloy Plant (FAP) at Siltara Industrial Growth Centre, Raipur, Chattisgarh. Both the plants have started commercial operation from July 2001. The power plant has been put up with a view to meet the in-house power requirement of CECL and Raipur Alloys & Steel Ltd. (RASL), one of the promoting companies.

The project activity involves the phase wise installation of a Carbon Monoxide (CO)-laden flue gas fired boiler utilizing the chemical energy from flue gas of CECL's FAP and four Waste Heat Recovery Boilers (WHRBs) utilizing the sensible heat of waste flue gases from the rotary kilns of the Sponge Iron (SI) plant of RASL. The steam thus produced from the waste heat boilers will be fed to the CPP turbines of CECL for generating power to meet the power requirement of CECL and RASL. The power generated from waste heat will substitute coal consumption in the existing Fluidized Bed Combustion (FBC) boilers of the plant.

The project is being executed in phases starting from July 2002 and will be completed by April 2007. CECL is the main promoter of this project.

Purpose and Salient features of the Project Activity

The project activity primarily aims at reducing Greenhouse Gas (GHG) emissions through substitution of coal as fuel by utilizing the waste flue gases from process operations. The captive power plant (CPP) of CECL has been running on steam from coal fired FBC boilers for power generation.

In the non-project scenario, the flue gases would have been discharged to the atmosphere and the entire power demand of the plant of RASL and CECL would have been met by running the CPP based on coal based FBC boilers only. However, with the implementation of the project activity there is a partial substitution of coal for power generation and hence an equivalent amount of GHG emission reduction. .

The project activity started in the year 2002 with a phased plan to implement CO gas fired and Waste Heat Recovery based boiler systems at existing CPP. CECL has planned to set up five boilers of different steam generation capacities totaling to 140.9 TPH (mentioned in Table A.1 below).

Table A.1 – Phase-wise Implementation Details of the Project Activity:

PHASES	Process flue gas source	BOILER	IMPLEMENT-ATION DATE
PHASE I	2 x 100TPD sponge iron kilns	2x 9 TPH WHR boiler	July 2002
PHASE II	4 x 9MVA FAP furnaces	16.5 TPH CO fired boiler	February 2004
PHASE III	1 x 500TPD sponge iron kiln	53.2 TPH WHR Boiler	January 2005
PHASE IV	1 x 500TPD sponge iron kiln	53.2 TPH WHR boiler	April 2007

The project proposes to generate a total of 25 MW from waste heat (equivalent to 133632MWh/annum) and hence directly reduce around 134471.55 tonnes of CO_2 equivalent emissions per annum.

Contribution of the project activity to Sustainable Development:

The project leads to sustainable growth through conservation of non-renewable and polluting fuel resource (coal) by switching to waste heat recovery from flue gases. The project activity will be a pioneering effort on part of the promoter, and uplift the quality of life of local people by inflow of funds, technological and managerial capacity building, and over and above enhancing the energy efficient and eco-friendly functioning of the proponent company.

A very important part is sustainable growth of two different companies RASL and CECL whose business processes are not the same. The project brings in energy efficiency in both the SI manufacturing plant of RASL and the FAP of CECL by utilizing heat energy content in process flue gases and converting this heat energy into electrical energy for captive consumption by the two plants.

The following paragraph illustrates briefly the different aspects of sustainability being addressed by the project activity and its various activities for positive environmental development.

Socio-economic well-being – Introduction of a modern technology, associated inflow of funds and both technological and managerial capacity building will have a positive effect on the well-being of local people involved in the project. The project apart from employment generation will create a business opportunity for local stakeholders such as bankers, consultants, suppliers, manufacturers, contractors etc. Project activity will require skill development of the plant personnel in operation and maintenance of the associated technology. Such eco-friendly endeavors will reach out to the common people and encourage other similar industries to explore such possibilities.

Environmental development – By substituting coal the vehicular emission associated with transportation of coal from mining area of Korba to project site for plant operations will be reduced. Reduction in CO_2 emissions associated with coal combustion is the obvious benefit. Moreover, this is a positive step towards conservation of the fossil fuel resources. The project activity would also lead to reduction in air pollution occurring from coal mining. Positive benefits to the local environment will occur from reduction of thermal pollution by using the heat energy of the waste flue gases from SI Kilns and Ferro Alloy arc furnaces.

Technological benefits – The technology behind CO-laden FAP flue gas fired boiler and waste heat recovery boiler will result in energy efficiency and make the industry self-reliant. This is a technology that helps industries to utilize their own waste gases and avoids energy loss in the form of heat. The successful running of the project activity will help other similar industries replicate this technology.

A.3. Project participants:

Name of the Party involved ((host) indicates a host party)	Private and/or public entity(ies) Project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Government of India, Ministry of Environment and Forests (MoEF)	Chhattisgarh Electricity Company Limited	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

India

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

State: **Chhattisgarh**

A.4.1.3. City/Town/Community etc:

City: **Raipur**

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

CECL is located in the industrial growth center in in Siltara, Raipur district of the state Chhattisgarh, India (see Fig 1 below). Chattisgarh state is abundant in coal and minerals. The location of CECL plant has been selected considering aspects like proximity to iron ore and coal mines, its group company RASL (for importing steam and transmission of power), availability of water and other infrastructure.

CECL has total land of 37 acres under its jurisdiction. Geographically the site is located between 210^o 22’ North Latitude and 810^o 41’ East Longitude, and 298 meters above the mean sea level. It is just 16 km away from Raipur, the capital city of Chhattisgarh state. Raipur city is well connected by road, rail and air network.

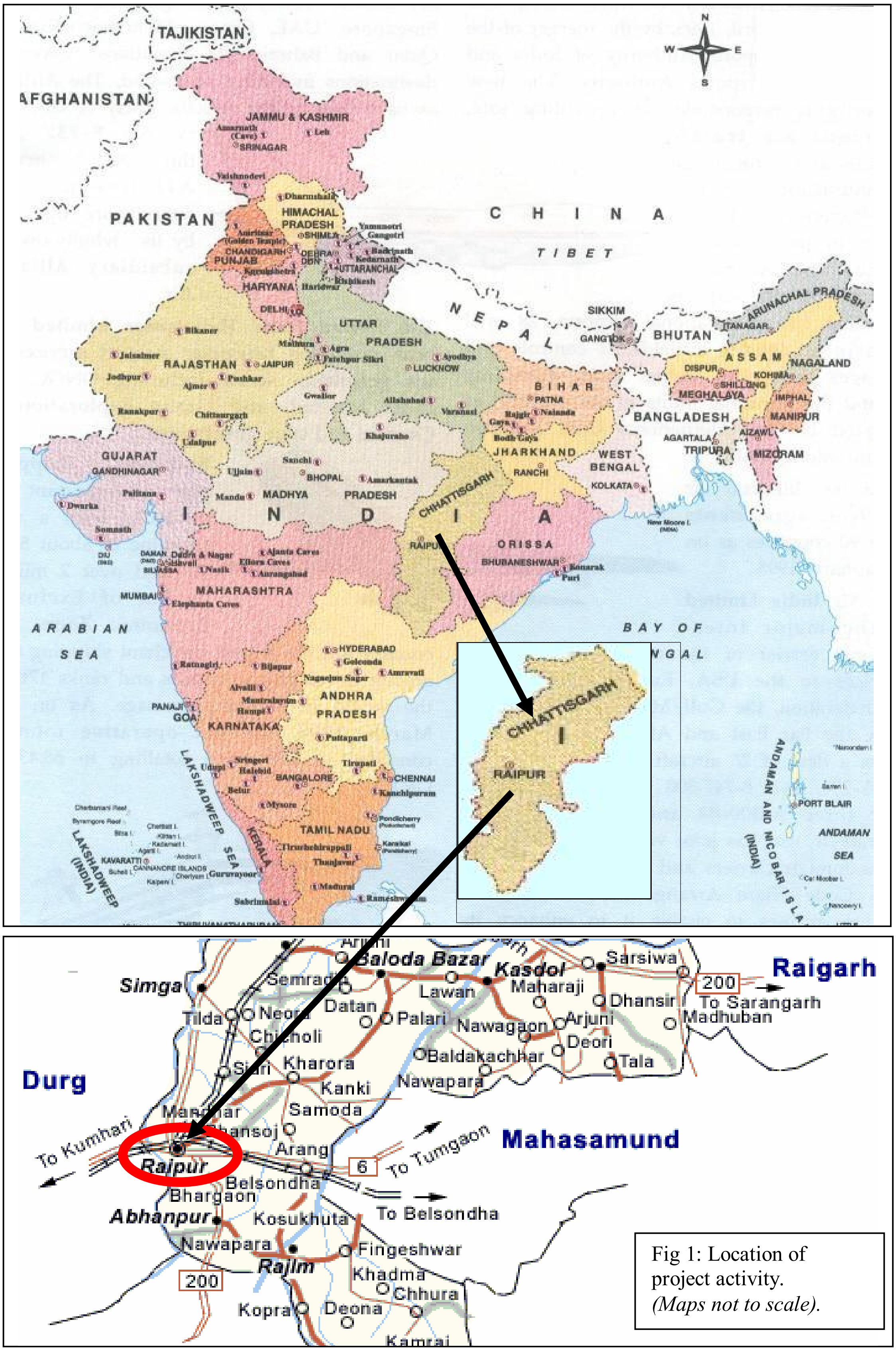

Fig 1: Location of project activity. *(Maps not to scale).*

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

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

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

The technology involved in utilization of waste flue gas involves two components: -

- Utilization of waste heat energy of flue gas from Sponge Iron kilns of RASL
- Utilization of combustion heat energy of CO-laden flue gas from submerged arc Ferro Alloy furnaces of CECL

Utilization of waste flue gas from Sponge Iron kilns: -

The waste flue gases of the DRI Kilns of RASL are received at the boiler inlet after passing through the After Burning Chamber (ABC). The WHRBs utilize the sensible heat component of the same for generation of steam, through mechanisms of heat transfer. A total number of four WHRBs for four kilns of capacity will be installed under the project activity to generate 124.4 TPH. (Refer to the table A.2 below for technical specifications of all the WHRBs).

