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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

VGL - Waste Heat based 4 MW Captive Power Project at Raipur

Version No. – 03

Date: 08th May 2006

A.2. Description of the project activity:

Purpose:

The project activity aims to utilize the heat content of the flue gas released during sponge iron manufacturing process, for generating clean power. Prior to the project activity, power was imported from grid to meet the entire electricity demand of the sponge iron plant while the hot waste flue gas from the Direct Reduction Iron (DRI) kiln of the plant was released to the atmosphere after treatment.

By implementing the project activity, the project proponent intends to reduce import of power from grid and hence indirectly reduce greenhouse gas (GHG) emissions that would have occurred, in its absence, at the thermal power plants connected to the grid.

Salient features of the project:

The project proponent Vandana Global Limited (VGL) is a sponge iron and steel manufacturing industry that belongs to the 'Vandana Group of Industries' of Chhattisgarh State, India. The other companies belonging to the Group are Vandana Rolling Mills Limited, Vandana Udyog Limited, Vandana Ispat Limited, Vandana Industries Limited and Vandana Vidyut Limited. VGL produces around 60000 tonnes of Sponge Iron and 30000 tonnes of Steel ingots per annum. The plant is connected to Chattisgarh State Electricity Board (CSEB) grid, which is a part of the Western Regional grid network of India.

The project generates 4MW of power [equivalent to around 25 million kWh (MkWh)] utilizing the sensible heat from process flue gas of the DRI kiln. The power generated is used to meet the captive power requirement of VGL plant and the surplus is wheeled through CSEB grid for supply to group companies. The net result is a reduction in electricity demand from the grid supply.

Therefore, the project fundamentally achieves the following goals:

- Utilization of heat energy of waste gas.
- Reduction in GHG emissions
- Reduction in Transmission & Distribution (T& D) losses of the grid.
- Technological up gradation and sustainable industrial growth in the state.
- Conserves natural resources and betterment of working environment.

Project contribution to sustainable development:

The contributions of the project activity towards sustainable development have been addressed under the following pillars of sustainable development:

Socio-economic benefits: - Project activity has led to direct and indirect employment during stages of power plant construction and operation in the region. Also, with growing technological advancement the project activity contributes to capacity building in terms of technical knowledge and managerial skills.

The project shows less dependence of project proponent on grid electricity and better management of waste. This brings in related benefit for the employees and the local community.

Environmental Well-being: - In India, coal is the most abundantly available fossil fuel and is mainly used for power generation. Power plants run by coal contribute around 70% of total power generation in the Western Regional grid[1]. The project activity curtails further depletion of non-renewable energy resources like coal, thus increasing its availability to other important processes in future. It also leads to reduction in GHG (CO_2), SOx and NOx emissions.

Technological Well-being: - With the project activity, the company has upgraded its technology through improved instrumentation and automation. The project activity introduces a cleaner and energy efficient technology by enabling utilization of heat energy in process waste gas streams in power generation. Ash from electrostatic precipitator (ESP) is collected in ash silo and sold to brick manufacturers. Thus, the implementation of project activity is a demonstration of a clean technology. The successful implementation of the project activity can encourage replication of the technology in similar industries of the state.
Implementing the modern technology will lead to sustainable economical and industrial growth in the long run and further conserving natural resources like coal.

The detailed references of the above mentioned contributions are provided in Section F (Environmental Impacts) of the PDD.

A.3. Project participants:

Name of the Party involved ((host) indicates a host party)	Private and/or public entity(ies) Project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Government of India	Vandana Global Limited (Private Entity)	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

India

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

[1] Western Regional Electricity Board, Annual Report 2004-05 – http://www.wreb.gov.in/anrpt0405.pdf

Chhattisgarh

A.4.1.3. City/Town/Community etc:

Raipur

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

The project activity has been implemented in the VGL Sponge Iron Manufacturing plant located in Siltara Industrial area in Raipur district of Chhattisgarh state of India. Raipur is well connected with road, rail and airport infrastructure. The region is abundant with coal and mineral deposits. The geographical location of Raipur is detailed in the maps shown in Fig 1 below.

