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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8MW Waste Heat Recovery based Captive Power Project at OCL

Version - 01

Date of document – 30th August 2005.

A.2. Description of the project activity:

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Background

OCL India Limited (hereinafter referred to as OCL) was established in the year 1949 at Rajgangpur in the state of Orissa, India. The company manufactures cement, refractory and sponge iron. OCL Works has a power demand of 24.8 MVA which is met by importing power from grid.

The company commenced production of sponge iron in the financial year 2002-2003 by setting up a Direct Reduced Iron (DRI) kiln of capacity 30,000 Metric Tonnes (MT) per annum. OCL's Sponge Iron Works presently has a capacity of 120,000 MT per annum with actual production for 2004-05 at 95943 MT. OCL proposes to come up with a Captive Power Plant (CPP) of 14MW capacity running primarily on waste heat energy with minor contribution coming from DRI kiln coal waste (like coal char, coal fines) and coal washery rejects. The CPP will be meeting partial electricity demand of OCL Works.

Project Activity and its Purpose

Of the 14 MW installed capacity of the power plant at OCL, about 8 MW of power will be generated by utilizing the sensible heat content of the waste gas from the DRI kilns (i.e. from waste heat energy) for generating steam through Waste Heat Recovery Boilers (WHRBs). The power generated using waste heat comes under the scope of term **Project Activity** mentioned hereinafter.

The electricity generated shall be utilised to partially meet the power requirements of the sponge iron plant, cement plant and refractory unit and will replace power received from the power distribution company Western Electricity Supply Company of Orissa (WESCO) Limited[1].

The main purpose of the project is to achieve energy efficiency and environmental improvements in sponge iron making process. The project activity of OCL will contribute to industrial energy efficiency, environmental improvement and at the same time lead to sustainable economic growth, conservation of energy and natural resources as well as reduction in Greenhouse Gas (GHG) emission.

Salient Features of the project

The project activity proposes to utilize the flue gases from the Direct Reduced Iron (DRI) kilns of the sponge iron unit, for waste heat recovery and steam generation, which will be used for electricity generation. An average estimated amount of about 24,000 Nm^3/ hr of flue gas at about 900-920^oC would be available from each of the DRI kilns consisting of significant amount of heat energy. The energy is available in the form of sensible heat in the waste gases available after secondary combustion in the After-burning Chamber (ABC) attached to the sponge iron kilns. The waste heat energy will be utilized in WHRBs to generate steam. The steam is further utilized in a steam turbine to generate about 8 MW of electrical energy. In absence of this 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 OCL's Sponge Iron Works (SIW).

The components/utilities in the Captive Power Plant (CPP) includes 4 WHRBs each of 10 tonnes per hour (tph) steam generation capacity [65 kg/cm^2 and 485^OC] and one Steam Turbo Generator

[1] Orissa was the pioneer in SEB reforms in India. It was the first to unbundle its SEB in 1996 into Orissa Power Generating Company (OPGC) and Orissa Hydel Power Corporation (OHPC) - which are generating companies and Grid Corporation of Orissa (GRIDCO) - the T&D company. It was also the first state to privatise power distribution. Four distribution companies were formed in for each of the 4 zones - Western Electricity Supply Company of Orissa Limited (WESCO), North Eastern Electricity Supply Company of Orissa Limited (NESCO), Southern Electricity Supply Company of Orissa Limited (SOUTHCO) and Central Electricity Supply Company of Orissa Limited (CESCO). Gridco decided to hold 49% in each company, while offering a 51% stake to private companies.

of 14 MW rating with necessary accessories for transfer of steam. The CPP is capable of generation of around 8 MW of electricity from waste heat sources. The unit is expected to generate 44.88 million kWh [Million Units (MU)] per annum from waste heat sources out of which 39.5 MU will be available after auxiliary consumption.

The GHG emission reduction due to the project activity arises from replacement/ displacement of an equivalent amount of electricity from the state grid with high carbon intensity, which is comprised 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 **257133 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 objective fundamentally achieves in the following terms:

- Utilization of heat energy of waste gas.
- Meet the process requirement of power without any Transmission and Distribution (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 will increase a small fraction of skilled labour and professionals in the state by providing direct and indirect employment. Also with growing technological advancement the project activity contributes to capacity building in terms of technical knowledge and managerial skills. Such a project entailing energy efficiency will certainly have long-term indirect social benefits.

Economical Benefits: - The project activity will bring in economic benefits for the company considering the related benefits of replacement of equivalent grid electricity and the waste energy utilization in conjunction. The project shows less dependence of project proponent on grid-supplied electricity and better management of waste. The project brings in related economic benefits for the local community and the employees.

Environmental Well-being: - In India, coal is the most abundantly available fossil fuel profusely used for power generation. A major share of the country's electricity is generated from fossil fuel sources, mostly from coal based thermal power plants. The waste heat recovery CPP in OCL will be able to displace/ replace electricity generated by grid-connected power plants. Being able to do away with grid power, OCL will be saving further exploitation and depletion of natural resource – coal, or else increasing its availability to other important processes like metallurgical and manufacturing process.

Clean Technology: - WHR based captive power plant will be developed as a cleaner technology for utilizing waste flue gases of sponge iron kiln which otherwise would have been emitted to the atmosphere leading to thermal pollution. The electricity generated from the system has partly substituted the power supplied from grid enabling project proponent to reduce carbon dioxide emission and other associated pollution at the thermal power plants; equivalent of which would be emitted in absence of the project. Further, transmission and distribution losses have been reduced as the total generation is being consumed for captive requirement. The wastewater generated from the project activity will be reused for sprinkling on roads, fire-fighting purposes and for green belt development. Particulates from hoppers of Electrostatic Precipitator (ESP) and Air Pre Heater will be collected in Silo and used in cement manufacturing process.

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 Chapter 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)
Ministry of Environment & Forests, Govt. of India	Public Entity	No
OCL India Limited	Private Entity	Yes

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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Orissa

A.4.1.3. City/Town/Community etc:

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Rajgangpur, Sundargarh District

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

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Project Location

The project activity, waste heat based captive power plant, is proposed to be implemented in the Sponge Iron Works of OCL India Limited, located at Rajgangpur, Sundargarh district, state of

Orissa, India. The geographical location of the site is at 84^0 35' E longitude and 22^0 12' N latitude. The site is well connected with rail and road. Rourkela city is approximately 40 kilometer (km) from the place, which also has an airport.

Other requirements of the project including water requirement, infrastructure facilities *etc.* are also available at site.

Location advantages:

- Availability of well developed industrial infrastructure [transport, telephone exchange, banks, other civil amenities and housing facilities at Rajgangpur and extensive infrastructure facilities at Rourkela, only 40 km away]
- Abundance of skilled and semi-skilled labour
- Proximity to highways (State Highway # 10), only 40 km from Rourkela a big industrial township, railway station [Rajgangpur]

The geographical location with rail/road connectivity of Rajgangpur is detailed in Fig 1 below.

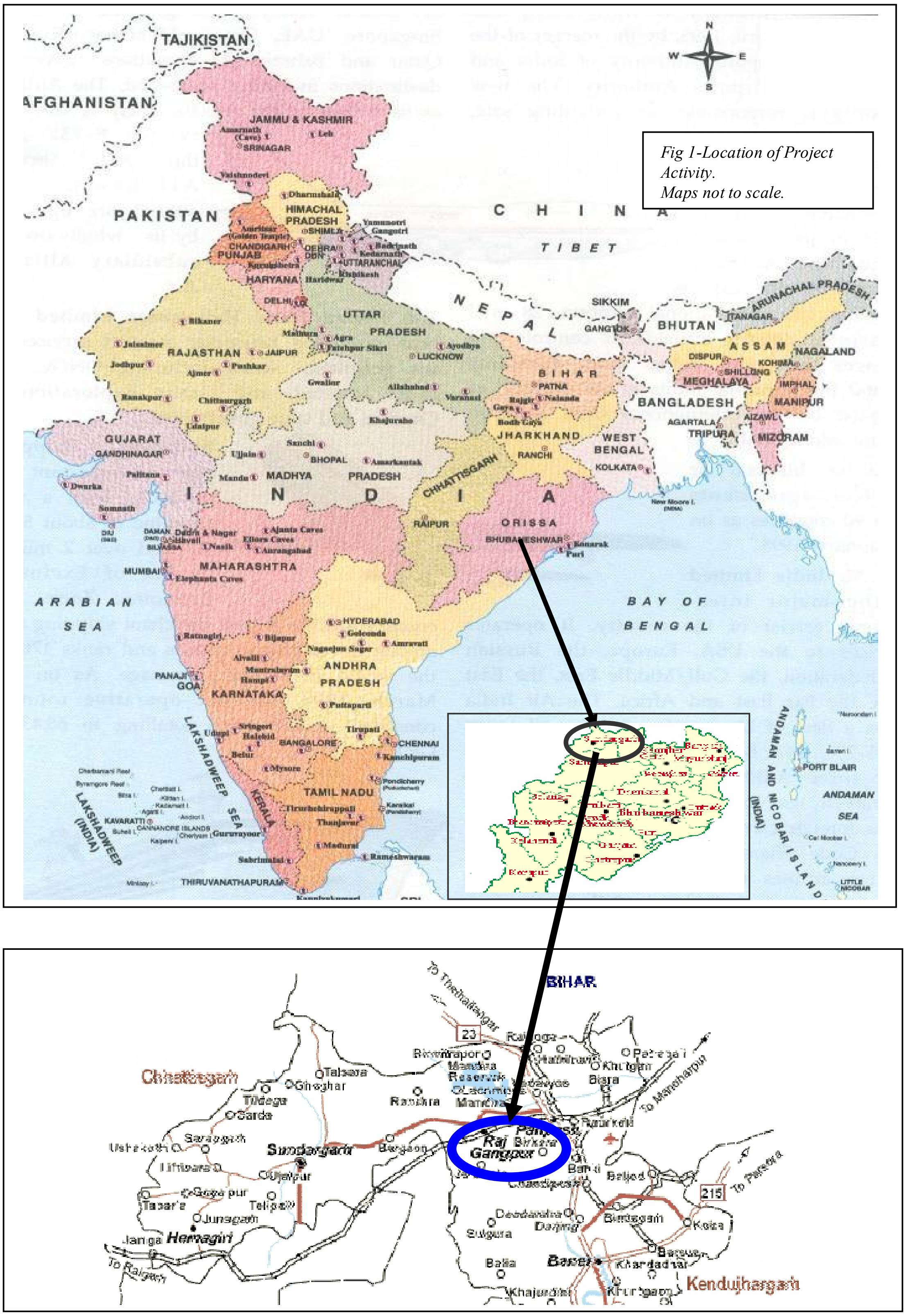

Fig 1-Location of Project Activity.
Maps not to scale.

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 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 linked approved baseline and monitoring methodologies (version 17 Aug 05) on the UNFCCC website for accreditation of Designated Operational Entities[2].

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

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The Waste Heat Recovery based captive power plant using modern equipments, utilizes heat content of the waste flue gas from DRI kilns of sponge iron unit to generate electricity for captive consumption of OCL. Average flue gas availability from the sponge iron kilns of OCL is 24,000 Nm^3/hr from each of the 4 kilns, amounting to a total availability of 96,000 Nm^3/hr.

The flue gases from the sponge iron kilns are received at the After-Burning Chamber (ABC) inlet at a temperature of about 900-920^oC. After secondary combustion (of un-burnt carbon monoxide and hydrogen) the hot flue gas leaves ABC at temperatures ranging from 950^oC to 1050^oC and is introduced to the WHRBs through a hot gas duct.