Utilization of waste flue gas from submerged arc furnaces of Ferro Alloy Plant

The utilization of waste heat energy follows a different principle. The FAP flue gases from 4 existing submerged arc furnaces [9 MVA each], contain a high percentage of CO [64% v/v] which in absence of the project activity, would get combusted at the point of release to atmosphere through stack to meet the pollution control norms.

In the project case, this flue gas is passed through the boiler to make use of the heat of combustion of CO. LDO is used in the process as auxiliary fuel. There is one FAP flue gas fired boiler of 16.5 TPH capacity implemented under the project activity steam generation capacity. [Refer to Table A.2 for technical specifications of all flue gas fired boilers].

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

Table A. 2 Details of technical parameters of the boilers to be installed under the project activity

Flue gas Source	Quantity of flue gas available Nm^3/hr	Steam Generation capacity (TPH)	Pressure kg/cm^2	Temperature ^oC
2 nos. 100 TPD Sponge Iron Kilns of RASL	2 x 20000	2 x 9	64	500
4 nos. 9 MVA submerged arc ferro alloy furnaces of CECL	5400	1 x 16.5	64	500
2 nos. 500 TPD SI Kiln of RASL	2 x 125000	2 x 53.2	64	500

Steam generated from these boilers will be fed to two 25 MW steam turbines with pressure and temperature configuration of $59.7kg/cm^2$ and 482^oC of the CPP. Combustion gases after maximum heat transfer in the boiler leads to the exhaust stack through the Electrostatic precipitator. Other auxiliary systems required for waste heat power plant include boiler feed pump, circulating cooling water system, DM Plant, Instrument air compressor system, Induced draft fan, etc.

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:

The proposed CDM project would utilize available waste heat energy of process flue gas for power generation in the CPP and hence reduce the CO_2 emissions that would have generated from a coal based power plant in its absence.

The statutory obligations in Chattisgarh and India do not require sponge iron plants and FAPs to utilize the heat content of the waste flue gases from the respective processes, in generation of electricity for captive consumption. The project proponent will implement such a project not out of legal obligations but as voluntary action towards a more eco-friendly operation and achievement of energy efficiency in its facility.

In the non project scenario, flue gas from RASL's sponge iron plant was passed through the afterburning chamber (ABC) and discharged through the stack to the atmosphere. Additionally, in this scenario, the flue gas from CECL's FAP arc furnaces which have a high CO content of 64% v/v was also flared and discharged to atmosphere.

After implementation of the project activity, the sensible heat of sponge iron kiln flue gas will be recovered through mechanisms of heat transfer in WHRBs installed and chemical heat of FAP furnace flue gas will be recovered through combustion in CO fired boiler. The steam from the WHRBs and the

FAP flue gas fired boilers will be fed to the STG set for generation of electricity. Hence, the CO_2 emission reductions correspond to the equivalent CO_2 emissions due to the generation of same quantum of electricity through the steam produced from coal fired FBC boilers. There will be no additional GHG (CO_2) emissions from the utilization of process flue gases in the respective boilers as the emissions will be the same as in case of the non-project scenario. The only emissions inside project activity will occur from the use of LDO as auxiliary fuel in FAP flue gas fired boilers, which have to be deducted to arrive at net CO_2 emission reductions.

Thus the proposed project activity will result in GHG (CO_2) emission reductions that would not occur in the absence of it.

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

Operating Years	CO_2 Emission Reductions (tones of CO_2)
2007-08	134471.55
2008-09	134471.55
2009-10	134471.55
2010-11	134471.55
2011-12	134471.55
2012-13	134471.55
2013-14	134471.55
2014-15	134471.55
2015-16	134471.55
2016-17	134471.55
Total estimated reductions (tonnes of CO_2 e)	**1344715.50**
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	134471.55

A.4.5. Public funding of the project activity:

No funding from Annex I country is available to the project activity.

B. Baseline methodology

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

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

Reference: Approved consolidated baseline methodology ACM0004/ Version 01, Sectoral Scope: 01, 8 July 2005[2]

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

The "ACM0004 consolidated baseline methodology for electricity generation projects from utilization of waste heat from waste gases" applies to all CDM project activities, which are based on use of in-situ waste heat streams for generation of electricity that displaces imports of electricity from the grid or from any captive fossil fuel based electricity generation.

Justification concerning applicability conditions of the new 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 under following conditions:

"This methodology applies to electricity generation project activity

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"

The project activity will involve utilization of the waste heat of flue gases from the rotary kilns of the SI plant of RASL and flue gases of CECL's FAP. This waste heat will be used to generate steam which will subsequently be utilized for power generation. In the non-project scenario the project proponent

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

would have opted for the business-as-usual scenario, i.e. releasing thermal energy of the flue gas from the rotary kilns of the SI plant of RASL and the FAP of CECL into the atmosphere and generating captive power through coal fired FBC boilers.

Moreover, no fuel switch is planned during the crediting period at the generation point of the flue gas from the rotary kilns of the SI plant of RASL as well as the FAP of CECL. The project activity thus meets both the applicability criteria of the methodology.

The non-project option is "captive power generation on-site using other energy sources i.e. coal". The baseline scenario (as established in Section B2) is continuation of the earlier practice and the selected approach is 'existing actual and historical emission",

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 will involve waste heat recovery based captive power generation sourcing the waste flue gas from rotary kilns of the SI plant of RASL and the FAP of CECL. The project activity will generate 25 MW for meeting the in-house power demand of RASL and CECL. 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 alternatives. These alternatives are to be verified for legal and regulatory compliance requirements and also for their dependence on key resources such as fuels, materials or technology that are not available at the project site. Further, among those alternatives that do not face any prohibitive barriers, the most economically attractive alternative is to be considered as the baseline scenario.

As mentioned above, the project activity requires supplying a total of 25 MW of power for in-house consumption in the facility of RASL and CECL. Four plausible alternative scenarios were available with the project proponent that was contemplated during project inception stage:

Alternative 1: Continuation of the earlier practice – captive power generation through coal fired FBC boilers in the CPP

The project proponent already has existing two nos. of 90 TPH FBC boilers for catering to existing power demand of 25 MW. Thus, one of the options would be to continue with the earlier practice and generate additional 25 MW of power (i.e.project activity) through coal fired FBC boiler(s) only. 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 plausible baseline option.

Alternative 2: Import of power from grid

The project proponent would purchase required power from the grid. An equivalent amount of CO_2 emissions would take place at the thermal power generation of the grid. This alternative is in compliance with all applicable legal and regulatory requirements and can be considered as one of the baseline options.

Alternative 3: Light diesel oil or furnace oil based CPP at CECL

The project proponent could set up 25 MW light diesel oil (LDO) or furnace oil (FO) based generator. The power generated would partially meet the power demand of CECL and RASL. An equivalent amount of CO_2 emissions would be released at the CPP end due to combustion of diesel. This alternative is in compliance with all applicable legal and regulatory requirements and can be a baseline option.

Alternative 4: Implementation of project activity without CDM benefits

The project proponent could set up a 25 MW waste heat recovery based CPP at its existing sponge iron plant and FAP to partially meet the power demand of RASL and CECL. This alternative is in compliance with all applicable legal and regulatory requirements. The energy content of the flue gases from the rotary kilns of the SI plant and the arc furnaces of the FAP would be fully utilized and the project proponent would reduce an equivalent amount of CO_2 emissions at the CPP end. However, for this option, the project proponent would face a number of technological, regulatory and, investment barriers (as detailed in Section B3 below) making it predictably prohibitive. Hence this option has not been considered as a baseline alternative.

Evaluation of the alternatives on economic attractiveness:

From the discussion above it is found that alternatives 1, 2 and 3 can be a part of baseline scenario. Further, as per the methodology, the alternatives are to be evaluated on the basis of economic attractiveness to find the appropriate baseline scenario. The broad parameters used for the evaluation of sources of power are capital (installation) cost figures and the unit cost of electricity purchased or produced. Table B-1 below shows the economic evaluation of the three options:

Table – B1: Comparison of the baseline alternatives:

Alternative	Capital Cost Rs. Million / MW	Unit charges Rs. / kWh	Source of information	Comments	Conclusion
1) Import of Power from Grid	Nil	4.75	CECL sources	High recurring costs in the form of tariff. Load shedding and power quality problems are frequent.	Not an economically attractive option
2) Continuation of the earlier practice of captive power generation through coal fired FBC	40	2.51	CECL Sources	Lower cost of generation, easier coal linkage, stable power supply for production. The project proponent already had the facility for captive power generation through coal fired FBC boiler. Continuation of the earlier practice for generation of power would mean additional investment. However, expertise for coal based power generation is already in place.	This option is economically most attractive
3) LDO/FO Based CPP	6.0	9.67	CECL Sources	Marginal Low capital cost but high variable cost mainly due to higher fuel prices. Generally used as backup for supplying power to essential equipments and not for complete grid displacement at such a scale. Moreover, CECL anticipated further oil price increase in future.	Not an economically attractive option

Evaluation of the alternatives on economic attractiveness:

From the above analysis it can be concluded that the alternative 2 is more attractive compared to alternatives 1 and 3. Continuation of the earlier practice i.e. captive power generation through coal firing in the FBC boilers would mean lower power cost. Moreover the project activity directly replaces the use of coal fired FBC boiler for captive power generation as such facility was already existing and the available grid connectivity was only to the tune of 5 MVA.