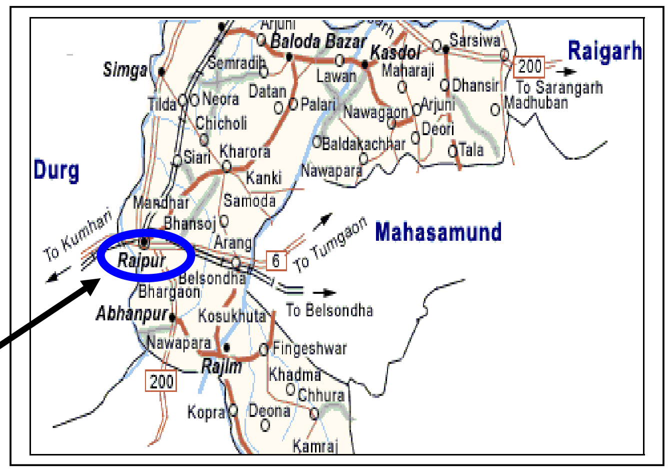

Fig 1: Location of project activity.
(Maps not to scale).

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

The project activity is an electricity generation project utilizing waste heat where aggregate electricity generation savings of the project exceeds the equivalent of 15 GWh per annum. The baseline and monitoring methodology is adopted as per ACM0004. The project activity may principally be categorized in Category 1- Energy Industries (Renewable/Non-Renewable sources) as per the scope of the project activities enlisted in the 'list of sectoral scopes and approved baseline and monitoring methodologies' on the UNFCCC website for accreditation of Designated Operational Entities[2].

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

VGL sponge iron plant has a 200 tonnes per day (tpd) capacity DRI kiln and is currently producing around 60000 tonnes per annum (tpa) of sponge iron. The Waste Heat Recovery (WHR) based captive power plant at VGL utilizes the sensible heat content of waste flue gas from DRI kiln to generate electricity for its captive requirement. The exhausted flue gas of the sponge iron kiln enters the After-Burning Chamber (ABC) inlet at a temperature of around 900^oC. The waste gases are burnt in ABC to remove traces of carbon monoxide. After secondary combustion the hot flue gases leave the ABC at a temperature of around 950^oC which is finally introduced to the WHRB through a hot gas duct.

The flue gas is circulated through two passes in the WHRB to transfer the sensible heat energy of the waste gas to water and generate 30 tonnes per hour (tph) of steam at 67kg/cm^2, 510^0C. Finally, the gas is passed through economiser bundles for optimum recovery of heat from the hot exhaust.

The high pressure steam is fed into fully condensing steam turbo-generator of 8MW capacity. The steam turbine is coupled with an electric generator which converts the mechanical energy of the turbine into electrical energy. The turbine is of single cylinder, single exhaust, condensing type with uncontrolled extraction for the de-aerator, designed for high operating efficiencies and maximum reliability. The generator is a three phase, four pole, synchronous type with brushless excitation.

The waste gases after maximum heat transfer in the WHRB is led to exhaust stack through Electrostatic Precipitator (ESP) which reduces Suspended Particulate Matter (SPM) load to a large extent. SPM is collected in the hoppers of the ESP. The particulate matter collected in the hoppers is conveyed to existing ash silo by a conveyor belt. The project will generate around 25 MkWh per annum, excluding auxiliary consumption.

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:

VGL has set-up the CPP with an objective to utilize waste gases of substantial heat content available from the DRI kilns of the Sponge Iron manufacturing unit and to use it to generate electrical energy for its own utilization in the manufacturing facilities of sponge iron and steel. In the absence of the project, the electricity requirements of equivalent amount would have been met by Western Regional grid supply resulting into an equivalent amount of CO_2 emission from the thermal power stations. More than 80% of Western Regional grid comprises of thermal power mix (coal, gas)[3]. However, due to project activity, project proponent has been able to reduce and replace an equivalent amount of demand on grid

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

[3] Western Regional Electricity Board, Annual Report 2004-05 – http://www.wreb.gov.in/anrpt0405.pdf

electricity, resulting in reduction of corresponding CO_2 emissions at the thermal power plants of the grid.