Four WHRBs will be installed under the project activity, connected respectively to the four DRI Kilns. The flue gas available from each kiln will be fed to the respective WHRB of 10 tph steam generation capacity. The combusted gas is circulated through three passes of WHRB to transfer the heat energy of the waste gas to water and generate steam. At first two passes the radiation heat in addition to convection heat component of the hot gas will be recovered. About 75% of heat shall be recovered at this point. Finally, the gas passes 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 WHR chamber at a temperature of around 180-200^oC. The steam from the WHRBs at

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

65kg/cm^2 and 485^0C will be fed into the high efficiency single extraction-cum-condensing type multistage Steam Turbine & Generator (STG) set of 14 MW rating to generate power.

Combusted gas after maximum heat transfer in the boiler will lead to the exhaust stack through Electrostatic Precipitator (ESP), which reduces the Suspended Particulate Matter (SPM) load to a large extent. The SPM will be collected in the hoppers of the ESP. The particulate matter collected in the hoppers will be conveyed to existing silo by totally enclosed pneumatic conveyors.

Other accessory systems required for the CPP includes water-cooled condenser, cooling water system, de-aerator, de-mineralization plant, air compressor system etc. Water cooled condenser will be used to condense exhaust steam after passing through turbine casing. Only treated water is supplied to the boiler to avoid scale formation in boiler heat transfer tubes and better performance. Blow down water is used for other purposes like plantation.

In OCL's DRI plant each of the 4 sponge iron kilns are shut down for a period of 30 days in a year, one at a time. So for cumulative period of 120 days in a year 3 kilns would be operating which will enable the CPP to generate at 6 MW. For the rest of the year the CPP generates at design capacity of 8 MW from waste heat sources.

The electrical energy produced partially meets the electricity demand of the cement plant, refractory unit and the sponge iron unit. 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, OCL India Limited started civil construction on the WHR based Captive Power Plant in the year 2004. The CPP will start commercial operation in April 2006. The zero date for CER calculations and quantification of CO_2 reduced for this project has been considered from 01 April 2006 and will extend till March 2016, 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:

OCL proposes to set up its Waste Heat Recovery Based CPP with an objective to utilize waste resources available from manufacturing process and use it to generate electrical energy for its own utilization.

The project proposes to employ a non-GHG emitting technology - Waste Heat Recovery and Steam Generating System. In the absence of the project, the electricity requirements of equivalent amount shall be met by WESCO's grid supply resulting into an equivalent amount of CO_2 emission from the thermal power station. However, due to project activity, project proponent OCL shall be able to do away with equivalent amount of generation from thermal power plants, resulting in corresponding reduction of CO_2 emissions.

The project activity will be generating an output of approximately 39.5 MU/annum after auxiliary consumption. The average estimated total of emission reductions to be achieved by the project is 25713.35 tonnes of CO_2/year and 257133 tonnes of CO_2 for the entire 10 years of crediting period. In absence of the project the same energy load would have to be borne by the thermal power plants and the reductions in CO_2 emissions as mentioned above would not occur.

There is no legal or mandatory requirement under local, state, or central governments for sponge iron units to have their own captive power units and utilize the heat content of the waste gases generating from the manufacturing processes. The project proponent will be implementing the project activity over and above the national or sectoral requirements.

Further, the project faced a number of regulatory/institutional barriers during granting of permission of the waste heat recovery based CPP. The project activity was conceived in the year 2002 when the rules related to captive power generation in India were not clear. The distribution licensee of the Government that supplied power to OCL strongly opposed the setting up of the CPP on superfluous reasons. These factors led to significant time and cost overrun. Later, though the new Electricity Act which was enacted in 2003 liberalised captive power generation, the project proponent still continued to face numerous barriers on a continuous basis. These barriers are further dealt in detail in Section B3.

OCL decided to implement the project activity by overcoming the regulatory and cost overrun barriers and developing technical expertise for power generation. OCL 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 that would be made available under CDM. The project meets the additionality tests of 'Tool for the demonstration and assessment of additionality' because its existence and operation has the effect of reducing GHG emissions below the level that would have occurred in its absence (refer section B.3 for further details).

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

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Crediting Years	Annual Estimation of emission reductions in tonnes of CO_2 e
2006-2007	25713.35
2007-2008	25713.35
2008-2009	25713.35
2009-2010	25713.35
2010-2011	25713.35
2011-2012	25713.35
2012-2013	25713.35
2013-2014	25713.35
2014-2015	25713.35
2015-2016	25713.35
Total estimated reductions CO_2 e	**257133**
Total number of crediting years	**10**
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**25713.35**

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[3]

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 OCL's sponge iron unit through WHRSGS in the CPP of OCL. The electricity generated shall meet a part of the demand for the cement plant, refractory and the sponge iron unit.

In absence of the project OCL would have drawn equivalent amount of electricity from the state grid supply GRIDCO (the state transmission utility from where WESCO draws power) consisting of a generation mix from various sources mainly thermal (gas, coal), hydro and renewable resources like wind and some individual CPPs. Also the waste heat energy in the flue gases would have been lost in the ambient air adding to thermal pollution of the area.

In the project activity scenario, a major part of the heat energy of the waste gases is recovered and efficiently utilized to generate steam, which is used to generate electricity to meet a part of OCL's electricity requirement. This heat energy recovery and utilization measure will eliminate equivalent energy need from the grid and allows grid to reduce this much of electricity generation at source

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

end. Therefore with successful operation of captive power plant, the project will be able to displace/ substitute the equivalent power units from grid mix with an emission factor of 0.651 $kgCO_2/kWh$ estimated as per the approved methodology ACM 0004 (refer to Appendix III).

However since the project has a capacity of 8MW, which is less then 1% of the state grid capacity (3489.335 MW[4]) 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 a 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 applies 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

OCL's project activity is a WHR based power project utilizing waste heat from sponge iron rotary kilns that uses coal as fuel. Before project activity OCL was importing power from the grid to meet

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[4] http://www.gridco.co.in/ab/a1a.htm

its power requirement and was releasing the waste gases (along with its heat content) into the atmosphere. In addition the sponge iron kilns of OCL continue to use coal as fuel and no fuel switch is planned during the crediting period. Hence, the project activity meets both the applicability criteria of the methodology.

The non-project option is "import of electricity from the grid". Since the baseline scenario of the project activity is grid connected (detailed in SectionB2) 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 GRIDCO 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 fuel consumption, total electricity generated,plant load factor, CO_2 emission factor and total run time, etc of the individual 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:
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The project activity involves setting up of 8MW WHR based CPP by OCL to meet a part of its total in-house power consumption. The methodology ACM0004 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 consider 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 will be supplying a total of 8MW of power to OCL Works. Five plausible alternative scenarios were available with the project proponent which has been considered for analysis of the alternative scenarios:

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

The project proponent could continue to purchase their power requirement from WESCO that draws power from the state transmission utility GRIDCO .An equivalent amount of CO_2 emissions would take place at the thermal power plants supplying power to GRIDCO. This alternative is in compliance with all applicable legal and regulatory requirements and can be a part of baseline option.

Alternative 2: 8MW Coal based CPP at OCL

The project proponent could set up an 8 MW coal based CPP at its existing sponge iron plant. The power generated would partially meet OCL's own demand. 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: 8MW Gas based CPP at OCL

The project proponent could generate their 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 Orissa[5]. Therefore, alternative 3 may be excluded from consideration as a baseline alternative.

Alternative 4: 8MW light diesel oil or furnace oil based CPP at OCL

OCL could also set up 8MW light diesel oil (LDO) or furnace oil (FO) based CPP at its existing sponge iron plant. An equivalent amount of CO_2 emissions would be released at the CPP end. This

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

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

The project proponent may set up an 8MW waste heat recovery based CPP at its existing sponge iron plant to partially meet its demand. This alternative is in compliance with all applicable regulatory requirements. The energy content of the flue gases from the kilns in this case would be fully utilized and OCL would reduce an equivalent amount of CO_2 emissions at the thermal power plants feeding to GRIDCO. However, for this option, the project proponent would face a number of regulatory, investment and technological barriers (as detailed in Section B3 below) making it predictably prohibitive. Hence this option cannot be considered as a plausible baseline alternative.

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 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 cost per MW installed and the unit cost of electricity purchased or produced. Table 1 below shows the evaluation of the three options:

Table 1: 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 2001-2002	2.93	OCL Annual Report 2002-03 and 2003-04	Continuation of current situation, lower annual expenses in the form of electricity tariff, No additional investment, easy government approvals	An economically attractive option
		Year 2002-2003	3.21			
		Year 2003-2004	3.05			
2) Coal based CPP	42.5 - 45.0	1.78 - 1.92		Indicative prices available in India during project inception stage[6]	High Capital Cost - uneconomical for small sizes, difficulty in accessing bank loans, government approvals cumbersome.	This option is economically unattractive
4) LDO/FO Based CPP	7.50 – 12.0	3.50 – 4.60		Indicative prices available in India during project conception stage[6]	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, OCL expected further oil price hike in future.	This option is economically unattractive

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

Thus in view of the above points, the Baseline 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 (business-as-usual-scenario). Out of 64 sponge iron plants in the state only 5 plants (excluding OCL) have waste heat recovery based captive power generation (see Section B3 for details).
- No power generation risk involved
- There is no additional capital investment required
- The OCL plant was already connected to the state grid and depended on the same in absence of the project. Even in the post-project scenario the plant imports grid electricity based on their requirements.
- The grid's generation mix comprises of power generated through sources such as thermal (coal and gas), hydro and renewable energy. The project activity would therefore displace an equivalent amount of electricity the plants would have drawn from the grid. The Baseline Emission Factor of the grid is more conservative than that of the coal based CPP.

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

Establishing the additionality for the project activity

This step is based on Annex I: "Tool for demonstration and assessment of additionality" of the sixteenth meeting of Executive Board. Information/data related to preliminary screening, identifying alternatives, common industry practice and other investment, 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 section provides steps for analysis of the selected baseline scenario to calculate the baseline emission factor. Details of baseline emissions are shown in Annex3.

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 GHGs 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 'Tools 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.