Thus in view of the above points, the Alternative 2: ‘captive power generation on-site using other energy sources i.e. coal’ is the most likely alternative and has been considered as the baseline scenario for the project activity.

Establishing the additionality for the project activity

This step is based on Annex I: "Tool for the demonstration and assessment of additionality" as provided in "Annex I to the Executive Board – 16 meeting report" of the sixteenth meeting of Executive Board. 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.

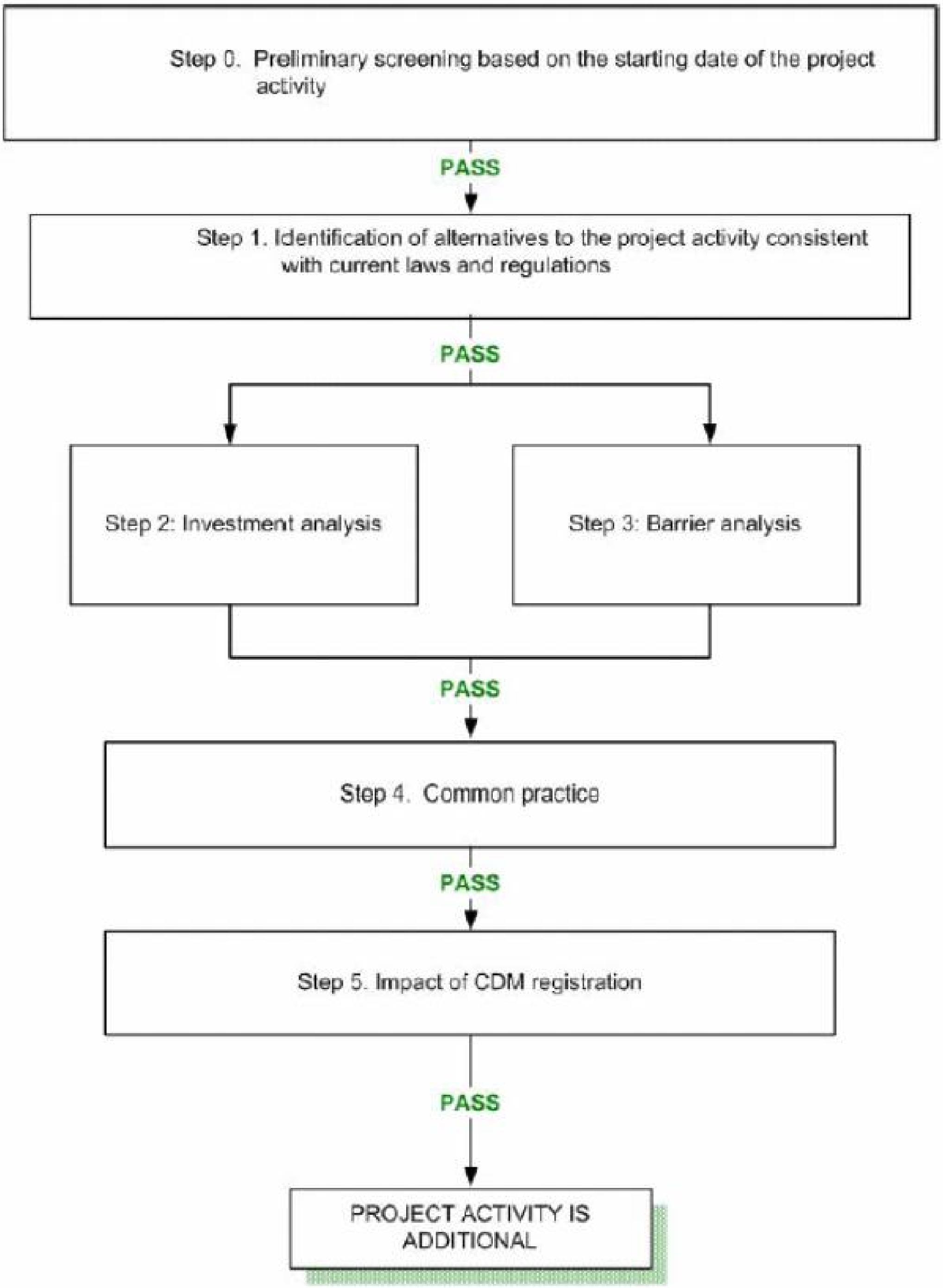
B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

As per the decision 17/cp.7 para 43, a CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity.

The methodology requires the proposed project activity to determine its additionality based on the "Tool for the demonstration and assessment of additionality", agreed by the CDM Executive Board at its twentieth meeting.

The flowchart presented below provides a step-by-step approach to establish additionality of the proposed project activity.

Flowchart: Additionality scheme



The additionality aspects of the proposed project activity are developed in the following discussions.

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 CECL launched the project activity on waste gas recovery and waste heat utilization for power generation in July 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.
CECL would provide sufficient evidences to establish the same.

(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, CECL is committed for business growth keeping in mind the environmental protection aspects both locally as well as globally. CECL 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 intricately connected with the development objectives and polices. All activities undertaken by CECL take in to consideration the environmental, health and social assessment. Consequently, climate change issues are very much a part of CECL decision making covering all its proposed activities. CECL was aware of the number of barriers it would face for recovery of waste flue gas from the rotary kilns of the SI plant of RASL and arc furnaces of its own FAP. Despite these barriers, the top management of CECL in its Board meeting decided to take up the project activity in view of the potential risk mitigation cover CDM would provide[3]. The Board also decided to bear the costs for CDM documentation, registration and for adhering with the M&V protocol. Adequate evidences are available which shows that CDM benefits was seriously considered to proceed with the project activity.

[3] Extracts of Minutes of Meeting of Board of Directors

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

The project proponent is required to define realistic and credible alternatives to the project activity(s) that can be (part of) the baseline scenario through the following sub-steps:

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

Sub-step 1b. Enforcement of applicable laws and regulations:

CECL had four plausible alternatives for the project activity under consideration which could be adopted to generate power in the CPP. The alternatives are as discussed in Section B.2 above and all the alternatives are in compliance with applicable laws and regulations in India. .

The project proponent is required to conduct

Step 2. Investment analysis

OR

Step 3. Barrier analysis.

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

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

(a) Prevent the implementation of this type of 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

Technological Barrier:

a. CECL was one among the first few ferro alloy plants in India that had conceived the utilization of chemical heat content of the flue gases. Around 1000 m^3 of gases is generated per tonne of Ferro Alloy (silico manganese and ferro manganese) which comes out from the submerged arc furnaces at 400^oC. A two stage economizer was envisaged while designing the CO fired boiler for flue gases from two 9 MVA furnaces to generate 16.5 TPH steam at 500 ^oC, 64 kg/cm^2. However, during operation of the boiler, the temperature of the incoming waste gases from the furnaces dropped below 400 ^oC leading to heavy hydrocarbon deposits on the boiler tubes. This led to reduction of heat transfer of the heat of combustion resulting in stalling of the boilers. As the performance of the boiler was varying with respect to FAP flue gas property, CO content and availability which in turn was dependent on the production of Ferro Alloy plant, CECL did not include performance guarantee testing of the equipment (boiler) in its boiler purchase order[4]. This led to heavy liability on the part of CECL. After continuous research and development CECL came up with a special burner for firing the CO gas. The gases from two additional 9 MVA furnaces were also led to the same boiler to bring in stability of firing in the boiler furnace. Although, the boiler was facing many of the above problems CECL has pursued continuously with power generation from CO waste gas and aims to make its operation successful.

b. Regarding the quality of the sponge iron kiln flue gases, the main difficulty is faced in cleaning of the gases and its associated moisture content before it can be used in the WHRBs. Waste gases from the rotary kilns is passed through a horizontal duct chamber called dust settling chamber which is located beneath the ABC. The dust-settling chamber reduces waste gas velocity and thereby removes larger dust particles by gravity, retards pressure fluctuations; achieve uniformity of gases with regard to temperature and concentration of combustibles. At the end of the dust-settling chamber, the waste gases move upward into the combustion area of ABC. A water nozzle controls the inlet temperature of gas. Combustion in ABC takes place in a controlled temperature range between 950 to 1000 ^oC and it is ensured that the gas leaving the chamber has no traces of CO, soot or tar components. This leads to addition of moisture in the gases which goes up to 14 -15 %[5]. However, for a normal coal fired FBC boiler this would be only 4-5%. The higher moisture content in the waste gases from ABC of sponge iron kiln affects the stability of boiler operation.