The project does not contribute to any additional GHG emission. The chemical composition of the waste gas utilized by the project activity, at the inlet and outlet of the boiler remain same and no other secondary fuel is fired in the boiler. Taking into consideration the power deficit in India, demand rise in Western Region[4] and recent capacity additions to meet the electricity demand in the region, the project activity contributes by reducing this demand by around 25 MkWh per year. The project activity reduces anthropogenic emissions by sources that would have occurred (due to future generation mix) or are occurring (due to present generation mix) to cater to a certain proportion of the demand. The average estimated total of emission reductions to be achieved by the project is 18965.2 tonnes of CO_2/year and 189652 tonnes of CO_2 for the entire 10 year crediting period.

The Chhattisgarh state and Indian governments do not require sponge iron manufacturing industries to utilize the heat content of the waste gases generated from the DRI kilns. The project proponent has implemented the project activity over and above the national or sectoral requirements. The GHG reductions achieved by the project activity are additional to those directed by the governmental policies and regulations. The other "additionality" criteria of the project activity are dealt with in section B.3. In absence of the approval and registration of the project activity as a CDM project activity the associated regulatory barriers from Government authorities for power generation, would prevail and VGL would eventually resort to business-as-usual scenario which is releasing the waste heat into atmosphere and importing power from grid. The waste heat based power plant is not only justified in view of its capability to affect the generation mix but also lead as an example of eco-friendly power from a sponge iron industry.

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

Years	Annual estimation of emission reductions in tonnes of CO_2 e
2005-06	18965.2
2006-07	18965.2
2007-08	18965.2
2008-09	18965.2
2009-10	18965.2
2010-11	18965.2
2011-12	18965.2
2012-13	18965.2
2013-14	18965.2
2014-15	18965.2
Total estimated reductions (tonnes of CO_2 e)	**189652**
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**18965.2**

A.4.5. Public funding of the project activity:

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

[4] Refer- Salient Features of Western Regional Electricity Board, Annual Report 2004-05 – http://www.wreb.gov.in/anrpt0405.pdf

SECTION B. Application of a baseline methodology

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

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

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

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

As stated in ACM0004, "*This methodology applies to project activities that generate electricity from waste heat or the combustion of waste gases in industrial facilities*".- The project activity under consideration recovers the heat content of waste gases emitted from the DRI Kiln in WHRB and utilizes the same to produce steam which is further used to generate electricity.
Apart from the key applicability criteria, the project activity is required to meet the following conditions in order to apply the baseline methodology-
The methodology applies to electricity generation project activities:

1. *"that displace electricity generation with fossil fuels in the electricity grid or displace captive electricity generation from fossil fuels, electricity"*-As per the Baseline Scenario analysis, conducted in Section B.2 of this PDD, the project activity displaces electricity generation with fossil fuels in the Western Regional electricity grid. Therefore the project activity meets the above applicability criteria.
2. *"where no fuel switch is done in the process where the waste heat or pressure or the waste gas is produced after the implementation of the project activity"*- The project activity involves utilization of the heat content of waste gases of the sponge iron kiln, earlier dissipated into the atmosphere, for power generation. There is no fuel switch involved in the sponge iron kiln operation.

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

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

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

The project activity involves setting up of 4MW WHR based CPP by VGL to meet its own power requirement at the manufacturing facilities of sponge iron and steel and wheel the power through the CSEB grid. The methodology is applied in the context of the project activity as follows:

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

As per the methodology, the project proponent should include all possible options that provide or produce electricity (for in-house consumption and/or other consumers) as baseline scenario alternatives. These alternatives are to be checked for legal and regulatory compliance requirements and also for their

dependence on key resources such as fuels, materials or technology that are not available at the project site. Further, among those alternatives that do not face any prohibitive barriers, the most economically attractive alternative is to be considered as the baseline scenario.

As mentioned above, the project activity requires supplying power to the captive demand of the manufacturing unit of VGL. Five plausible alternative scenarios were available with the project proponent which was discussed during project inception stage:

Alternative 1: Import of power from grid– continuation of current scenario
The VGL plant would continue to purchase required power from Chhattisgarh State Electricity Board (CSEB) that belongs to Western Regional electricity grid network. An equivalent amount of CO_2 emissions would take place at the thermal power plants supplying power to Western Regional grid. This alternative is in compliance with all applicable legal and regulatory requirements and can be a part of baseline option.