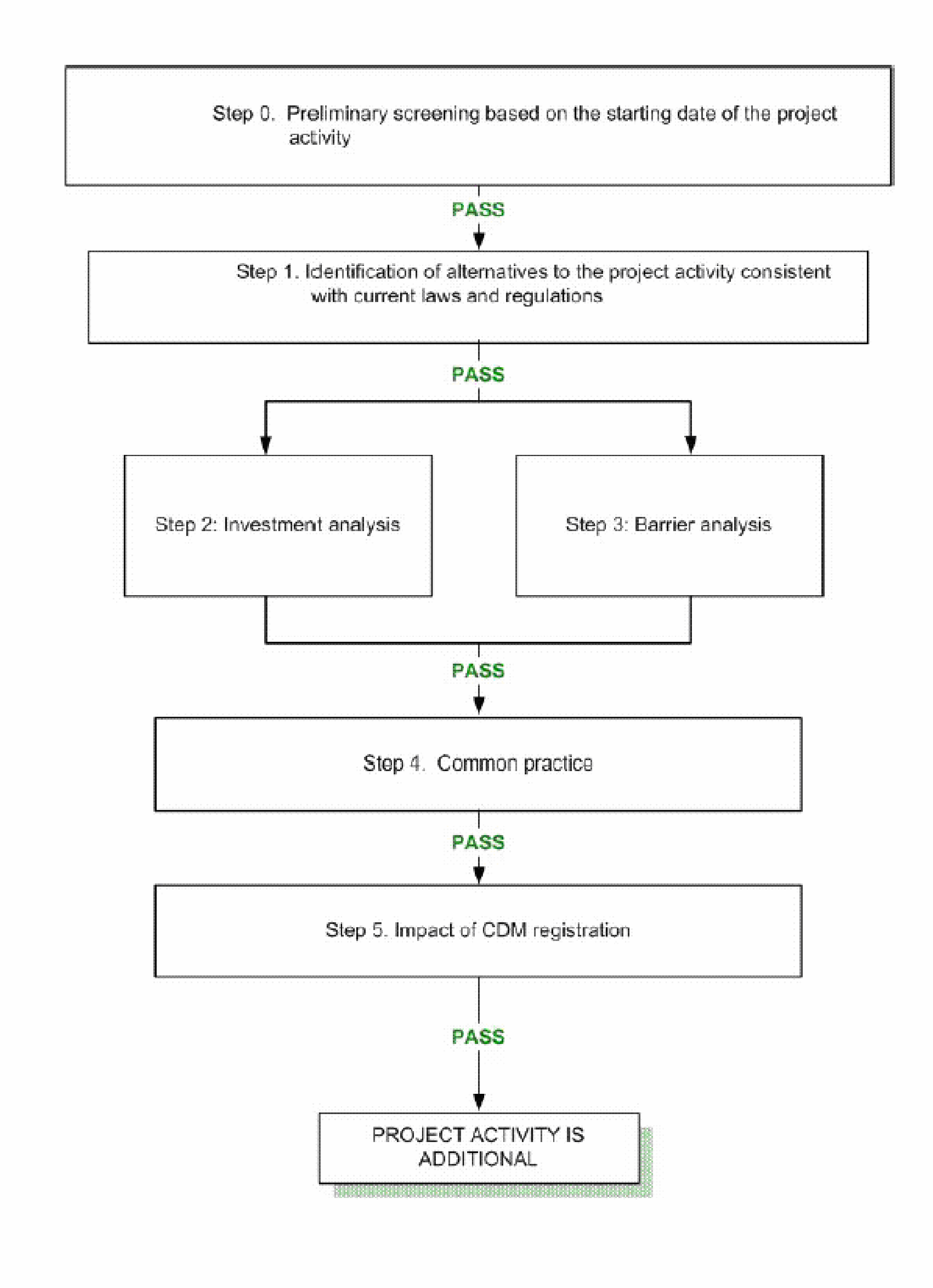

Fig 2: Flow chart for establishing additionality

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 OCL India Limited started the construction of the project on WHR based captive power generation in August 2004. OCL 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, OCL is committed for business growth keeping in mind the environmental protection aspects both locally as well as globally. OCL is aware that the emergence of the concept of sustainable development in recent years has brought in the general realization that environmental issues are inexorably linked with its development objectives and polices. All activities undertaken by OCL take into consideration the environmental, health and social assessment. Consequently, climate change issues are very much a part of OCL's decision making covering all its proposed activities. OCL 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 OCL in its meeting on 17th May 2003 decided to take up the project activity in view of the risk mitigation cover CDM would provide[7]. 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.

[7] Minutes of Meeting of Board of Directors of OCL held on 17th May 2003.

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 8MW of power to OCL plant. 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 OCL – continuation of current scenario
Alternative 2: 7 MW Coal based CPP at OCL
Alternative 4: 7 MW light diesel oil or furnace oil based CPP at OCL

These alternatives are in compliance with all applicable legal and regulatory requirements. There is no legal binding on OCL 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 Orissa Pollution Control Board to implement the same. From the above we can conclude that the project activity is a voluntary activity on part of the project proponent and is no way mandated by the law or instigated by the promotional policies of the Government. It is a proactive endeavor to improve on energy efficiency by utilization of waste heat energy and reduce greenhouse gas emissions.

Next the project proponent is required to conduct

Step 2. Investment analysis OR

Step 3. Barrier analysis

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

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

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

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

1. **Regulatory and Institutional Barriers:**

Macro Perspective: In India the power demand has always outstripped supply and the quality and reliability of power supply have not improved[8]. This has resulted in widespread power shortages throughout the country, wide fluctuations in supply voltage and frequency, frequent grid disturbances and general lack of system integrity. Shortages in power are exacerbated by the very high (and worsening) transmission and distribution (T&D) losses, which have increased from 18% in 1970 to around 32% in 2004[9] against an international average of less than 10%. This situation is largely a result of under-investment in T&D systems in comparison with investment in generation capacity addition, and is also strained by inadequate billing, improper metering and pilferage of power.

The Indian Power sector faces a number of problems like

- inadequate financial resources
- cumbersome project clearance procedures
- poor financial management of financial resources
- irrational tariff structure

During the project conception phase in 2002, the prevailing statute for setting up captive power plants in Orissa was governed by the law of Orissa Electricity Reform Act enacted in 1996. Under the Act, the authority for setting up CPPs was conferred with Orissa State Electricity Regulatory Commission (OERC). Consent to establish and operate were to be taken from OERC on the condition that the power distribution licensee had no objection for setting up of the CPP. This made obtaining approvals for implementation of captive power plants cumbersome and time consuming. The regulatory barriers faced by OCL (the project proponent) are detailed below:

- The agricultural and domestic consumers are being heavily cross subsidized by the industrial and commercial consumers in India[10]. Billing and collection is much more efficient for High Tension (HT) industrial consumers[11]. The development of captive power stations would reduce the revenues of state utilities that could in turn lead to reduction in cross subsidy to the domestic and agricultural sector. With this trend the financial problems of the SEBs would continue to worsen[8].

[8]'Problems and prospects of privatisation and regulation in India's power sector' http://www.ieiglobal.org/ESDVol3No6/india.pdf

[9] http://www.cea.nic.in/ge_re/2004-05/chap-5.pdf

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

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

In fact, one of the major reasons SEBs have 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 are unwilling to give up the industrial segment and hence have framed policies which do not encourage captive power plants. Such an 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 WHR CPP in OCL's case.

- 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[12]. This factor was also one of the reasons why SEBs in India dissuaded industrial consumers like OCL from setting up their own CPP.

Problems OCL had to face in particular: OCL conceived the WHR based CPP in the year 2002. During this period, the project proponent had to face stiff objection from WESCO, the government authorized distribution licensee, as granting of such a generating license in favour of OCL would eventually eat into its profitability and reduce substantial demand (equivalent to 8 MW) from a power intensive consumer like OCL. A number of arguments for a prolonged period were held between OCL and WESCO, the copies of correspondences for which are available with project proponent and can be shown on request. Finally, OCL filed a petition with OERC[13] (Case no. 59/2002) against the refusal of WESCO to setup the CPP. In the hearing of the case on 31st Jan 2003, WESCO expressed their apprehension about:

- technical soundness of OCL's proposal
- misuse of Consent and
- Suppression of actual drawl from WESCO by OCL once the project becomes operational.

Representatives of OCL argued in the hearing that

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

[13] See OERC Orders – Cases in 2002 : http://www.orierc.org/

- utilizing waste heat could directly result in conserving scarce natural resources like coal and petroleum
- the project activity is an environmentally friendly proposition.

OERC was aware that Government of India was encouraging captive power plants that reduce pollution and stated (in its ruling on 18th Feb 2003) that WESCO dwelt on extraneous issues and their objections merit no consideration. The commission finally granted OCL permission to set up the CPP subject to certain strict conditions. The Commission also ruled that consent for installation shall remain valid for a period of 24 months from date of issue and shall lapse automatically, if the units are not installed during that period.

In view of the above regulatory risks, OCL's management was apprehensive of implementing the project activity. This was further compounded by the shortage of availability of funds and requisite technical skills (explained below) in the limited time allowed by the Commission. However, OCL was fully committed to environmental concerns and in view of CDM developments at UNFCCC and benefits it provides for risk cover, the management in its board meeting in 17th May 2003 decided to take up the project as a CDM project activity.

2. Technological barriers:

a. <u>Availability of Flue Gas</u>: The power generation from the waste heat recovery based system in OCL is a function of availability flue gas at required temperature from 4 x 100 tonnes per day DRI kilns. 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. OCL had to overcome such barrier by streamlining the operation of the DRI kilns with the power plant. Hence, operation of the kilns has to be monitored in order to keep co-ordination between the 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.

OCL would have 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 has to be ensured that no leakages took place through the pipeline system resulting in loss of energy into the atmosphere. The same is being monitored under project monitoring and verification plan.

b. Spray System: The other problem associated with the project activity is due to the high temperatures of the flue gas from the DRI kilns. The high temperatures to the tune of around 950-1050^{o}C with the heavy dust loading, gives rise to the possibility of fusing /choking the inlet duct, which may lead to stoppage of production. This problem has been overcome by OCL by installing water spray system in the ABCs connected to the DRI kilns.

The highly abrasive nature of the dust that goes in to the WHRBs along with the flue gas creates possibilities of heavy erosion in the boilers. The WHRB tubes are designed with wear resistant material. And an extra radiation chamber for extraction of heat and to reduce the gas velocity will be provided having hopper at the bottom for collecting the settled particulates.

Moreover in order to overcome some problems in the existing design for waste heat recovery based power generation systems, OCL will be utilizing auto retraction type soot blower for cleaning of the tubes which will give better efficiency. A standby feeding-pump is also provided to take care of any breakdown.

c. Lack of relevant technical background

OERC in its ruling had clearly stated that for operating the CPP, OCL should abide by grid code so as not to have any adverse effect on the operation of WESCO's Grid System. Further, it stated that power plant would have to be installed within the stipulated time i.e. two years from the date of consent to establish. The violation of these conditions would lead to lapse of the consent.

Energy generation is not a core business of potential users - the project participant belongs to OCL Group of Industries which has never before taken up a power generation project. The group is engaged mainly in the manufacturing cement, refractory, sponge iron and steel billets. The waste heat recovery based power project is a steep diversification from the core business field to a new field of power generation. It had to face the obstacles of captive power policies, delivery/non-delivery of power and techno-commercial problems associated with electricity boards for which it had no proper prior experience.

However, OCL went ahead in implementing the project activity despite the above risks with an aim to meet its environmental commitments and reduce GHG emissions. OCL invited experts in power plant domain to implement the project activity. OCL's employees were given extensive training to develop expertise on design, development, implementation and operation of heat recovery based power plant.

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

The sponge-iron manufacturing sector belongs to steel industry sector with limited knowledge and exposure of complications associated with production of power. OCL 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 OCL 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 3 b. 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 1 in Step-I of Section B.2 above. OCL's project activity is a WHR based power project utilizing waste heat from sponge iron rotary kiln that uses coal as fuel. OCL would not have faced any regulatory or investment barrier in case it continued to import power from grid. Further for import of grid, OCL would not have to face any technological barriers as it would have to face for generation and synchronization of waste heat based power. Therefore, it is most likely that in absence of the project activity OCL 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.

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 Orissa with similar socio-economic environment, geographic conditions and technological circumstances there are 64 similar sponge iron plants. Table 2 below summarizes the common practices adopted by sponge iron manufacturing industries to meet their power requirement on a continuous basis – at the time of implementation of project activity in August 2004.

Table 2: Common practice analysis for WHR based CPP in Sponge iron plants of Orissa	
Scenario	**Number of Sponge Iron Plants in Orissa**
Scenario 1: Import of electricity from grid	59
Scenario 2: Coal based CPP	0
Scenario 4: Diesel/ LDO/ FO based CPP [i.e.DG sets]	0
Project activity: Waste heat recovery based CPP [excluding project activity]	05
Total number of sponge iron plants[14]	64

Source: OCL and Orissa Government Sources.

As per the Table, out of 64 sponge iron plants in Orissa, 59 plants import electricity from grid. None of the plants have fossil fuel fired CPP supplying power on a continuous basis. The implementation of project activity – WHR based CPP delivering power continuously occurs in only five similar industries (excluding OCL). Among these five plants, two plants [Orissa Sponge Iron Limited (OSIL) – 10 MW, and Tata Sponge Iron Limited (TSIL) – 7.5 MW] have implemented the project taking into account potential benefits under CDM and hence they are not considered for common practice analysis. It means that project activity occurs in only in 3 other plants i.e 4.6 % of total plants in Orissa. We may therefore conclude from the assessment of sponge iron units in Orissa that the project activity is not a common practice.

Step 4b: Discuss any similar options that are occurring

The other sponge iron plants that are operating Waste Heat Recovery based CPP in Orissa are SMC, Jharsuguda – 8 MW, Shree Metallic, Barbil – 8 MW and Bhushan Steel & Scrips, Jharsuguda- 40 MW. This shows that there is poor penetration of this technology in Orissa and hence not widely observed.