c. While FBC boilers use the radiant heat for transfer of heat to generate steam, the sponge iron WHR boilers use only convective heat for heat transfer. Thus, the WHR boilers require more surface area as compared to FBC boiler. Other accessory equipments like refractory lined inlet duct to take care of high

[4] Purchase order of 16.5 TPH boiler
[5] Design specification of 53.2 TPH WHR boiler at CECL.

temperatures, suitable expansion joints for the ducting and refractory lining to take care of thermal movement, and the Evaporators, Economizer, steam drum and connecting flanges and ducting are also designed and maintained to suit the requirements of the project activity

An optimum waste gas flow rate and characteristics both physical and chemical are essential to consistently generate the desired output. The project activity, which has been only partially implemented, has to ensure the availability of adequate energy from the waste flue gases in order to successfully replace the coal fired FBC boiler attached with the captive power-house and sustainably maintain the project equipments and accessories.

d. The production of steam and hence the electrical power utilizing the energy content in the waste gases of a sponge iron kiln is based on a technology which depends very much on the quality of the coal used for the production in the kiln. In CECL 'F' grade coal is used for production[6] which is the lowest grade of coal available in India[7]. There has been a serious problem for getting higher-grade coals from the coal supplying agencies. Hence, this has not only affected sponge iron production but also the generating of adequate quantity of flue gas, which further affected steam generation. The sponge iron technology being used in India was based on usage of higher grades of coal. CECL plant, therefore suffers from non-availability of the desired coal and continuous efforts are being made to overcome this problem.

The current problem faced by the industry has got multiplied because of the non- availability of the high grades Iron Ore. At present most of the Sponge Iron manufacturers are using Iron ore upto 63% Fe compared to 66% Fe ore used in the past. This is giving rise to higher generation of fines and higher tendency of deposits of Fe-Ca-Mg-Alumina-Silica mixtures in the passage from the kiln to the boilers. This problem is also being studied and corrective actions have been taken to see that the deposit does not occur and the steam generation does not suffer[8].

Investment Barriers:

The implementation of the project activity requires a considerably high capital investment of approximately Rs.75 Crores. Moreover the overhead costs on account of operation and maintenance, administration etc. are also higher compared to the alternatives of a coal based or diesel/furnace oil based captive generation. The changeover to a new technology (waste heat based power generation) has additional hidden costs of training and in-house expertise development for proper operation and maintenance of such a plant which will be the source of supply of power to CECL and RASL.

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[6] Bill from South Eastern Coalfield Limited to CECL
[7] http://iis-db.stanford.edu/pubs/20798/WP34,_14_Jan_05.pdf (pg. 14)
[8] http://spongeironindia.com/chairmanadd.htm

Other Barriers:

Lack of relevant technical and relevant managerial background: 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 CECL were also required to develop expertise on design, construction and operation of waste heat recovery based power plant.

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

This is as demonstrated in Sub-step 3a and Section B.2 above. CECL already has the expertise in operating a coal based power plant. Further, Chattisgarh is a coal rich state and this would ensure stable coal linkage at lower prices. This would in-effect lead to a more assured means of power supply for CECL and RASL production units. Hence, for alternative 2 (i.e. Fossil fuel (coal) based captive power generation) the project proponent would not have faced the technological and investment barriers as in the case of project activity.

Step 4.Common practice analysis

The project proponent is further required to conduct the common practice analysis as a credibility check to complement the barrier analysis (Step 3). The project proponent is required to identify and discuss the existing common practice through the following sub-steps:

Sub-step 4a. Analyze other activities similar to the proposed project activity:

Sub-step 4b. Discuss any similar options that are occurring:

From Step 3: Barrier Analysis it may be concluded that Alternative 1 (i.e. coal firing in the FBC boilers of CPP for captive power generation) would not face barriers to implementation. However, the project activity under consideration would have to face all the barriers to implementation. The common practice scenario discussed below further substantiates that the project activity faces barriers to implementation and is therefore not a widespread proposition for the sponge iron manufacturing industries under similar socio-economic environment. The common practice analysis also reflects that Alternative 1 is the option adopted by most of the sponge iron manufacturing industries in the region.

The pioneering aspect of the project is utilization of waste flue gases from FAP arc furnaces as fuel. Moreover plants with a captive power generation facility based on coal as fuel in the FBC boiler, and more so in a state, which has abundant coal reserves, it is a common practice to continue with coal based CPP in the future. Further, the utilization of sensible heat component of the flue gases from ABC of the sponge iron kilns of RASL, through WHRBs for power generation has also been found to be a not-so-common practice among sponge iron plants of the region. At the time of writing this document there were only around 7 such plants having similar activity out of around 65 sponge iron plants in the state.

The above analysis leads us to fair indication that the project is not a business-as-usual scenario and was not the likely to occur under the present circumstances. Moreover, as explained in the section above, it is evident that in absence of the project the GHG emissions reduction related with the implementation of the project would not have occurred.

Hence we can conclude that the project results in reduction of anthropogenic emissions of GHG by sources below those that would have occurred in the absence of the registered CDM project activity and that the project case is additional and therefore not the baseline scenario.

5. Impact of CDM registration

The project proponent is required to explain how the approval and registration of the project activity as a CDM and the attendant benefits and incentives derived from the project activity will alleviate the other identified barriers (Step 3) and thus enable the project activity to be undertaken.

The benefits and incentives expected due to approval and registration of the project activity as a CDM activity, will improve the sustainability of the project activity.

As mentioned above in Step 0, before implementation of the project activity, CECL considered all the barriers mentioned above. The management of CECL discussed various aspects of project activity implementation in the Management meeting. CECL's management finally took the decision of taking the investment risks and secure financing through internal accruals so as to invest in the CDM project activity after computing the proposed carbon financing.

The corporate decision to invest

- in overcoming the barriers faced by the project activity implementation and operation
- in the CDM project activity through internal accruals

- in additional transaction costs such as preparing documents, supporting CDM initiatives and developing and maintaining Monitoring methodology to fulfill CDM requirements

was guided by the anthropogenic greenhouse as emission reductions the project activity would result in and its associated carbon financing, the project activity would receive the sale of CERs under the Clean Development Mechanism .

CDM fund will provide additional coverage to the risk of failure of the project activity, shut down of plant and loss of production.

Further with CDM project activity registration many more sponge iron manufacturing industries in the country would take up similar initiatives under CDM by overcoming the barriers to project activity implementation resulting in higher quantum of anthropogenic greenhouse gas emissions reduction.

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

The **spatial extent** of the project boundary comprises the waste heat or gas sources, waste heat based captive power generating equipment, any equipment used to provide auxiliary heat to the waste heat recovery process, and the FBC boilers existing in the CPP.

In this project case the same project boundary has been considered including the unit operations from the point of fuel supply to the point of electricity generation from the turbo-generator.

For the purpose of baseline emission calculation the boundary includes the FBC boiler with use of coal as fuel. One of the the project boiler will be fed by flue gas from FAP furnaces and four other are WHRBs using flue gases of SI Kilns of RASL.

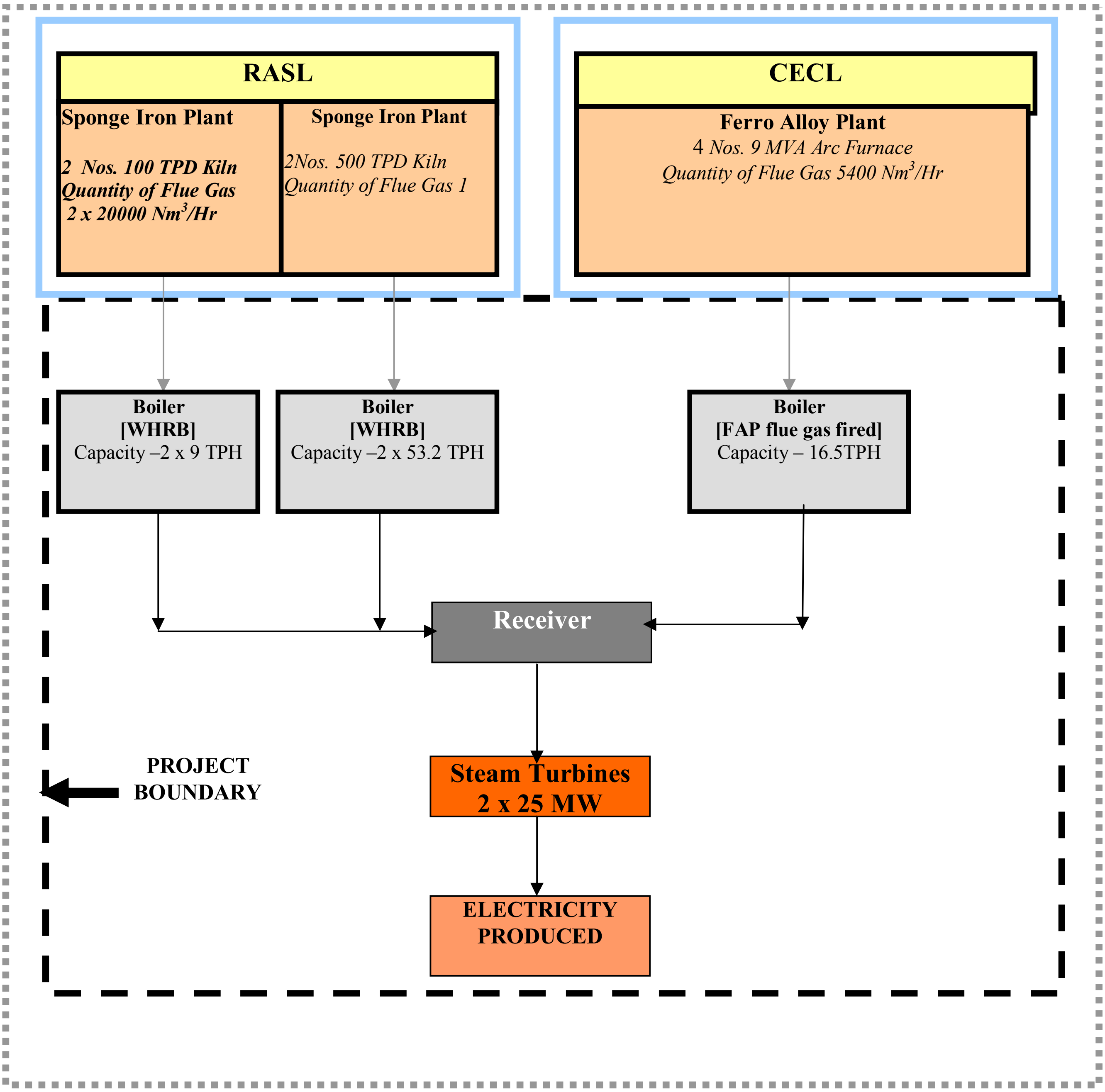
The project boundary on the upstream side starts from the point of flue gas feeding to the one boiler in case of CECL's FAP, while in case of RASL's SI Plant, the boundary starts at a point where the flue gases from the SI Kilns (passed through the afterburner) will be fed to the 4 WHRBs.