Alternative 2: 4 MW Coal based CPP at VGL
The project proponent may generate the same amount electricity (4 MW) from coal based CPP at its existing sponge iron plant. The power generated would meet VGL's own demand in the manufacturing units and wheel the remaining power through the CSEB grid. An equivalent amount of CO_2 emissions would be released at the CPP end. This alternative is in compliance with all applicable legal and regulatory requirements and can be considered as one of the plausible baseline alternative.

Alternative 3: 4 MW Gas based CPP at VGL
VGL may generate its own power using natural gas based captive power plant and an equivalent amount of carbon dioxide would be generated at the power plant end. Though this alternative is in compliance with all regulatory and legal requirements it is not a realistic alternative due to non-availability of natural gas distribution network in Chhattisgarh[5]. Therefore, Alternative 3 may be excluded from baseline scenario.

Alternative 4: 4 MW light diesel oil or furnace oil based CPP at VGL
VGL may set up 4 MW light diesel oil (LDO) or furnace oil (FO) based CPP at its existing sponge iron plant. The power generated would meet VGL's own demand and the remaining power would be wheeled through CSEB grid. An equivalent amount of CO_2 emissions would be released at the CPP end. This alternative is in compliance with all applicable legal and regulatory requirements and can be one of the plausible baseline options.

Alternative 5: Implementation of project activity without CDM benefits
VGL may set up a 4 MW waste heat recovery based CPP at its existing sponge iron plant. The power generated would meet VGL's own demand and the remaining power would be wheeled through CSEB grid. This alternative is in compliance with all applicable legal and regulatory requirements. The heat energy of the kiln flue gases would be utilized and for the total power supplied, VGL would reduce an equivalent amount of CO_2 emissions at the thermal power plants feeding to the Western Regional grid. However, for this alternative the project proponent faced a number of regulatory and technological barriers (as detailed in Section B3 below) and hence this option is not a part of baseline scenario.

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

Evaluation of the alternatives on economic attractiveness:
From the discussion above it is found that alternatives 1, 2 and 4 can be a part of baseline scenario. Further, as per the methodology, the alternatives are evaluated on the basis of economic attractiveness. The broad parameters used for evaluation are capital cost and the unit rate of electricity purchased or produced. Table 1 below shows the economic 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 the grid	Nil	Year 2001-2002	4.38	Electricity bills of VGL for the respective years	Continuation of current situation, annual expenses in the form of tariff is low, no additional investment, easy government approvals	This option is economically attractive
		Year 2002-03	3.46			
		Year 2003-04	2.87			
2) Coal based CPP	42.5 – 45.0	1.78 - 1.92		Indicative prices available in India during project conception stage[6]	High Capital Cost - uneconomical for small sizes, difficulty in accessing bank loans, government clearances cumbersome.	This option is economically unattractive
4) LDO/FO Based CPP	7.5 - 12.0	3.5 - 4.6		Indicative prices available in India during project conception stage[5]	VGL expected further oil price hike in future, hence the variable cost of power generation would be high.	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- ie. business-as-usual-scenario. Only 7 sponge iron plants (including VGL) out of around 65[7] (refer Step 4 in section B3 of 'Tool for the demonstration and assessment for Additionality' for details) in the state have waste heat recovery based captive power generation.
- No power generation risk involved
- The VGL plant is connected to the regional grid and will be dependent on the same in absence of the project.
- The grid's generation mix comprises of power generated through sources such as thermal (coal and gas), hydro and nuclear power plants and renewable energy. The project activity would therefore displace an equivalent amount of electricity the plants would have drawn from the grid. The Baseline Emission Factor of the grid is more conservative than that of the coal based CPP.

We may therefore conclude that in the absence of project activity, the VGL plant would draw power from CSEB (Western regional) grid, and the system boundary would include the regional grid's generation mix. It may also be noted that in the pre-project scenario the VGL drew power from the state grid. This further reaffirms that the grid as baseline will be the most appropriate choice.

Establishing the additionality for the project activity

This step is based on Annex ~~I~~ 8 to Executive Board (EB) 22 meeting report and follows the 'Tool for the demonstration and assessment of additionality (version 02)'. Information/data related to preliminary screening, identifying alternatives, common industry practice and other financial, regulatory and technology related barriers were used to establish the additionality. Details of establishing additionality are explained in section B3.