[14] http://www.telegraphindia.com/1050426/asp/nation/story_4662694.asp

Step 5: Impact of CDM registration

The project proponent and sponsor, OCL India Limited started the project work on WHR based Captive Power Plant in August 2004. The CPP will start commercial operation from April 2006. OCL was among the first three WHR based power projects in sponge iron units of Orissa. OCL invested in the project activity with an aim to maximize the waste heat recovery potential and minimize the GHG emission due to import of power, despite facing regulatory and investment barriers.

Although, the new Electricity Act that was passed in June 2003 by Government of India provided for freeing of license to generate captive power[15], a number of regulatory/institutional problems are still being faced by project proponent on a basis. Project activity getting registered as CDM project would give instant visibility among the state utilities power ministries/departments, environment ministries/departments enabling OCL to face lesser governmental hurdles thereafter.

Again, registering the project activity as CDM project would allow OCL to make the project successful and sustainable which would lead to banks lowering interest rates for similar activities to sponge iron industries located in the state. This would act as a precursor for other industries to invest in waste heat recovery based power generation and wheeling projects leading to further reduction in GHG emission reduction.

Successful implementation and running of the project activity on a sustainable basis requires continuous investments in technological up gradation. It also requires manpower training and skill development on a regular basis. The project proponent could get the necessary funding from selling the project related CERs. Apart from these, registration of the project under CDM would enhance the visibility would aid WESCO or GRIDCO in appreciating the GHG emission reduction efforts of the project proponent. This could lead to smoother transactions in future between the project proponent and utility. Further CDM fund will provide additional coverage to the risk due to failure of project activity, shut down of plant and loss of production of OCL.

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

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

Orissa/India and without the proposed carbon financing for the project the OCL would not have taken the investment risks in order to implement the project activity. Therefore the project activity is additional. Also, the impact of CDM registration is significant with respect to continuity of the project activity on a sustainable basis.

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

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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 OCL facility from their Waste Heat based Captive Power Plant. The activities include recovery and utilization of waste flues gases of Sponge Iron kiln of OCL after complete combustion and completes with transmission and distribution of generated power from the plant to OCL's cement plant, refractory division and sponge iron unit.

Hence, a boundary line along the periphery of the above mentioned activities (those components affected by project activities) should be the project boundary for this Waste Heat Recovery based Captive Power Project. Figure 3 shows graphical representation of the physical boundary of this Project. The boundary comprises of the Waste Heat Recovery Boiler unit, Economiser, Steam Turbine Generator, ESP, and Ash Removal System.

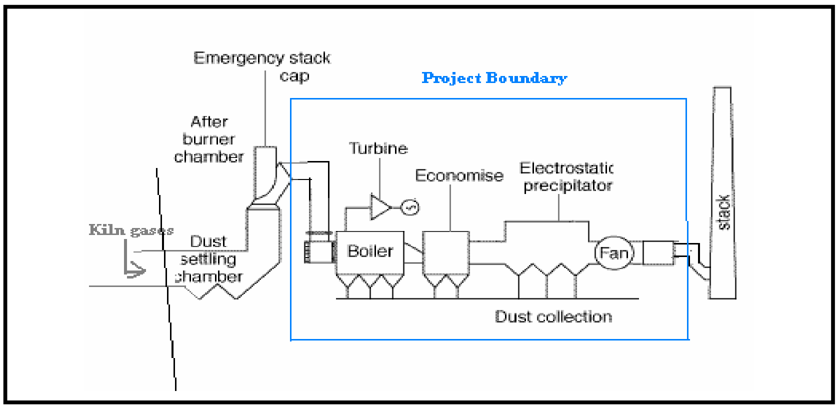

Figure 3: Project Boundary for OCL's Waste Heat based Power Project.

The project boundary starts from supply of waste flue gas at the boiler inlet to the point of electricity generated for end users.

Further, for the purpose of calculation of baseline emission, GRIDCO has been considered within the system boundary. Estimation of baseline emissions has been done based on data and information available from GRIDCO sources 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 ACM0004, baseline is calculated as per ACM0002 and the net baseline emission factor was found to be 0.651 kg CO_2/ kWh. Please refer to details in Annex 3 of the PDD.

Date of completing the final draft of this baseline section *(DD/MM/YYYY)*: 30/08/2005

Name of person/entity determining the baseline:

OCL India Limited and its associated consultants

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:

>>

August 2004

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

>>

20y

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

C.2.1. Renewable crediting period

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

>>

C.2.1.2. Length of the first crediting period:

>>

C.2.2. Fixed crediting period:

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

>>

01/04/2006

C.2.2.2. Length:

>>

10y

SECTION D. Application of a monitoring methodology and plan

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

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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

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 some of the essential parameters to be monitored. The methods of monitoring adopted should also qualify as economical, transparent, accurate and reliable.

Applicability Criteria of ACM0004 monitoring methodology:

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

OCL’s project activity is a waste heat recovery based power project utilizing waste heat from DRI kilns. The project activity displaces electricity of equivalent amount from GRIDCO having a generation mix of thermal (coal, gas) hydro and nuclear sources. Coal was used as fuel in the sponge iron kilns prior to project activity. The kilns 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 ACM0004 requires monitoring of the following:

- *Net Electricity Generation from Project Activity* (MWh / year)– This will be calculated as the difference of gross waste heat power generated for a year minus the auxiliary power consumption during that year. The project activity 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 will be calibrated and marked at regular interval to ensure accuracy.

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

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

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

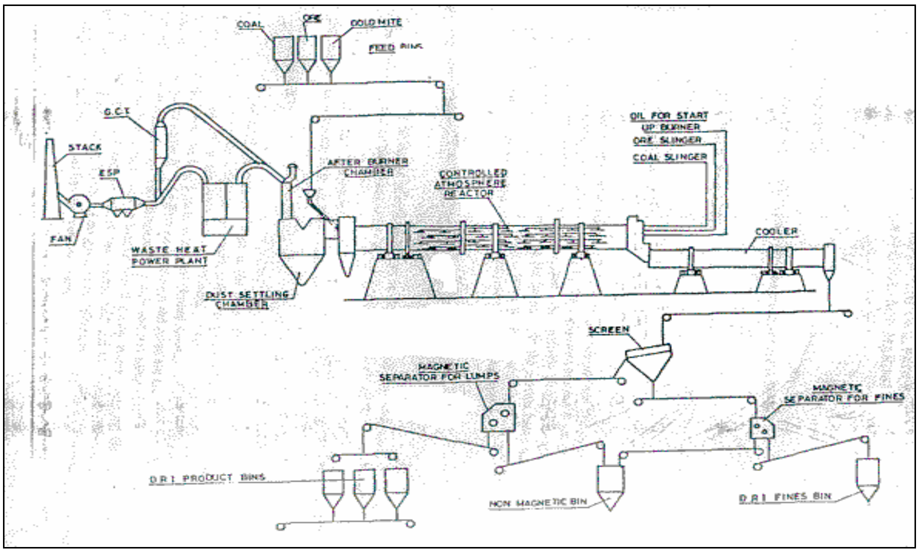
- *Data needed to calculate emission factor for captive power generation* - Not applicable for the project activity

Further, within the OCL facility there is no or negligible amount of T&D losses of electricity distributed and hence neglected.

Project Boundary and GHG Sources

To clarify the characteristics of the OCL waste heat recovery based power project, a full flow diagram is presented below. The project system comprises of the waste heat recovery boiler, STG, all other accessories for power generation, captive consumption units, ESP etc. The heat recovered from the waste gas is transferred to the water to generate steam, which in turn generates power through a turbine. The waste gas after passing through ESP and is released to the environment.

Figure 4: OCL Sponge Iron Works and waste heat recovery based CPP



The project boundary covers the point of supply of waste gas from ABC outlet to the WHRB inlet upto the point of power generated for use in OCL's cement plant, refractory unit and sponge iron unit.
However, for the purpose of calculation of baseline emissions GRIDCO is also included in the system boundary.
Further, upstream emissions should be placed within the project boundary when the project developer can significantly influence these emissions. In principle this could mean that the waste gas emissions that are made available from the ABC as input to the Waste Heat Recovery Boiler should be included within the system boundaries. These waste gas emissions were emitted in the atmosphere in the absence of the project activity. The project boundary will therefore not include the upstream emissions, which will any way be generated during production.

The project is using the energy in the waste gas and therefore eliminating the need of grid electricity. It reduces the production of the same energy from generating stations connected to grid. The amount of electrical energy generated and thereby substituted in the grid, is directly controlled by the project proponents, and will be under the preview of monitoring and verification protocol. The actual amount of CO_2 reduction however depends on the generation mix and production scenario of the grid that is taken into consideration in the baseline factor. The project does not have a direct control on the baseline. But since the baseline parameters like actual generation mix in million units and efficiency of thermal power plants will affect the actual emission reduction units that are attained during verification, they too will be included in the Monitoring and Verification procedure. The verification methodology takes into account the methodology to estimate the CO_2 reduction.
Therefore, the direct project boundary includes the WHRSG (Waste Heat Recovery Steam Generator and its auxiliaries) and STG (and its auxiliaries), whereas the system boundary extends to the thermal power plants.

GHG Emissions Sources of the Project

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

Indirect on-site emissions

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

Direct off site emissions

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

In-direct off-site emissions

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

Monitoring Plan Application

For such industrial energy efficiency projects - waste heat energy to electricity, it is adequate to monitor and verify the amount of electricity produced from the WHRSGS. To produce equal amount of electricity at the 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 kilns after complete combustion in ABC
- Utilization of recovered heat to produce steam, which in turn generates electricity.

The electricity produced by the system is used for in-house consumption of OCL facility. 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 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 GRIDCO and CEA sources. (Refer to Annexe 3 for details of baseline calculation). To monitor the actual amount of energy used and total electricity produced from project, flow meters and power meters should be installed at specific points. Power meters should be installed at the outlet of the turbine and other transmission points to calculate the total electricity produced. This can be further categorized into the auxiliary consumption and electricity transmitted/distributed to the SIW, Cement Plant and Refractory of OCL. The total electricity produced is the function of total heat recovered from the flue gas; total flue gas used as well as the characteristics of the flue gas. Gas Flow meter should be placed at the inlet of the WHR boiler to measure the total volume of flue gas utilized per kWh of power produced. The temperature, pressure and chemical composition of the flue gas should also be monitored for evidence that electrical energy being generated with zero net GHG emission. Flow rate of steam generated in the WHRB and fed to the turbine, steam temperature and pressure should be measured for calculation of total electricity produced from the project activity.