On the downstream side the boundary covers the electricity generation from the turbine. The waste gas emissions from the boilers are also included in the boundary.

The flue gas that is emitted into the atmosphere with or without the project activity does not differ in composition or GHG content; only emissions due to use of LDO as auxiliary fuel with FAP flue gases will have to be estimated as project emissions.

There is no significant possibility of leakage that would need accounting, since all the units, fuel sources, generating equipments are in close proximity to each other.

Fig 2 - Project Boundary:



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:

Date of completing the final draft of this baseline selection: 20/10/05

Name of person/entity determining the baseline:

Experts and Consultants of CECL.

C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

July, 2002

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

20 y.

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

C.2.1. Renewable crediting period

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

>>

C.2.1.2. Length of the first crediting period:

>>

C.2.2. Fixed crediting period:

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

01/05/2007

C.2.2.2. Length:

10 y.

D. Monitoring methodology and plan

The Monitoring procedures define a project-specific standard against which the performance of the project (i.e. GHG reductions) is monitored and conformance of the relevant criteria is monitored. The purpose of these procedures would be to direct and support continuous monitoring of project performance/key project indicators to determine the project's greenhouse gas (GHG) emission reductions.

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

Title : Consolidated monitoring methodology ACM0004 for electricity generation projects from utilization of waste heat from waste gases.

Reference: The consolidated methodology ACM0004, has been approved by Meth Panel of Executive Board, UNFCCC at its twentieth meeting

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

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 and use of power units, auxiliary consumption, steam generation, steam characteristics [temperature and pressure], flue gas quantity and quality, are some of the essential parameters to be monitored. The methods of monitoring adopted should also qualify as economical, transparent, accurate and reliable.

The justification of the choice of the approved Baseline and Monitoring Methodology ACM 0004 for the project activity has been detailed in section B.1.1. The project's fit to the methodology has been evaluated against each of the applicability criteria of ACM 0004 and it has been concluded that the methodology is aptly applicable to the project activity.

Description of the Monitoring Plan

The monitoring and verification system mainly comprise of metering facilities for electricity fed to CECL and RASL plant. The instrumentation and control system for the power plant is designed with adequate instruments to control and monitor the various operating parameters for safe and efficient operation of the waste heat recovery system, the boiler and the turbo generator unit. The project activity has employed modern monitoring and control equipment that will measure, record, report, monitor and control various key parameters like total power generated, power used for auxiliary consumption, flow rate, temperature and pressure parameters of the waste gas, steam generated and steam sent to turbine to generate power.

The instrumentation system comprises of microprocessor-based instruments of reputed make with the best accuracy available. All instruments are calibrated and marked at regular intervals so that the accuracy of measurement can be ensured all the time. The calibration frequency too is a part of the monitoring and verification parameters.

The actual amount of CO_2 reduction however depends on the generation mix and production scenario of the existing captive power plant of CECL that is taken into consideration in the baseline factor. Since the baseline parameters like efficiency of the CPP, CO_2 emission factor of the fuel used for captive power generation will affect the actual emission reduction units that are attained during verification, they too will be included in the Monitoring and Verification procedure. CECL monitors the performance of its captive power generation unit and the transparency of measurements, recording, monitoring and control of the generation mix of the CPP is ensured all the time.

Project Emissions

Additional emission comes from combustion of LDO, as auxiliary fuel in the FAP flue gas fired boilers. The flue gases from SI Kilns in absence of the project were emitted to the atmosphere after passing through the After-Burning Chamber (ABC) and in project case the flue gases from ABC are fed to the four WHRBs for waste heat recovery and utilization of the same for steam generation. There is no change in composition of the flue gases due to the project.

Hence the only anthropogenic emission of GHGs from within the project boundary is the CO_2 emissions associated with LDO combustion.

GHG emission of the project

Direct on-site emissions

Measurement of quantity of waste gas used, its temperature and its composition in pre and post project scenario will produce evidence that the energy is being generated with negligible CO_2 emissions. The project emission is mainly due to usage of LDO used as auxiliary fuel in FAP flue gas-fired boilers. The FAP flue gases (high CO content) although undergoes change in composition after combustion in boiler and releases equivalent CO_2, the same is not additional due to project as in absence of project the same conversion of CO to CO_2 would take place at point of release of waste gas to atmosphere due to the high CO content. The waste flue gas of SI Kilns (after ABC) that is being used in WHRB systems does not undergo any change in composition under project boundary and hence does not lead to any additional GHG emission/ project emission.

Indirect on-site emissions

The indirect on site GHG source is the consumption of energy and the emission of GHGs therein for construction activity that the project proponent has to undergo to implement the system. Considering the life cycle of the project activity and the emissions that would be avoided in the life span of 15 years, emissions from the above-mentioned source is too small and hence neglected.

Direct & In-Direct off site emissions

There is no direct off site emissions from the project activity. The indirect off-site emission includes emissions during the manufacturing process of machineries and related transportation activities required for building the project. These emissions are too small in quantity and are outside the control of the project and hence excluded.

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 table D.3)*	Data Type	Data variable	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
1. Qi	Quantitative	Volume of the auxiliary fuel used by the project activity	Tonnes	Measured	Continuously	100%	Electronic/ paper	To be measured at the entry of the FAP flue gas fired boiler and this data will be used for estimating project emissions
2. NCVi	Quantitative	Net calorific value of the fuel	TJ/tonnes	IPCC default value	Monthly	Random	Electronic/ paper	To be measured used for estimating project emissions
3. EFi	Quantitative	Carbon emission factor of the fuel	tC/TJ	IPCC default value	Monthly	Random,	Electronic/ paper	To be measured used for estimating project emissions

As per the methodology, project emissions are applicable only if auxiliary fuels are fired for generation start up, in emergencies or to provide additional heat gain before entering the boilers of CPP using waste heat of the waste gases from the SI plant and FAP.

LDO is fired as auxiliary fuel only in the FAP flue gas fired boiler.

The Additional Heat Gain can take place due LDO is fired as auxiliary fuel in the FAP flue gas fired boiler.

Since, the project emission is due to the firing of auxiliary fuel only the data associated with the auxiliary fuel firing will needed to be monitored.

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

The only project emission comes from combustion of LDO, as auxiliary fuel in the FAP flue gas fired boilers.

Hence the only anthropogenic emission of GHGs from within the project boundary is the CO_2 emissions associated with LDO combustion. The same is estimated using the standard emission factor for diesel oil (20.2 TC/TJ) as per revised 1996 IPCC guidelines for National Greenhouse Gas Inventories).

Formula:

Estimated project emissions in the year *y* in tonnes of CO_2 eqv = PE_y
$PE_y = \sum Q_i \times NCV_i \times EF_i \times 44/12 \times OXID_i$

Where

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

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 number *(Please use numbers to ease cross-referencing to table D.3)*	Data Type	Data variable	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
4. EG_{GEN}	Quantitative	Total electricity generated by waste gas	MWh/yr	Calculated (c)	Daily	Total	Electronic	Monitoring location: meters at plant and DCS will measure the data. Manager In charge will be responsible for regular calibration of the data. See Annexe 4 for details.
5. EG_{AUX}	Quantitative	Auxiliary consumption	MWh/yr	Calculated (c)	Daily	Total	Electronic	Monitoring location: meters at plant and DCS will measure the data. Manager In charge will be responsible for regular calibration of the data. See Annexe 4 for details.
6. EG_y	Quantitative	Net electricity generated	MWh/yr	Calculated (c)	Daily	Total	Electronic	Calculated from the above measured parameters. Algorithm for project emission calculations given in baseline methodology.