[7] Chattisgarh Sponge Iron Manufacturers' Association

Baseline Emissions
Since "Alternative 1: Import of electricity from the grid" is the baseline scenario, therefore the baseline emission is calculated as per Option 2 of ACM0004.

Baseline Emissions Factor
The CO_2 baseline emission factor of the Western regional grid has been calculated as Combined Margin [average of the Operating Margin, calculated as 3-year average, based on 2002-2003, 2003-2004 and 2004-2005 (the most recent statistics available) and Build Margin, calculated for the most recent year, 2004-2005] following the guidelines provided in ACM0002 (version 05) and was found to be 0.759 kg. of CO_2/ kWh. Please refer to "Annex 3: Baseline Information" and Enclosure – I for detailed analysis of the generation mix of Western regional grid and calculation of the grid emission factor.

Electricity generation in the project activity
The project activity would generate a net electricity of 25 million kWh per annum. Without the project activity, the same energy load would have been taken up by grid power and emission of CO_2 would have occurred due to fossil fuel combustion.

Project Emissions
As per the methodology, project emissions are applicable only if auxiliary fuels are fired for generation start up, in emergencies, or to provide additional heat gain to waste gases before entering the WHRB However, there is no provision of auxiliary fuel firing for generation start up or for additional heat gain of the waste gases in the project activity. Therefore there is no project emission resulting from the project activity. Please refer to Section D.2.1 for details.

Estimation of emission reductions resulting from the project activity
As per the methodology, the emission reductions resulting from the project activity is calculated as a difference between the baseline emissions and the project emissions. As described in the methodology, there is no leakage associated with the project activity. The baseline emissions and the project emissions are quantified as per the guidelines given in the methodology.

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

As per the decision 17/cp.7, para 43, a CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in absence of registered CDM project activity. The methodology requires the project proponent to determine the additionality based on 'Tool for the demonstration and assessment of additionality (version 02)' as per EB 22 meeting. The flowchart in Fig 2 below provides a step-wise approach to establish additionality of the project activity.