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

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:									
ID number *(Please use numbers to ease cross-referencing to D.3)*	Data type	Data Variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording Frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data to be kept	Comment

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

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

For Electricity Generated by Project Activity

ID No.	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (Electronic/ paper)	For how long is archived data to be kept?	Comments
1. EG_{gen}	Quanti tative	Total Electricity Generated	MWh /year	Calculated[16]	Continuously	100%	Electronic/ paper	Credit Period + 2 years	MONITORING LOCATION: The data will be measured by meters at plant and DCS. Manager In-charge would be responsible for calibration of the meters. See Annexe 4 for details
2. EG_{aux}	Quanti tative	Auxiliary consumption of Electricity	MWh /year	Calculated[17]	Continuously	100%	Electronic/paper	Credit period + 2 years	MONITORING LOCATION: The data will be measured by meters at plant and DCS. Manager In-charge would be responsible for regular calibration. See Annexe 4 for details
3. EG_y	Quanti tative	Net Electricity supplied	MWh /year	Calculated (EG_{gen}- EG_{aux})	Continuously	100%	Electronic/paper	Credit Period + 2 years	Calculated from the above measured parameters. Algorithm for project emissions given in baseline methodology

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

[17] 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
4. EF_y	Emission factor	CO_2 emission factor of the grid	tCO_2/ MWh	Calculated	Simple OM, BM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated as weighted sum of OM and BM emission factors
5. $EF_{OM,y}$	Emission factor	CO_2 operating margin emission factor of the grid	tCO_2/ MWh	Calculated	Simple OM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated as indicated in the relevant OM baseline method above
6. $EF_{BM,y}$	Emission factor	CO_2 Build Margin emission factor of the grid	tCO_2/ MWh	Calculated	BM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated as [∑I Fi,y*COEFi]/ [∑mGENm,y] over recently built power plants defined in the baseline methodology
7. $F_{i,j,y}$	Fuel	Amount of	t or	measured	Simple	Yearly	100%	Electronic	During the crediting	Obtained from

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
	Quantity	each fossil fuel consumed by each power source/ plant	m^3/year		OM BM				period and two years after	authorised latest local statistics
8. $COEF_{i,k}$	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	Calculated based on the IPCC default value of the Emission Factor, Net Calorific Value and Oxidation Factor of the fuel used by the power plants feeding to GRIDCO.
9. $GEN_{j,y}$	Electricity quantity	Electricity generation of each power source/plant	MWh/ year	measured	Simple OM BM	Yearly	100%	Electronic	During the crediting period and two years after	Obtained from authorised latest local statistics

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

>>

Emission Factor of the Grid (EF_{Grid})

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

STEP1: Calculate the Operating Margin emission factor

The Simple OM emission factor ($EF_{OM,simple,y}$) for GRIDCO 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 (2001-2002, 2002-2003 & 2003-2004) 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 2001-2002, 2002-2003 and 2003-2004

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 GRIDCO. 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 6 (six) 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 GRIDCO, EF_y is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

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

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

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

Baseline Emission Calculations

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

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

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

Therefore the Baseline Emission is calculated as,

$$BE_y = EG_y \otimes EF_y$$

where,

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

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

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

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

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

Not applicable

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

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

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

>>

D.2.3. Treatment of leakage in the monitoring plan

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

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

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

Not Applicable

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

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

Please refer to Section E.5 of this document.

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

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

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

>>

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

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

>>

Experts and consultants of OCL.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>>

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

E.2. Estimated leakage:

>>

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

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

>>

A net emission by project activity (E1+E2) is zero tonnes of CO2 per kWh of power generation.

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

>>

Sl. No.	Operating Years	Baseline Emission Factor (kg CO_2 / kWh)	Baseline Emissions (tonnes of CO_2)
1.	2006-2007	0.651	25713.35
2.	2007-2008	0.651	25713.35
3.	2008-2009	0.651	25713.35
4.	2009-2010	0.651	25713.35
5.	2010-2011	0.651	25713.35
6.	2011-2012	0.651	25713.35
7.	2012-2013	0.651	25713.35
8.	2013-2014	0.651	25713.35
9.	2014-2015	0.651	25713.35
10.	2015-2016	0.651	25713.35

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.	2006-2007	25713.35	0	25713.35
2.	2007-2008	25713.35	0	25713.35
3.	2008-2009	25713.35	0	25713.35
4.	2009-2010	25713.35	0	25713.35
5.	2010-2011	25713.35	0	25713.35
6.	2011-2012	25713.35	0	25713.35
7.	2012-2013	25713.35	0	25713.35
8.	2013-2014	25713.35	0	25713.35
9.	2014-2015	25713.35	0	25713.35
10.	2015-2016	25713.35	0	25713.35

Total estimated Emission Reductions: **257133 tonnes of CO_2 equivalent** over 10 year crediting period

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

>>

Please refer to Appendix III for Details

SECTION F. Environmental impacts

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

>>

Sustainable Development has been an emerging concept which has brought in the realisation of the importance of the environmental issues linked with the development objectives and policies. A project activity can cause impacts on environment either positive or negative depending on the type of the activity, throughout the project lifetime. The project also requires the clearance from the Orissa Pollution Control Board, which is mandatory. The impacts of the project activity on the environment are considered before issuance of such clearance. OCL has already obtained clearance from OPCB for the said project activity. OCL 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 a remote area; hence it is 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.

A broad assessment of the benefits to the environment due the project activity on a local, regional and global level in various ways may be as follows:

- 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 will also successfully conserve the non-renewable natural resource such as coal, oil and natural gas by reducing power demand by 39.5 MU annually on local grid.

- Project activity will also enable OCL 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:

>>

An EIA study for the project has been initiated by the project proponent. Considering the environmental impacts associated with such a project activity the impacts in then following phases of the project implementation has been considered:

⇒ During Construction Phase

⇒ During Operational Phase

⇒ During Maintenance Phase

<u>During Construction Phase</u>

The main area of concern during construction phase is: -

⇒ 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 will not affect the environment considerably.

<u>**During Operational and Maintenance Phase**</u>

Impact on Air Environment

Air Quality

Project activity will have no negative impact on the ambient air quality of the project site. OCL 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. ESP with ducts, extraction fan and air vents of appropriate height shall be installed at critical points to capture flue dust from the process. The plant and process area has been designed in such a way that the work environment will have dust loading less than permissible limits from the process equipment, thereby maintaining safe work place.

The CPP will be utilizing the waste gas of the 4 kilns generated at the rate of 24,000 Nm^3/ hr from each, thereby by reducing air pollution that would have occurred in absence of WHRB. Electrostatic Precipitator (ESP) will be installed as pollution control equipment. The ESP will be collecting the dust from the flue gas after it passes through the WHRBs and discharge into the hopper from where it is collected and disposed off. The flue gas from ESP will be vented to the atmosphere through a stack. Adequate stack height will be provided as per CPCB norms. All sources of dust generation in the plant shall be well designed for producing minimum dust and shall be provided with high efficiency ESP. The emission level shall be limited to 100 mg/Nm^3.

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 the exit temperature is about 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 OCL boundary thus benefiting the local as well as regional environment by reducing mobile emission.

Noise Generation

Noise pollution from turbine, fans, centrifugal pumps, electric motors etc. shall be kept below the permissible level by proper design. Noise from safety valves, start up vents, steam jet ejectors of condenser etc. are reduced by providing silencers ate the outlet of the downstream piping. Signboards shall be 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 shall be followed.

IMPACT ON WATER ENVIRONMENT

Project is a zero discharge unit. OCL proposes to use water cooled condenser for condensate collection However OCL proposes to arrange for whatever water is required from its own mining area at Lanjiberna, which is about 6kms from OCL's Sponge Iron Plant. Pipelines have been laid and water will be pumped to feed the project activity, from the Lanjiberna mines to the CPP in the sponge iron plant. The water will be treated in an efficient effluent water treatment plant.

The other main sources of wastewater related to OCL's project activity will be the DM Plant backwash.

DM plant wastewater: Acidic and alkaline effluents will be generated during regeneration of various ion exchange units in the DM water plant. The project proponent proposes to neutralize these effluents in a neutralizing pit and the treated effluent shall be used for development/maintenance of green belt.

Solid Waste Management

A waste heat recovery based power generation project does not have any significant effects as regards solid waste generation.

Safety Management

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

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. OCL as a policy gives a lot of priority to green belt development and has a continuous programme for increasing the same in the vicinity of its activity areas.

Social

The project has obvious socio-economic benefits creating employment opportunities, improving income structure, transportation, medical facilities, housing and other ancillary businesses 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 air, 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

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

The stakeholders identified for the project are as under.

- Local Authority
- Local community
- Grid Corporation of Orissa (GRIDCO)
- Western Electricity Company of Orissa Ltd. (WESCO)
- Orissa Electricity Regulatory Commission (OERC)
- Indian Renewable Energy Development Agency (IREDA)
- Orissa Pollution Control Board (OPCB)
- Environment Department, Govt. of Orissa
- Ministry of Environment and Forest (MoEF), Govt. of India
- Ministry of Non-conventional Energy Sources (MNES)
- Chambers of Commerce
- Workers' Unions
- 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. OCL 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 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 beneficiary of the project activity, as the power that is generated from the power plant will be substituting grid supply thus improving the power reliability and stability in the local electricity network. 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 Orissa have prescribed standards of environmental compliance and monitor the adherence to the standards. The unit will have minimum discharge unit with compliance to these standards.

The project proponent is in the process of acquiring the necessary statutory clearances from the concerned government departments like GRIDCO, OPCB etc.

The project proponent has already received clearances from the local bodies at Rajgangpur. The Rajgangpur Municipality has communicated its appreciation for such an effort on OCL's part. It has recognized OCL as a responsible corporate citizen proactive on sustainable development issues.

The Office of Tahsildar (local government authority) Rajgangpur has also communicated its appreciation for such a commendable energy efficient endeavour by OCL.

Some of the other stakeholders who have communicated their support and appreciation for the proposed project activity are:

- Lions Club of Rajgangpur

- Rourkela Chamber of Commerce

- Investech Fiancial Services (one of the consultants to OCL)

- Lanjiberna Shramik Sangha

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), local clearances *etc.* were considered while preparing the CDM Project Design Document.

The OCL 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:	OCL India Limited
Street/P.O.Box:	Rajgangpur
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City:	Rajgangpur, District – Sundargarh
State/Region:	Orissa
Postfix/ZIP:	770 017
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FAX:	91-6624-220733
E-Mail:	
URL:	www.oclindia.com
Represented by:	Assistant Executive Director
Title:	Mr.
Salutation:	Pandey
Last Name:	
Middle Name:	R.
First Name:	-
Department:	Engineering
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

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

Annex 3

BASELINE INFORMATION

Determination of Carbon Intensity of Chosen Grid

The project activity would generate electricity by utilising the heat content of the waste gas of the sponge iron kiln and displace an equivalent amount of electricity from the grid. The emission reduction resulting from the project activity would depend on the emission factor of the grid mix. Therefore it is required to select the appropriate grid where an equivalent amount of electricity would be displaced by the electricity generated from the project activity.

A) Choice of the Grid

The Current Delivery System in India and Orissa were studied for selection of a realistic grid representing the factual scenario associated with the project activity. Relevant information/data are provided herein.

Indian power grid system (or the National Grid) is divided into five regional grids namely Northern, North Eastern, Eastern, Southern and Western Region Grids. The Eastern Regional Grid consists of Bihar, Jharkhand, Orissa, West Bengal, Damodar Valley Corporation (DVC) and Sikkim state sector grids. These regional grids have independent Load Dispatch Centres (LDCs) that manage the flow of power in their jurisdiction. Power generated by state owned generation units and private owned generation units are consumed totally by respective states. The power generated by central sector generation plants is shared by all states forming part of the grid in fixed proportion. This central share amount has been allocated for the Orissa State. In Orissa, Grid Corporation of Orissa Limited (GRIDCO) is the state grid authority. Load Despatch Centre, Bhubaneswar is the unit within GRIDCO, which has responsibility for monitoring the state demand. GRIDCO is the sole Transmission Licensee for the supply of power in the state. Under the commercial structure currently envisaged, GRIDCO purchases power from the various generating stations and supplies to the four Distribution Companies under the terms of a bulk Power Supply Agreement. The total installed capacity of the power generating stations in the National Grid, Eastern Regional Grid and the Orissa State Grid are provided below.