For Baseline Emission Factor: Captive Power

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data Type	Data variable	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comments
7. $EF_{CO2,\ i}$	Quantitative	CO_2 emission factor of fuel used for captive power generation	tC/TJ	IPCC default value	Yearly	Total	Electronic	This data will be calculated based on the IPCC, 1996 value as plant specific values are less conservative than IPCC values.
8. $Eff_{captive}$	Quantitative	Energy efficiency	%	Measured	Yearly	Total	Electronic	This data will be calculated by the design station heat rate from the manufacturer nameplate .for similar size power generating units.

D. 2.1.4. Description of formulae used to estimate baseline emissions (values should be consistent with those in section E).

1. **Calculation of the Emission Factor for Captive Power generation:**

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

Where,

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

$EF_{CO2,\,i}$: CO2 emission factor for fuel used in captive power generation (tC/TJ)

Since, in the baseline scenario coal would have been used as fuel for power generation in the CPP, EF_{CO2} will stand for the emission factor of coal

$E_{ff,\,captive}$: Efficiency of captive power generation (%)

44/12 : Carbon to carbon di oxide conversion factor

3.6/1000: TJ to MWh conversion factor

2. Calculation of Baseline Emissions:

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

Where,

EG_y: Net quantity of electricity supplied to the manufacturing facility by the project during the year y in MWh

$EF_{captive,\,y}$: CO_2 baseline emission factor for the captive power generation (tCO2/MWh)

$EG_y = EG_{GEN} - EG_{AUX}$

EG_{GEN}: Total electricity generated from the project activity (MWh/year)

EG_{AUX}: Auxiliary consumption for the project activity (MWh/year)

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.):

Not applicable

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

There is no leakage associated with the project activity.

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

There is no leakage from the project activity.

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.)

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

$ER_y = BE_{,y} - PE_y$

Where,

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

$BE_{,y}$ are the baseline emissions due to displacement of electricity from coal fired FBC boilers during the year y in tons of CO_2,

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

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

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored			
Data *(Indicate table and ID number e.g. 1. , -14.)*	Uncertainty level of data (High/Medium/Low)	Are QA/QC procedures planned for these data?	Outline explanation why QA/QC procedures are or are not being planned.
1.,-3.,	Low	Yes	This data will be required for the calculation of project emissions.
4.,-6.	Low	Yes	This data will be used for the calculation of project electricity generation.
7.,-8.	Low	Yes	This data will be required for the calculation of baseline emissions (from captive power plant electricity).

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

CECL will implement an operational and management structure in order to monitor emission reductions and any leakage effects, generated by the project activity. They have already formed a CDM team comprising of persons from relevant departments, which will be responsible for monitoring of all the parameters mentioned in this section. The CDM team also comprises of a special group of operators who will be assigned the responsibility of monitoring of different parameters and record keeping as per the monitoring plan. On a weekly basis, the monitoring reports will be checked and discussed by the senior CDM team members/managers. In case of any irregularity observed by any of the CDM team member, it will immediately be informed to the concerned person for necessary actions. On monthly basis, these reports will be forwarded at the management level.

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

Experts and consultants of CECL.

E. Calculation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

The project activity uses the waste heat energy of flue gases from FAP furnaces of CECL and SI Kilns of RASL to generate steam, which is used for electricity generation. For waste heat recovery from sponge iron kilns there is no auxiliary fuel and hence, no project emissions.

However, for the flue gases from FAP furnaces, the project emissions comes from combustion of LDO, as auxiliary fuel in the FAP flue gas fired boilers.

Hence the only anthropogenic emission of GHGs from within the project boundary is the CO_2 emissions associated with LDO combustion. The same is estimated using the standard emission factor for diesel oil (20.2 TC/TJ) as per revised 1996 IPCC guidelines for National Greenhouse Gas Inventories[9]). It is estimated to use 500 litre of LDO per day, which works out to be 520 t CO2 equivalent per annum (see appendix III for details).

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:

The total emissions from the project activity would be 520.09 t CO_2 equivalent per annum.

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

Sl. No.	Operating Years	Baseline Emission Factor (kg CO_2 / kWh)	Baseline Emissions (tonnes of CO_2)
1.	2007-08	1.01	134991.64
2.	2008-09	1.01	134991.64
3.	2009-10	1.01	134991.64
4.	2010-11	1.01	134991.64
5.	2011-12	1.01	134991.64

[9] http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1wb1.pdf (pg.1.6)

Sl. No.	Operating Years	Baseline Emission Factor (kg CO_2 / kWh)	Baseline Emissions (tonnes of CO_2)
6.	2012-13	1.01	134991.64
7.	2013-14	1.01	134991.64
8.	2014-15	1.01	134991.64
9.	2015-16	1.01	134991.64
10.	2016-17	1.01	134991.64

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.	2007-08	134991.64	520.09	134471.55
2.	2008-09	134991.64	520.09	134471.55
3.	2009-10	134991.64	520.09	134471.55
4.	2010-11	134991.64	520.09	134471.55
5.	2011-12	134991.64	520.09	134471.55
6.	2012-13	134991.64	520.09	134471.55
7.	2013-14	134991.64	520.09	134471.55
8.	2014-15	134991.64	520.09	134471.55
9.	2015-16	134991.64	520.09	134471.55
10.	2016-17	134991.64	520.09	134471.55

Total tonnes of CO_2 Estimated Emission Reductions: **1344715 t CO_2** over 10 year crediting period

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

Please refer to Appendix III for Details

F. Environmental impacts

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

The utilization of waste flue gases from process and subsequent reduction in the coal consumption has positive environmental impacts. The project activity also extends the beneficial impacts indirectly to the mining sector and other activity related to coal extraction, and transportation of same to project site.

The project activity of CECL, involving substitution of coal consumption in the FBC boiler for steam generation primarily aims at moving towards cleaner technology and energy efficiency. This further enables the project developer to conserve coal – as a non-renewable, fossil fuel that is much in demand for other important process of manufacturing and metallurgical needs. Coal mining and crude coal processing leads to added particulate matter emission and fugitive coal bed methane emissions which is also an indirect environmental benefit form the project activity.

Substitution of coal by waste flue gas also eliminates emission arising from transportation (by trucks using diesel) of coal from mine site to CECL project boundary.

Moreover combustion of coal leads to high amount of particulate matter emissions and other associated gaseous emissions. Along with GHG reduction credits the project reduces emission of particulate matter due to combustion of coal as well as the burden of ash disposal, which is a major problem.

The project, which adopts energy efficient technology also achieves, reduction in thermal pollution in the vicinity of the plant by using the waste flue gas that was earlier being emitted in to the atmosphere.

Significant environmental benefits can be summarised as following: -

- Conservation of Coal
- Avoidance of CO & CO_2 emission from coal combustion
- Avoidance of vehicular emission from transportation of coal
- Reduction of particulate matter emission due to combustion of coal, coal mining and extraction process
- Reduction of methane emission from coal bed at mining site
- Reduction of thermal pollution in the vicinity of the project site

Summary Of Environmental Impacts

This section represents the environmental impacts related to the project by CECL at their Raipur site. It further details the mitigation steps taken by the project facilitator to deal with significant environmental issues (if any) and comply with all legal environmental laws. Monitoring methodology and plan (Chapter D of this document) developed for this project includes monitoring plan for all key environmental performance indicators to show compliance with all environmental laws of host country that applies to this project.

The project would create impacts on the local environment in two distinctive phases: -

- **During Construction Phase**
- **During Operation and Maintenance Phase**

During Construction Phase

The assessed environmental impacts in carrying out construction activity for the project were:

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

Project implementation includes construction activities such as installation of boilers and pollution control devices, drawing of pipelines for steam transportation, etc. Considering the life cycle of the project, the impacts arising due to construction work is negligible and temporary, therefore has been neglected.

During Operation and Maintenance Phase

The operational and maintenance phase involves usage of waste flue gas of Sponge Iron Kilns (from RASL) and Ferro Alloy Arc Furnace (from CECL). It further involves steam production from the extracted heat of the waste flue gasses and transportation of the same for production of power by STG set located at CECL.

The nature of the impacts that are evident during the operational and maintenance phase is discussed in detail in the following paragraphs below. All possible environmental aspects for the various project activities have been identified and discussed for their impacts on the baseline environment that prevailed before the project was executed. The following paragraph summarizes the environmental scenario before the project was executed, project's local and environmental, social and other impacts, benefits and the mitigation measures taken by CECL to reduce/eliminate negative impacts if any and enhance the positive impacts.

The impacts envisaged due to operational and maintenance activities are elaborated below:

Impact on Biological Environment

The impacts due to the project are hardly any on biological environment. Reduction in the consumption of coal as fuel may result in benefits for the components of biological environment as related emissions of pollutants into the atmosphere is reduced.

Impact on Water Quality

The existing quality of aquatic environment is satisfactory and the project activity does not involve wastewater discharge.

Impact on Air Quality

The air quality of the area would positive effect as project significantly reduces thermal pollution initially taking place due to emission of waste flue gas into the atmosphere from Sponge Iron Kilns stack and Ferro Alloy Furnace.

The project activity does not contribute to any amount of SPM as ash. There will be negligible SOx and NOx emission from use of a small quantity of LDO as auxiliary fuel with the FAP flue gases and substantial reduction of such emissions will result from replacement of coal as fuel by the process flue gases.