Table 3: Current Power Sector Scenario[18]

Monitored Capacity (MW)-As on 31st March 2004	
National Grid	112683.47
Eastern Region Grid	17249.58
Orissa State Grid (GRIDCO)	2300.91

As per the approved consolidated baseline methodology, the following points have been considered and discussed while selecting the grid level

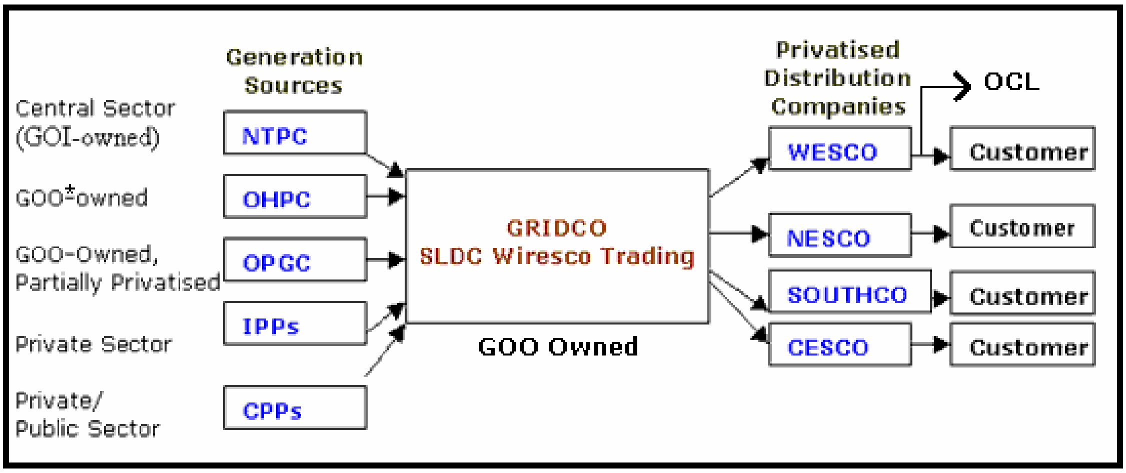
Size of the project activity: From the above data we may conclude that the project activity, a 7.5MW waste heat recovery based power plant, is 0.0067% of national grid capacity and 0.0435 % of the regional grid capacity and 0.326 % of state grid capacity as on 31st March, 2004. It is too small to have a significant impact on the national grid or regional grid in terms marginally effecting changes in the generation and dispatch system (operating margin) or delay future power projects that may be commissioned during the crediting period (build margin) in the national or eastern regional grid. Therefore, the principal effect of the project activity would be on the lowest level of the grid i.e. the carbon intensity of the Orissa state grid.

Connectivity of grid: Orissa state grid (GRIDCO) may be considered as an isolated system boundary because GRIDCO solely decides on the amount of demand to be catered, the amount of energy to be produced and purchased, the source of power, the cost of electricity (purchase and selling price), net power cuts and subsequently the generation mix. These decisions are independent as long as the state grid maintains the 'grid discipline'. This grid mix is entirely managed by the GRIDCO. The Orissa state grid is the most realistic choice of the grid for the project activity also because the power generated in this region is distributed in their jurisdiction only apart from small amount transferred as interregional exchange. We may therefore conclude that Orissa state as an isolated grid.

Taking into consideration the points mentioned above, it is concluded that "GRIDCO" is the most representative system boundary for the project activity. We would therefore determine the carbon intensity of the Orissa state grid to arrive at the baseline emission factor for baseline emission calculations for the project activity's crediting period.

The following figure represents the power scenario in Orissa:

Figure 5: Flow Chart of Current Delivery System of Orissa



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Therefore transmission and distribution system in Orissa has access to electricity generated from:

<u>Orissa's share from generating stations set up by the Central Government ["Central Sector Plants"]</u>

The central government (Government of India) owns power generation plants managed by Government of India Enterprises like National Thermal Power Corporation Ltd (NTPC) and National Hydroelectric Power Corporation Ltd (NHPC). Power generated by the central sector is being fed to the grid, which is accessible to all states in the region. The power generated by central sector generation plants is shared by all states forming part of the grid in fixed proportion as mentioned above. As per the Availability Based Tariff (ABT) Notification the central sector power generating units would operate at a plant load factor of 80% and Orissa state has to make payments for its total share in the central sector. Therefore Orissa would have to draw its allocated share from the central sector generating stations. In India, nuclear power generation is allowed only by Central Sector Organisations. However Orissa has no share in the nuclear power generating stations. Therefore the power mix may be thermal, hydro and wind.

<u>Orissa's State own generation</u>

[18] Source: Chapter 2 – Installed Electricity Generation Capacity (Utilities), General Review 2005 (Contains data for 2003-2004)

This includes generating stations exclusively available to Orissa owned by Orissa Power Generating Corporation Limited (OPGC) and Orissa Hydro Power Corporation Limited (OHPC) and the Talcher Thermal Power Station owned by NTPC.

Surplus availability from Independent Power Plants and Captive Power Plants

Power generated by all generation units as mentioned above is being fed to the GRIDCO, which is accessible to the Orissa state. Power mix is mainly thermal and hydro. There is 1.49MW wind power station and its contribution to the generation mix is negligible. Therefore GRIDCO is the point source that receives an electricity mix and further transmits the same to industries operating in Orissa.

The entire distribution system of the State has been further divided into four strategic business units.

Four distribution zones were first corporatized forming

Central Electricity Supply Company of Orissa Limited (CESCO)

North Eastern Electricity Supply Company of Orissa Limited (NESCO)

Western Electricity Supply Company of Orissa Limited (WESCO)

Southern Electricity Supply Company of Orissa Limited (SOUTHCO)

B) Determination of the Carbon Intensity of the chosen Grid

Complete analysis of the system boundary's electricity generation mix has been carried out for calculating the emission factor of GRIDCO 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 Orissa 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[19] 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, OCL conducted a baseline study wherein the power generation data for all power sources in the project electricity system (i.e. GRIDCO) were collected from government/non-government organisations and authentic sources. The power generation mix of GRIDCO comprises of coal based thermal power generation and hydro power generation. The actual generation data of entire Orissa was analysed for the years 1999-2000, 2000-2001, 2001-2002, 2002-2003 and 2003-2004 to arrive at the contribution of the coal based power plants and the hydro based power plants in the GRIDCO mix. (Refer to Table 4 given below). It was found that the average share of the hydro-based power projects over the five most recent years was lower than 50% of the total electricity generation in the grid.

Table 4: Power Generation Mix of Orissa for five most recent years[20]

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

Energy Source	1999-00	2000-01	2001-02	2002-03	2003-04
Total Power Generation (MU)	11133.95	11011.39	12435.13	12010.925	15896.934
Total Hydro Power Generation	4863.09	4957.99	6780.11	3540.116	6253.447
Total Thermal Power Generation	6265.76	6053.39	5655.02	8470.809	9643.487
Hydro % of Total grid generation	43.70	45.03	54.52	29.47	39.34
Thermal % of Total grid generation	56.30	54.97	45.48	70.53	60.66
Hydro % of Total grid generation – Average of the five most recent years – 42.412%					

OCL 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.

OCL 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.

<u>Present Power Generation Mix</u>

The consumer of a state of Orissa gets a mix of power from the different sources. The figures of installed power capacity, share of the state in the central pool, and actual plant availability decides the content of power. The real mix of power in a particular year is however based on actual units generated from various sources of power. The GRIDCO network gets major portion of thermal & hydropower from Orissa Power Generating Corporation Limited (OPGC) and Orissa Hydro Power Corporation Limited (OHPC) respectively along with the central

[20] Data for the year 1999-00 Source: OERC Tariff Order (Date of Order: 19.01.2001) – Case No. 27 of 2000 (6.5-Sources of Power); Data for the year 2000-01 and 2001-02 - Source: An Overview of GRIDCO (01.04.96 to 31.03.02);

sector generation plants. The actual generation data of the entire Orissa for the year 2001 – 2002, 2002-2003 and 2003-2004 is presented in this document (sources are referred and listed in list of references) which includes own generation, purchase from central sector power plants and purchase from private sector power plants. The Orissa grid is not power deficit.

Table 5: Power Generation Mix of Orissa from the State Generating Stations[21]

Sr. No.	Energy Source	Installed Capacity in MW (31/03/02)	Net Generation in MU (2001-2002)	Net Generation in MU (2002-2003)	Net Generation in MU (2003-2004)
I.	Orissa State				
1.	**Thermal (coal)**				
	TTPS Stage I [NTPC] TTPS Stage II [NTPC]	240 220	2179.16	1997.424	2446.18
	IB Valley (I&II) [OPGC]	420	2317.27	2327.378	2677.006
A	**Thermal Total:**	**880**	**4496.43**	**4324.802**	**5123.186**
2.	**Hydro**				
	Hirakud, Burla [OHPC] Hirakud, Chiplima [OHPC]	331.5 72	925.16	615.806	901.169
	Balimela P.H.[OHPC]	360	1049.47	523.274	1121.392
	Rengali P.H. [OHPC]	250	772.18	620.974	1028.82
	U. Kolab P.H. [OHPC]	320	640.18	472.629	636.779
	Indravati P.H. [OHPC]	600	2923.87	790.458	2109.864
	Machhkund PH [OHPC]	57.375	325.29	265.678	195.437
B.	**Hydro Total:**	**1918.875**	**6636.15**	**3288.819**	**5993.461**
3.	**Wind**	**1.49**	**0**	**0**	**0**
C.	**Wind Total:**	**1.49**	**0**	**0**	**0**
4.	**Principal CPPs – All Thermal**				
	NALCO	720	347.74	409.895	499.392
	Rourkela Steel Plant	248	9.39	9.170	29.724
	ICCL	108	113.54	99.921	91.587
	HPCL [INDAL]	67.5	10.12	7.905	1.642
	FACOR	21	0	0	0
	ISPAT ALLOYS	40.46	0	0	0
	OTHERS	174.54	0	15.994	41.42
D.	**Principal CPPs Total:**	**1379.5**	**480.79**	**542.885**	**663.765**
E.	**State Sector Total**	**4178.375**	**11613.37**	**8156.506**	**11780.412**

[21] Source: An Overview of GRIDCO (01.04.96 to 31.03.02), GRIDCO document "Power Purchased with Cost and Energy Sold During 2002-2003" received on 14/05/03, Tariff Order 2003-2004,OERC http://www.orierc.org/

Table 6: Power Generation Mix of Orissa from the Central Generating Stations[22]

Sr No	Energy Source	Central Share (31/03/02)	Central Share (28/04/03)	Generation (2001-2002)	Generation (2002-2003)	Generation (2003-2004)
II.	Orissa's share in Central Schemes	MW	MW	in MU	in MU	in MU
1.	**Thermal (coal)**					
	Farakka STPS (NTPC) (1600MW)	235	235	234.04	1421.839	1276.997
	Kahalgaon STPS (NTPC) (840MW)	134.99	79	46.56	727.884	507.164
	Talcher STPS (NTPC) (1000MW)	262.00	318	397.20	1453.399	2072.375
A.	**Total Thermal**	**631.99**	**632**	**677.80**	**3603.122**	**3856.536**
2.	**Hydro**					
	Chukka (Bhutan)	58.46	47	143.96	232.436	259.986
B.	**Total Hydro**	**58.46**	**47**	**143.96**	**232.436**	**259.986**
	Regional Pool				18.861	0
	Central Sector Total	**690.45**		**821.77**	**3854.419**	**4116.522**

As mentioned above after the implementation of ABT, the state would be liable to draw its entire allocated share from the Central Sector.

The Government of India, Ministry of Power, has revised these shares as per Document No. 3/13/2000-OM dated 11th April 2003.

[22] Source: An Overview of GRIDCO (01.04.96 to 31.03.02) Note from GRIDCO (Document No. 3/13/2000-OM dated 11th April, 2003) and Tariff Order 2003-2004,OERC http://www.orierc.org/

The following table gives a step by step approach for calculating the Simple Operating Margin emission factor for GRIDCO for the most recent 3 years at the time of PDD submission i.e.2001-2002, 2002-2003 & 2003-2004.

Table 7: Data used for Simple OM emission factor				
Parameters	**2001-2002**	**2002-2003**	**2003-2004**	**Source**
	Coal	**Coal**	**Coal**	
$COEF_{i,j\ y}$- is the CO_2 emission coefficient of fuel i (tCO_2 / mass or volume unit of the fuel), taking into account the Net Calorific Value (energy content) per mass or volume unit of a fuel i (NCV_i), the CO_2 emission factor per unit of energy of the fuel i($EF_{CO2,i}$), and the oxidation factor of the fuel i ($OXID_i$).				
NCV_i (kCal/kg)	3877	4171	3820	CEA General Review 2000-2001, 2002-2003 & 2005 (Contains data for 2003-2004)
$EF_{CO2,i}$ (tonne CO_2/TJ)	96.1	96.1	96.1	IPCC 1996 Revised Guidelines and the IPCC Good Practice Guidance
$OXID_i$	0.98	0.98	0.98	Page 1.29 in the 1996 Revised IPCC Guidelines
$COEF_{i,j\ y}$(tonne of CO_2/ton of fuel)	**1.526**	**1.642**	**1.503**	Calculated as per Equation (2) of ACM0002
$F_{i\ ,j,\ y}$ - Fuel Consumption – is the amount of fuel consumed by relevant power sources j (where j – power sources delivering electricity to the grid, not including low-operating cost and must-run power plants). The Fuel Consumption is calculated based on total generation of the relevant power sources (j) ($\Sigma_j GEN_{j,y}$), , efficiency of power generation of the respective power plant with fuel source i ($E_{i,j}$) and the Net Calorific Value (energy content) per mass or volume unit of a fuel i (NCV_i).				

$GEN_{j,y}$ is the electricity (MU) delivered to the grid by source j, j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants The j power sources would also include electricity imports from the Central Generating Stations.				
Parameters	**2001-2002**	**2002-2003**	**2003-2004**	**Source**
	Coal	**Coal**	**Coal**	
$\Sigma_j GEN_{j,y}$ (MU)	**5655.02**	**8470.81**	**9643.49**	Refer to Tables 5 & 6 for Power Generation Data
Efficiency of power generation with fuel source in % ($E_{i,j}$) -The most important parameter in calculating the 'Fuel consumption' by relevant power sources is the thermal efficiency of the power plant with fuel source i. The methodology requires the project proponent to use technology provider's nameplate power plant efficiency or the anticipated energy efficiency documented in official sources. The design efficiency is expected to be a conservative estimate, because under actual operating conditions plants usually have lower efficiencies and higher emissions than the nameplate performance would imply. The efficiency of power generation with fuel source is calculated using the most conservative Design Station Heat Rate Value for thermal power plants in Eastern Region of India for the thermal power plants in Orissa. For central generating stations (i.e. NTPC-Farakka, Kahalgaon and Talcher STPS), the Design Station Heat Rate Values for the corresponding power generating stations are used to arrive at the efficiency of power generation.				
Parameters	**2001-2002**	**2002-2003**	**2003-2004**	**Source**
	Coal	**Coal**	**Coal**	
Orissa State Generating Stations				
Station Heat Rate (Design Values) (kCal/ kWh)	2383.47	2368.03	2373.82	Performance Review of Thermal Power Stations 2001-02, 2002-03 & 2003-04 -Section 13
$E_{i,j}$ (%)	36.082	36.317	36.229	Calculated using Station Heat Rate Values
NCV_i (kCal/kg)	3877	4171	3820	CEA General Review 2000-

				2001, 2002-2003 & 2005 (Contains data for 2003-2004)
$F_{i,j,y}$ (tons/yr)	**3059854**	**2763565**	**3596120**	Calculated
$COEF_{i,j\,y}$(tonne of CO_2/ton of fuel)	**1.526**	**1.642**	**1.503**	Calculated as per Equation (2) of ACM0002
Generation of thermal power plants of Orissa (MU)	**4977.22**	**4867.687**	**5786.951**	Refer to Table 5 for Power (State + CPPs)
EF (OM Simple, Orissa State) (ton of CO_2/MU)	**938.062**	**931.985**	**934.264**	Calculated as per ACM0002
Central Generating Stations				
NTPC-Farakka STPS				
Station Heat Rate (Normative Values) (kCal/ kWh)	2500	2500	2500	CERC Order
$E_{i,j}$ (%)	34.40	34.40	34.40	Calculated using Station Heat Rate Values
NCV_i (kCal/kg)	3877	4171	3820	CEA General Review 2000-2001, 2002-2003 & 2005 (Contains data for 2003-2004)
$F_{i,j,y}$ (tons/yr)	**150916**	**852217**	**835731**	Calculated

$COEF_{i,j\ y}$(tonne of CO_2/ton of fuel)	**1.526**	**1.642**	**1.503**	Calculated as per Equation (2) of ACM0002
Generation NTPC-Farakka (MU)	**234.04**	**1421.839**	**1276.997**	Refer to Table 6 for Power
EF (OM Simple, NTPC-Farakka STPS) (ton of CO_2/MU)	**983.925**	**983.925**	**983.925**	Calculated as per ACM0002
NTPC-Kahalgaon STPS				
Station Heat Rate (Normative Values) (kCal/ kWh)	2550	2550	2550	CERC Order
$E_{i,j}$ (%)	33.73	33.73	33.73	Calculated using Station Heat Rate Values
NCV_i (kCal/kg)	3877	4171	3820	CEA General Review 2000-2001, 2002-2003 & 2005 (Contains data for 2003-2004)
$F_{i,j,y}$ (tons/yr)	**30624**	**445002**	**338552**	Calculated
$COEF_{i,j\ y}$(tonne of CO_2/ton of fuel)	**1.526**	**1.642**	**1.503**	Calculated as per Equation (2) of ACM0002
Generation NTPC-Kahalgaon (MU)	**46.56**	**727.88**	**507.16**	Refer to Table 6 for Power
EF (OM Simple, NTPC-Kahalgaon STPS) (ton of CO_2/MU)	**1003.603**	**1003.603**	**1003.603**	Calculated as per ACM0002

NTPC-Talcher STPS				
Station Heat Rate (Normative Values) (kCal/ kWh)	2500	2500	2500	CERC Order
$E_{i,j}$ (%)	34.40	34.40	34.40	Calculated using Station Heat Rate Values
NCV_i (kCal/kg)	3877	4171	3820	CEA General Review 2000-2001, 2002-2003 & 2005 (Contains data for 2003-2004)
$F_{i,j,y}$ (tons/yr)	**256126**	**871133**	**1356266**	Calculated
$COEF_{i,j\,y}$(tonne of CO_2/ton of fuel)	**1.526**	**1.642**	**1.503**	Calculated as per Equation (2) of ACM0002
Generation NTPC-Talcher (MU)	**397.20**	**1453.40**	**2072.38**	Refer to Table 6 for Power
EF (OM Simple, NTPC-Talcher STPS) (ton of CO_2/MU)	**983.925**	**983.925**	**983.925**	Calculated as per ACM0002
$\Sigma_j GEN_{j,y}$ (MU)	**5655.02**	**8470.81**	**9643.49**	Refer to Tables 5 & 6 for Power Generation Data
$EF_{OM,simple,y}$ (tCO_2/MU)	**943.721**	**955.769**	**955.159**	Calculated as per Equation (1) of ACM0002
$EF_{OM,y}$ (tCO_2/MU)	**951.550**			Average of the most recent three

		years' Simple OM
$EF_{OM,y}$ (kg CO_2/ kWh)	**0.951**	

Step 2: Calculation of Build Margin

As mentioned above the project activity would have some effect on the Build Margin (BM) of the Orissa State 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.

OCL 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 OCL project activity the sample group m consists of (b) the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MU) and that have been built most recently. Power plant capacity additions registered as CDM project activities are excluded from the sample group.

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

Table 8: Plants considered for BM calculation[23]

No.	Name of Power Plant	Fuel	Commissioning	MW	MW For Orissa	2003-2004 (MU)
1	Indravati P.H. [OHPC], U-4	Hydro	2001	150	600	2109.86
2	Indravati P.H. [OHPC], U-3	Hydro	2000	150		
3	Indravati P.H. [OHPC], U-1	Hydro	1999	150		
4	Indravati P.H. [OHPC], U-2	Hydro	1999	150		
5	Kahalgaon STPS, U-4 [NTPC] (Total Capacity-840 MW;Orissa Share-16.07%)	Coal	1996	210	134.99	126.79
6	Talcher STPS, U-2** [NTPC] (Total Capacity-1000 MW; Orissa	Coal	March'1996	500	262	1036.19

[23] Source –An Overview of GRIDCO (01.04.96 to 31.03.02). Please refer to Enclosure-I for details.

	Share-26.2%)						
Total of Plants (1 to 6)							**3272.84**
20% of Total Gross Generation							**3179.39**
Total Thermal Coal based – State							**0**
Total Thermal Coal based – Central							**1162.98**
CPP							**0.00**
Total Hydro -State							**2109.86**
Total Hydro-Central							**0.00**

The following table gives a step by step approach for calculating the Build Margin emission factor for GRIDCO for the most recent year at the time of PDD submission i.e.2003-2004.

Table 9: Data used for BM emission factor		
Parameters	**2003-2004**	**Source**
	Hydro	
Generation (MU)	2109.86	Refer to Table 8 for Power
EF_{CO2} (tonne CO_2/TJ)	0	
Parameters	**2003-2004**	**Source**
	Coal	
$COEF_{i,m,}$- is the CO_2 emission coefficient of fuel i (tCO_2 / mass or volume unit of the fuel), taking into account the Net Calorific Value (energy content) per mass or volume unit of a fuel i (NCV_i), the CO_2 emission factor per unit of energy of the fuel i ($EFCO_{2,i}$), and the oxidation factor of the fuel i ($OXID_i$).		
NCV_i (kCal/kg)	3820	CEA General Review 2005 (Contains data for 2003-2004)
$EF_{CO2,i}$ (tonne CO_2/TJ)	96.1	IPCC 1996 Revised Guidelines and the

		IPCC Good Practice Guidance
$OXID_i$	0.98	Page 1.29 in the 1996 Revised IPCC Guidelines
$COEF_{i,m}$ (tonne of CO_2/ton of fuel)	**1.503**	Calculated as per Equation (2) of ACM0002
Where NCV_i ,$EF_{CO2,i}$ $OXID_i$, $COEF_{i,m}$ are analogous to the variables described for the simple OM method above for plants in the sample group m.		
Parameters	**2003-2004**	**Source**
	Coal	
$F_{i,m,y}$ - Fuel Consumption – is the amount of fuel consumed by relevant power sources m (where m – power sources which are a part of the sample group m delivering electricity to the grid). The Fuel Consumption is calculated based on total generation of the relevant power sources (m) ($\Sigma_m GEN_{m,y}$) , efficiency of power generation with fuel source i (Ei,m)and the Net Calorific Value (energy content) per mass or volume unit of a fuel i (NCVi).		
NTPC-Kahalgaon STPS (U-3 & 4)		
Generation NTPC-Kahalgaon (U-3 & 4) (MU)	**126.79**	Refer to Table 8 for Power
Station Heat Rate (Normative Values) (kCal/kWh)	2550	CERC Order
$E_{i,j}$ (%)	33.73	Calculated using Station Heat Rate Values
NCV_i (kCal/kg)	3820	CEA General Review 2005 (Contains data

		for 2003-2004)
$F_{i,j,y}$ (tons/yr)	**84638**	Calculated
Where NCV_i, $F_{i,m,y}$, are analogous to the variables described for the simple OM method above for plants in the sample group m.		
$COEF_{i,j\ y}$(tonne of CO_2/ton of fuel)	**1.503**	Calculated as per Equation (2) of ACM0002
EF (BM, NTPC-Kahalgaon STPS) (ton of CO_2/MU)	**1003.603**	Calculated as per ACM0002
NTPC- Talcher STPS (U-1 & 2)		
Generation NTPC-Talcher (U-1 & 2) (MU)	**1036.19**	Refer to Table 8 for Power
Station Heat Rate (Normative Values) (kCal/kWh)	2500	CERC Order
$E_{i,j}$ (%)	34.40	Calculated using Station Heat Rate Values
NCV_i (kCal/kg)	3820	CEA General Review 2005 (Contains data for 2003-2004)
$F_{i,j,y}$ (tons/yr)	**678133**	Calculated

Where NCV_i ,$F_{i,m,y}$, are analogous to the variables described for the simple OM method above for plants in the sample group m.		
$COEF_{i,j\ y}$(tonne of CO_2/ton of fuel)	**1.503**	Calculated as per Equation (2) of ACM0002
EF (BM Simple, NTPC-Talcher STPS) (ton of CO_2/MU)	**983.925**	Calculated as per ACM0002
$\Sigma GEN_{m,y}$ (MU)	**3272.84**	Refer to Table 8 for Power Generation Data
Where *GENm,y* is analogous to the variables described for the simple OM method above for plants in the sample group m.		
$EF_{BM,y}$ (ton of CO_2/MU)	**350.392**	Calculated as per Equation (8) of ACM0002
$EF_{BM,y}$ (kg CO_2/ kWh)	**0.350**	

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

As per Step 3, the baseline emission factor EF_y is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$), where the weights w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM} = w_{BM} = 0.5$), and $EF_{OM,y}$ and $EF_{BM,y}$ are calculated as described in Steps 1 and 2 above and are expressed in tCO_2/MU.