The flue gases after heat recovery in the project boilers are passed through ESP and discharged into the atmosphere through the stack. The height has been designed as per CPCB norms.

The Monitoring and Verification Plan envisages periodical check ups of the emissions from the stack once every month. Any deviations from the original levels shall indicate inefficient functioning of the ESP. Remedial action can be taken immediately and efficacy ascertained.

Avoiding vehicular pollution arising from fuel transportation from its extraction site, project facility has further reduced indirect impact on air quality.

The fugitive dust pollution will be reduced to a considerable extent due to reduced handling of coal, and for any, there are provisions of water sprinkling to control the same.

Effect on land environment: The evaluation of the impacts on the land environment indicates no detrimental effect due project operation. There is no related change in land-use pattern due to the project.

Effect of Noise pollution: Noise level rise due to operation of various equipments would be negative from point of view of occupational hazard. However impact was adjudged to be minor. The workers use precautionary measures to prevent the harm.

Solid Waste Management: The project activity does not generate any solid waste. The ash that is generated and collected in ESP is generated from the ferro alloy and sponge iron manufacturing process and is the same as that generated in the non-project scenario. The company has worked out an ash management plan and implemented the same for brick manufacturing.

Aesthetic environment

There will not be any detrimental effect on the aesthetic environment. The project is located in an industrial area. The development of green belt by the industry would rather enhance the same in the vicinity.

Overall impact

An overall positive impact is assessed for the project. The net effect on biological environment would be positive. The net impact on environmental pollution would be positive. With the adequate pollution preventive devices in line the Project is being able to meet all legal norms and other requirements. Adequate employee health & safety norms are in practice. The health care and safety of the workers is ensured by providing proper exhaust system at the work floor and by necessary personal protective devices. The aesthetic environment will have a positive value addition with the vegetation and plantation schemes of the company. Moreover, the human-interest parameters show encouraging positive impacts due to increased job opportunities, transportation, medical facilities, housing etc. These have long-term socio-economic benefits.

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:

Project does not lead to any significant negative impact. Project implementation includes construction activity of pipelines and installation of boilers run on process flue gases. Considering the life cycle of the project the impacts arising due to construction work is negligible and temporary, therefore has been neglected. The host country does not require EIA study to be conducted for these kind of projects. [Project activity not included under Schedule I of Environmental (Protection) Act 1986 notification for Environmental Clearance of new projects or which are modifications of old ones].

G. Stakeholders comments

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

CECL has primarily aimed at reduction of coal consumption in the existing 2 x90TPH FBC boilers, by utilization of waste flue gases from process in five boilers – one CO-laden FAP flue gas fired boiler, the other four being WHRBs fed on flue gases from RASL's SI Plant.

This section addresses the Stakeholder comments of the projects implementation and its operation to keep transparency in operational activity of the project promoter and thereby being able to comply with applied environmental regulations. Stakeholders have been identified on the basis of their involvement at various project activity stages. The list of relevant stakeholders includes all governmental and nongovernmental organization to those which were communicated/ applied to get necessary clearances.

The stakeholders identified for the project are as under.

- Elected body of representatives administering the local area (village *Panchayat*)
- Chattisgarh State Electricity Board (CSEB)
- Chattisgarh State Electricity Regulatory Commission (CSERC)
- Chattisgarh Renewable Energy Development Agency (CREDA)
- Chattisgarh Environment Conservation Board (CECB)
- Environment Department, Government of Chattisgarh
- Ministry of Non Conventional Energy Sources (MNES)
- Non-Governmental Organisations (NGOs)
- Consultants
- Equipment Suppliers

G.2. Summary of the comments received:

Stakeholders Involvement

The village true representative of the local population in a democracy like India are the local Panchayat / Local elected body of representatives administrating the local area. Hence, their appraisal / permission to set up and operate the project is very necessary. CECL has already completed the necessary consultation and documented their approval for the project.

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 to the project. They add to the project by providing with local manpower working at the plant site. Since, the project will provide direct and indirect employment opportunities and enhanced skilled labour as well as managerial competence to local populace thus encouraging the project and its related activities.

Since the project is being implemented at existing facility of CECL and RASL which is inside the Industrial Growth Centre, thus project does not require any displacement of 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.

Chattisgarh Environment Conservation Board (CECB) and Environment Department of the Goverrnment of Chattisgarh have prescribed standards of environmental compliance and monitor the adherence to the standards.

Chattisgarh Renewable Energy Development Agency (CREDA) is one who implements policies in respect of non-conventional renewable power projects in the state of Chattisgarh. The Government of India, through Ministry of Non-conventional Energy Sources (MNES), has been promoting energy conservation, demand side management and viable renewable energy projects including wind, small hydro, solar and biomass / cogeneration power.

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 documents, preparation of 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 clearances, local clearance etc. were considered while preparation of CDM project development document.

The CECL representatives met with the various stakeholders for appraisal and support. They were commended for their voluntary action toward environmental development and energy efficient measures undertaken in this project involving change of fuel with associated energy efficiency and positive environmental effects.

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

Annex 1

CONTACT INFORMATION FOR PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Chattisgarh Electricity Company Limited
Street/P.O.Box:	Industrial Growth Centre
Building:	-
City:	Siltara, Raipur
State/Region:	Chattisgarh
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Telephone:	+91 771 5093925
FAX:	+91 771 5093924
E-Mail:	-
URL:	-
Represented by:	
Title:	Director
Salutation:	Mr.
Last Name:	Jain
Middle Name:	K
First Name:	P
Department:	Finance
Mobile:	-
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: Please refer Section B for details

Annex 4

MONITORING PLAN

Introduction: The project activity of CECL is the waste heat recovery based power generation in the existing CPP of CECL. The project activity will involve installation of 2x9 TPH & 2x 53.2 TPH WHRBs using waste gases from the SI plant of RASL and 1x16.5 TPH CO fired boiler utilizing waste flue gases from the FAP of CECL. In the existing CPP of CECL there are 2x90 TPH Fluidised Bed Combustion Boiler that uses coal and a common steam header and 2 turbo generator (TG) sets having capacity 25 MW each as shown in Fig.3 below.

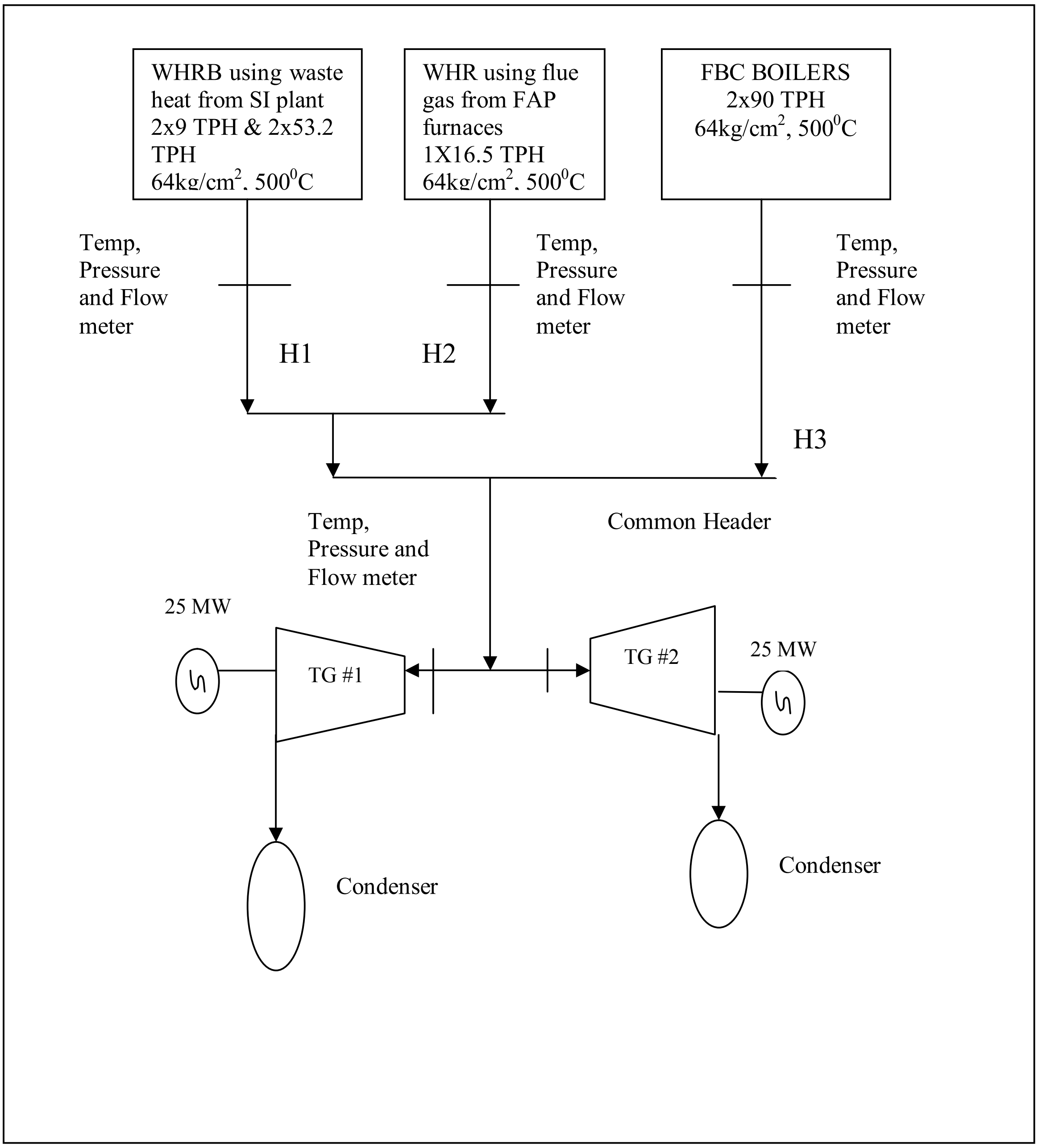

Fig 3 ; Schematic Diagram of CECL's CPP

The working parameters of various equipments and location of Steam Flow meters, pressure and temperature gauges are as indicated in the diagram.