The most recent 3-years (2001-2002, 2002-2003 & 2003-2004) average of the Simple OM and the BM of the base year i.e. 2003-2004 are considered. This is presented in the table below.

Table 10: Data used for Baseline Emission Factor		
Parameters	**Value (kg CO_2/ kWh)**	**Remarks**
OM, $EF_{OM,y}$	0.951	Average of most recent 3-years (2001-2002, 2002-2003 & 2003-2004) values
BM, $EF_{BM,y}$	0.350	Value of the base year i.e. 2003-2004

Baseline Emission Factor, EF_y	**0.651**	Calculated

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 OCL facility situated beside the project unit is utilized. Other infrastructure requirements for the project are also met from the OCL facility.

D) Baseline Emission

In absence of the project activity there will be emission as per the carbon intensity of the grid (0.651 kg CO_2/ kWh) from which the project activity would have drawn electricity to satisfy its total requirement of power. Based on the emission factor calculated as per Combined Margin Method detailed above the project activity will reduce 257133 tonnes of CO_2 in the entire 10 year crediting period.

Annex 4 – MONITORING PLAN

Introduction: OCL's 14 MW Captive Power Plant consists of 4 nos. of 10 tph Waste Heat Recovery Boilers which utilize waste heat from the four sponge iron kilns as energy source, a 30 tph Fluidised Bed Combustion Boiler that uses coal rejects (coal char and coal fines) from sponge iron process as fuel, a common steam header and 14MW turbo generator (TG) set as shown in Fig. 6 below. OCL will install WHRBs as a voluntary step to improve the energy efficiency of the manufacturing process whereas FBC will be installed to avoid pollution problems associated with disposal of coal rejects as required by pollution control norms. The entire CPP will be commissioned in April 2006.

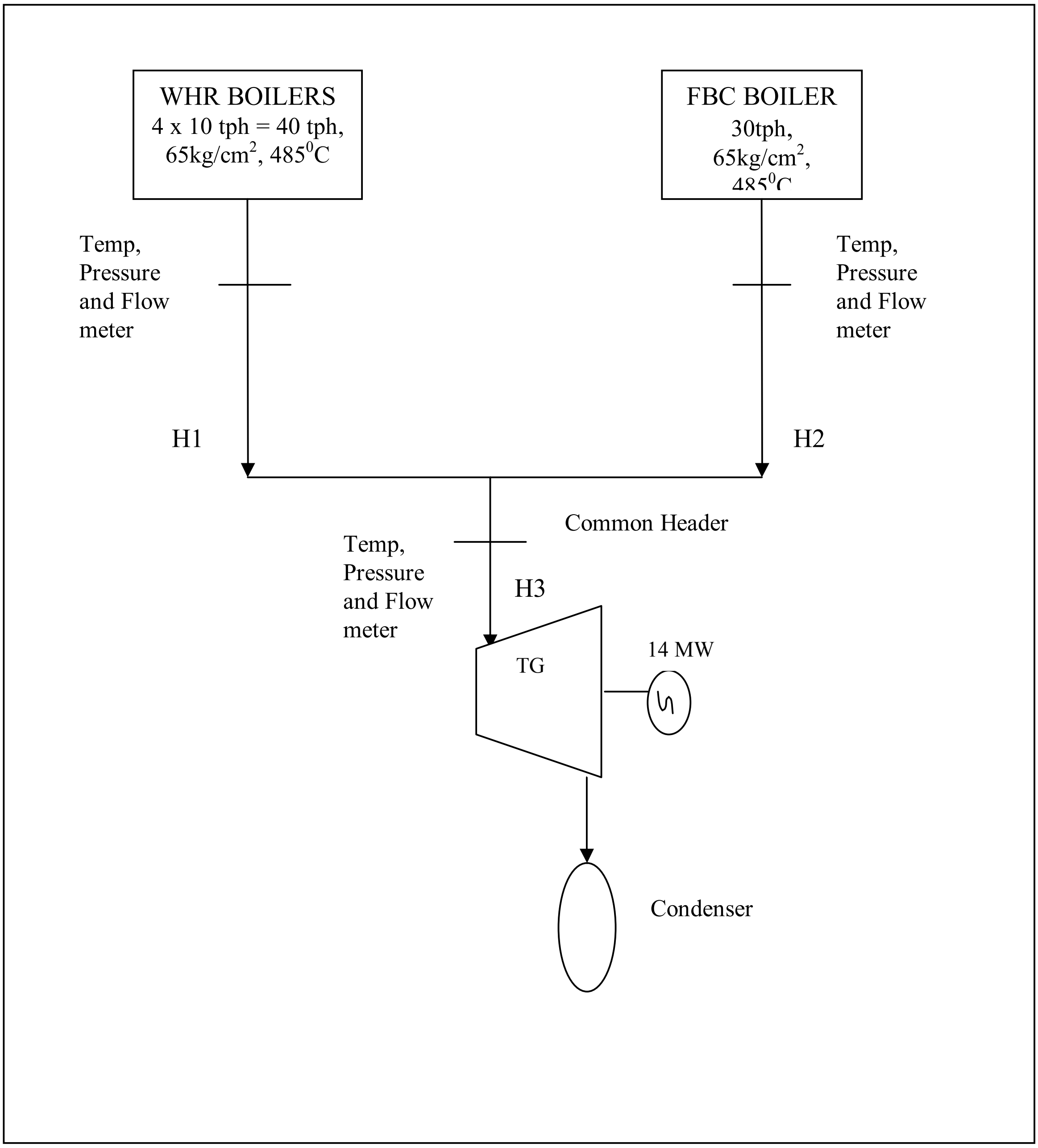

Fig 6: Schematic Diagram of OCL's CPP

The working parameters of various equipments and location of Steam Flow meters, pressure and temperature gauges are as indicated in the diagram. The pressure and temperature parameters for both WHR and FBC steam are the same i.e. 65 kg/cm^2 and 485^{0}C. As working steam parameters of pressure and temperature are identical for both the boilers, the only dependent variable for calculation of waste heat power would be the steam flow from respective boilers. However, to maintain transparency in calculating WHR power following monitoring methodology is used.

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

The calculation is shown as follows:

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

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

= h_1 x S_1

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

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

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

= h_2 x S_2

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

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

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

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

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

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

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

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

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

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

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., -5.	Low	Yes	This data will be used for calculation of WHR steam parameters.
6.,-10.	Low	Yes	This data will be used for calculation of FBC steam parameters
11.,-14.	Low	Yes	This data is used for calculating power contributed from waste heat recovery steam generation system in the CPP.

Appendix I: Abbreviations

1 Lakh	1,00,000
BAU	Business as Usual
BEF	Baseline Emission Factor
BM	Built Margin
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CER	Certified Emission Reductions
CESCO	Central Electricity Supply Company of Orissa Ltd.
CM	Combined Margin
CO_2	Carbon di-oxide
CPP	Captive Power Plant
DCS	Distributed Control System
EIA	Environmental Impact Assessment
ESP	Electro Static Precipitator
GHG	Greenhouse Gas
GOI	Government of India
GRIDCO	Grid Corporation of Orissa Limited
GWh	Giga Watt hour
IPCC	Intra-governmental Panel for Climate Change
IPICOL	Industrial Promotion And Investment Corporation Of Orissa Ltd.
IPP	Independent Power Producers
IREDA	Indian Renewable Energy Development Agency
Km	Kilo metres
KP	Kyoto Protocol
KV	Kilo Voltage
KW	Kilo Watt
KWh	Kilo Watt hour

M&V	Monitoring and Verification
MkWh	Million Kilo Watt hour
MNES	Ministry of Non-conventional Energy Sources
MoP	Ministry of Power
MoU	Memorandum of Understanding
MT	Metric Ton
MU	Million units (1 MU = 1 Million kWh)
MW	Mega Watt
NESCO	North Eastern Electricity Supply Company of Orissa Ltd.
NOC	No Objection Certificate
OCL	OCL India Limited
OERC	Orissa Electricity Regulatory Commission
OM	Operating Margin
OPCB	Orissa Pollution Control Board
p.a	Per annum
PLF	Plant Load Factor
SEB	State Electricity Board
SOUTHCO	Southern Electricity Supply Company of Orissa Ltd.
STG	Steam Turbine Generator
TJ	Trillion Joules
tph	tonnes per hour
UNFCCC	United Nations Framework Convention on Climate Change
WESCO	Western Electricity Supply Company of Orissa Ltd.
WHR	Waste Heat Recovery
WHRB	Waste Heat Recovery Boiler

Appendix II: Reference List

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 01(in effect as of: August 29, 2002)
5.	UNFCCC document : Annex B to attachment 3 Indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories
6.	Practical Baseline Recommendations for Green House Gas Mitigation Projects in the Electric Power Sector, OECD and IEA Information
7.	Techno-Economic Feasibility on Waste Heat Recovery based Captive Power Plant at OCL India Limited, Rajgangpur
8.	Various project related information / documents / data available with OCL India Limited
9.	An Overview of GRIDCO (01.04.96 to 31.03.2002)
10.	Website of Central Electricity Authority (CEA), Ministry of Power, Govt. of India - **www.cea.nic.in**
11.	CEA published document "Fifteenth Electric Power Survey of India"
12.	CEA published Report on "Perspective plan for generating capacity addition, Integrated Operation of regional grids (Free run studies using EGEAS model)"
13.	CEA published Report on "Power on Demand by 2012, Perspective plan studies"
14.	CEA Report on, Fourth National Power plan 1997 – 2012.
15.	India Electrical Distribution Reform Review and Assessment. A report prepared by CORE international, Washington for USAID, India, September 2002.
16.	Website of Ministry of Power (MoP), Govt. of India **www.powermin.nic.in**
17.	A paper on Anthropogenic Emissions from Energy Activities in India: Generation and Source Characterisation by Moti L. Mittal and C. Sharma.
18.	Website of Indian Renewable Energy Development Agency (IREDA), **www.ireda.nic.in**
19.	www.infraline.com
20.	Power Trading, http://www.electricityindia.com/powertrading.html

Sl.No	Particulars of the references
21.	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 -
22.	'Captive Power Plants- Case study of Gujarat India' Source : http://iis-db.stanford.edu/pubs/20454/wp22_cpp_5mar04.pdf
23.	OERC Orders, Section 6.40.10.2 - http://www.wescoorissa.com/cinfo/a39.htm#6.37
24.	OERC Orders – Cases in 2002 : http://www.orierc.org/
25.	Electricity Act 2003, Ministry of Power , Govt. of India http://www.powermin.nic.in/JSP_SERVLETS/internal.jsp

Appendix III: Baseline and CER calculation

The calculation sheet is enclosed along with this document

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