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

The calculation is shown as follows:

A.) Total Enthalpy of Steam from WHRB using waste gas from SI plant, in kcal (H_1)

= (Enthalpy of steam at boiler outlet in kcal/kg) x (WHRB 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 WHRB steam flow per day is measured by flow meter.

B.) Total Enthalpy of Steam from CO fired boiler using waste gas from FAP plant, in kcal (H_2)

= (Enthalpy of steam at boiler outlet in kcal/kg) x (CO fired boiler 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 CO fired boiler steam flow per day is measured by flow meter.

C) Similarly Total Enthalpy of Steam from FBC in kcal (H_3)

= Enthalpy of steam at boiler outlet in kcal/kg x steam flow in tonnes per day = h_3 x S_3

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

D) If $EG_{GEN\ CPP}$ is the Total Power generated by the CPP per day (in MWh) then total Power Generated by Waste heat Recovery Boilers and CO fired boilers (EG_{GEN}) would be calculated as

$$EG_{GEN}\,(MWh) = \frac{EG_{GEN\ CPP} \times (H_1 + H_2)}{(H_1 + H_2 + H_3)} \qquad \ldots\ldots\ldots\ldots 1$$

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

$$EG_{AUX}\ (MWh) = \frac{EG_{AUX\ CPP} \times (H_1 + H_2)}{(H_1 + H_2 + H_3)} \qquad \ldots\ldots\ldots.2$$

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

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

An. D1 – Total Enthalpy from WHR steam from sponge iron kilns									
ID No.	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	For how long is archived data to be kept?	Comments
1.. T_1	Quanti tative	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
2. P_1	Quanti tative	Avg. Pressure of WHR steam before Common header	kg/ cm^2	Online measurement	Continuously	100%	Electronic/paper	Credit period + 2 years	MONITORING LOCATION: The data will be monitored from meters at plant and DCS. Manager In-charge would be responsible for regular calibration
3.. h_1	Quanti tative	Enthalpy of WHR steam before Common header	kCal/kg	Calculated	Daily	100%	Electronic/ paper	Credit period + 2 years	Noted from standard Steam table/ Mollier Diagram from the avg. temperature and pressure for the day.
4.. S_1	Quanti tative	Flow of WHR Steam to Common header	tonnes per day	Online measurement	Daily	100%	Electronic /paper	Credit period + 2 years	MONITORING LOCATION: The data will be monitored from meters at plant and DCS. Manager In-charge would be responsible for regular calibration
5. H_1	Quanti tative	Total Enthalpy of WHR Steam from sponge iron kilns	kCal	Calculated (h_1 x S_1)	Daily	100%	Electronic/paper	Credit Period + 2 years	Calculated on a daily basis

An. D2 – Total Enthalpy from CO fired boiler from FAP furnaces									
ID No.	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	For how long is archived data to be kept?	Comments
6. T_2	Quanti tative	Avg. Temperature of waste heat steam before Common header	^0C	Online Measurement	Continuously	100%	Electronic/ paper	Credit Period + 2 years	MONITORING LOCATION: The data will be monitored from meters at plant and DCS. Manager In-charge would be responsible for calibration of the meters
7. P_2	Quanti tative	Avg. Pressure of waste heat steam before Common header	kg/ cm^2	Online measurement	Continuously	100%	Electronic/paper	Credit period + 2 years	MONITORING LOCATION: The data will be monitored from meters at plant and DCS. Manager In-charge would be responsible for regular calibration
8. h_2	Quanti tative	Enthalpy of waste heat steam before common header	kCal/kg	Calculated	Daily	100%	Electronic/ paper	Credit period + 2 years	Noted from standard Steam table/ Mollier Diagram from the avg. temperature and pressure for the day.
9. S_2	Quanti tative	Flow of waste heat Steam to Common header	tonnes per day	Online Measurement	Daily	100%	Electronic /paper	Credit period + 2 years	MONITORING LOCATION: The data will be monitored from meters at plant and DCS. Manager In-charge would be responsible for regular calibration
10. H_2	Quanti tative	Total Enthalpy of waste heat Steam from CO fired boiler	kCal	Calculated (h_2 x S_2)	Daily	100%	Electronic/paper	Credit Period + 2 years	Calculated on a daily basis

An. D3 – Total Enthalpy of Steam from FBC Boilers									
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_3	Quantitative	Avg. Temperature of FBC steam before Common header	^{0}C	Online measurement	Continuously	100%	Electronic/ paper	Credit Period + 2 years	MONITORING LOCATION: The data will be monitored from meters at plant and DCS. Manager In-charge would be responsible for calibration of the meters
12. P_3	Quantitative	Avg. Pressure of FBC steam before Common header	kg/ cm^2	Online measurement	Continuously	100%	Electronic/paper	Credit period + 2 years	MONITORING LOCATION: The data will be monitored from meters at plant and DCS. Manager In-charge would be responsible for regular calibration
13. h_3	Quantitative	Enthalpy of FBC steam	kCal/ kg	Calculated	Daily	100%	Electronic/ paper	Credit period + 2 years	Noted from standard Steam table/ Mollier Diagram from the avg. temperature and pressure for the day
14. S_3	Quantitative	Flow of Steam to Common header	tonnes per day	Online measurement	Continuously	100%	Electronic /paper	Credit period + 2 years	MONITORING LOCATION: The data will be monitored from meters at plant and DCS. Manager In-charge would be responsible for regular calibration
15. H_3	Quantitative	Total Enthalpy of FBC Steam	kCal	Calculated (h_3 x S_3)	Daily	100%	Electronic/paper	Credit Period + 2 years	Calculated on a daily basis

An.D4 – Total Waste Heat 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 Enthalpy Ratio H1+ H2/ (H1+H2 + H3)
19. EG_{AUX}	Quantitative	Auxiliary Electric Consumption on project activity	MWh /day	Calculated	Continuously	100%	Electronic/ paper	Credit period + 2 years	Calculated based on the Enthalpy Ratio H1+ H2/ (H1+H2+H3)

An. D4. 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., -10..	Low	Yes	It is a critical parameter that would used to calculate the waste heat recovery steam parameters
11.,-15.	Low	Yes	It is a critical parameter that would used to calculate the FBC steam parameters.
16.,-19.	Low	Yes	This data is used for calculating total power contributed from waste heat recovery steam generation system.

Appendix I : Abbreviations

ABC	After Burning Chamber
BAU	Business as Usual
^oC	Degree Celsius
CDM	Clean Development Mechanism
CECB	Chattisgarh Environment Conservation Board
CECL	Chattisgarh Electricity Company Limited
CER	Certified Emission Reduction
CIL	Chattisgarh Investments Limited
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
FAP	Ferro Alloy Plant
FBC	Fluidized Bed Combustion
GHG	Greenhouse Gas
Hr	Hour
IEA	International Energy Agency
IPCC	Inter Governmental Panel on Climate change
kg	Kilogram
KP	Kyoto Protocol
kVA	Kilo Volt Ampere

kW	Kilo-watt
kWh	Kilo-watt hour
LDO	Light Diesel Oil
ltr	Litre
M&P	Modalities and Procedures
M&V	Monitoring and Verification
MNES	Ministry of Non-conventional Energy Sources
MVA	Million Volt Ampere
MW	Mega-watt
MWh	Mega-watt hour
NGO	Non-governmental Organization
Nm^3	Normal meter cube
NOx	Oxides of Nitrogen
OECD	Organization for Economic Co-operation and Development
PDD	Project Design Document
RASL	Raipur Alloys and Steel Limited
SI	Sponge Iron
SOx	Oxides of Sulphur
SPM	Suspended Particulate Matter
STG	Steam Turbine Generator
TPH	Tonnes per hour
UNFCCC	United Nations Framework Convention on Climate Change
v/v	Volume by volume
WHRB	Waste Heat Recovery Boiler

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-Project Design Document (CDM-PDD) version 02(in effect as of: August 29, 2002)
5.	Practical Baseline Recommendations for Green House Gas Mitigation Projects in the Electric Power Sector, OECD and IEA Information
6.	Various project related information / documents / data received from Chattisgarh Electricity Company Limited and Raipur Alloy Steels Limited.
7.	Project Report of CECL
8.	Captive Power Plants- Case study of Gujarat India - http://iis-db.stanford.edu/pubs/20454/wp22_cpp_5mar04.pdf
9.	Revised 1996 IPCC Guidelines Workbook : http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1wb1.pdf

Appendix III: Baseline and CER calculation sheet.

The calculation sheet is enclosed along with this document.