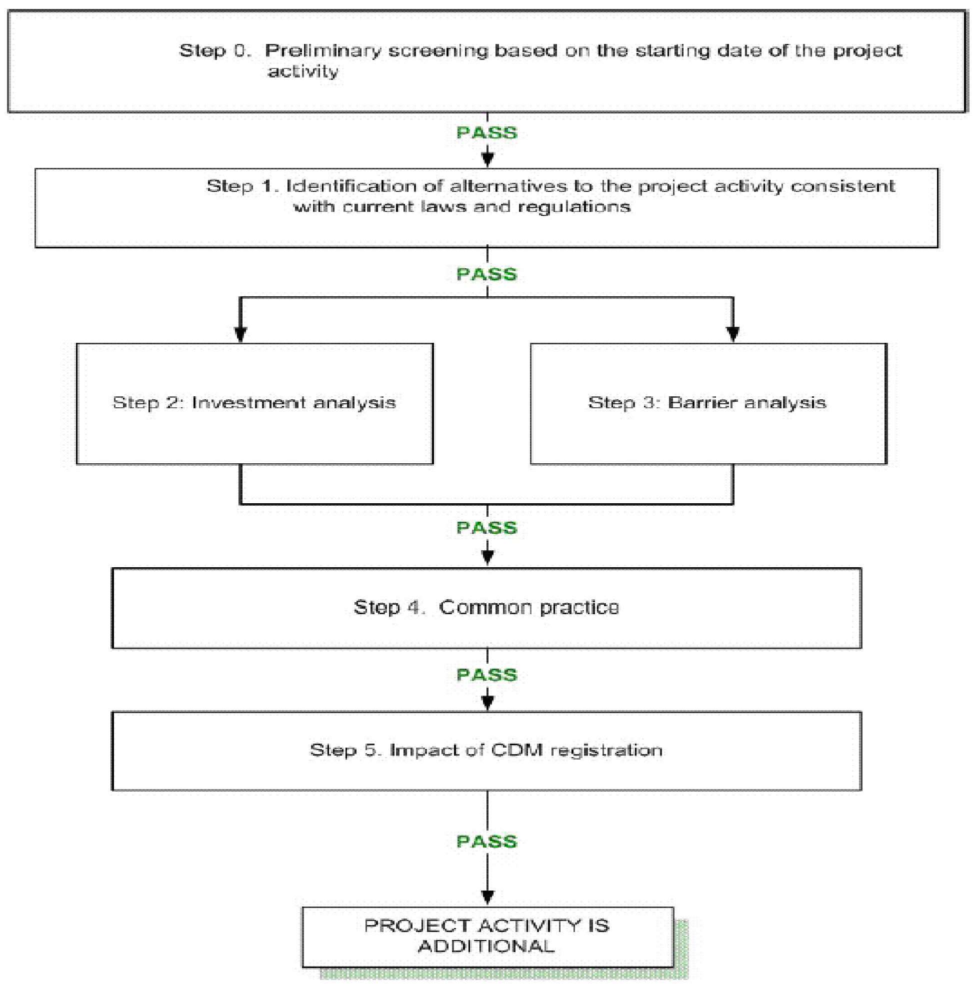

Fig 2: Flow chart for establishing additionality

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 Vandana Global Private Limited (VGL) launched the project activity on waste heat recovery based captive power generation by starting construction in 2003. VGL 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 at, or prior to, the start of the project activity.*

As a responsible corporate citizen, Vandana Group is committed to growth of business keeping in mind the environmental protection aspects both locally as well as globally. The Group is aware that the emergence of the concept of sustainable development in the recent years has brought in the general realization that environmental issues are inexorably linked with its development objectives and polices. Likewise, all activities undertaken by VGL too take into consideration the environmental, health and social assessment. Consequently, climate change issues are very much a part of VGL decision making covering all its proposed activities. VGL was aware of the number of regulatory and technological 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 VGL decided to take up the project activity in view of the risk mitigation cover CDM would provide. 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.

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

As discussed in section B2 above, there were five plausible alternatives available with the project proponent to provide the power requirement of the VGL iron and steel plant, among which three were feasible. The feasible alternatives were:
Alternative 1: Import of power from grid– continuation of current scenario
Alternative 2: 4 MW Coal based CPP at VGL
Alternative 4: 4 MW light diesel oil or furnace oil based CPP at VGL

These alternatives are in compliance with all applicable legal and regulatory requirements. There is no legal binding on VGL 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 100mg/Nm^3. These pollution control board norms were being met even in absence of the project. Though this alternative would bring down the SPM levels in the flue gas, there is no mandate by the Chattisgarh Pollution Control Board to implement the same.

Next the project proponent is required to conduct

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

VGL 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

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

1. Regulatory/Institutional barriers:

Regulatory barriers faced by VGL (the project proponent) are detailed below:

a. VGL in early 2002 decided to take permission for setting up its captive power plant with wheeling facility that included 4 MW from the waste heat utilization. The company had intended to reduce dependence on grid power once its captive power plant was commissioned. However, while granting permission, CSEB incorporated a condition that the VGL's contract demand of 7000kVA will not be reduced in future on account of installation of proposed captive power plant[8]. Hence, for VGL these demand charges would turn out to be considerable recurring costs when the operation of project activity would start.

b. As mentioned above, the project activity was conceived for in-house consumption and wheeling to VGL's group companies. But as the mandatory contract demand of 7000kVA was to cater to the power demand of VGL plant itself, the management of VGL decided to supply the power generated from the project activity to meet the demand of their group companies. VGL had applied for wheeling to CSEB on 6th Mar 2003 as per Chattisgarh state and Indian government policy. On 7th Mar 2003, CSEB issued No Objection Certificate to VGL on the condition that wheeling of power shall be commenced after obtaining the permission from the Energy Secretary of the State under Section 28 of Indian Electricity Act 1910. Moreover, under the same Act, consumers to whom the power would be wheeled would not be permitted to reduce their contract demand and shall pay tariff monthly minimum (TMM) charges as per the prevailing agreement between the consumers and the Board. Soon after, VGL applied on 8th March 2003 to the Energy Secretary, Government of Chattisgarh for permission to wheel to their group companies. VGL management waited for four months for the approval to come by from the Energy Secretary. In the meantime, a new Act, called Electricity Act 2003 was passed in India wherein for getting the permission to wheel the company had to apply to the State Electricity Regulatory Commission under Section 42 of the new Act[9]. However, this permission got delayed as Chattisgarh State Electricity Regulatory Commission (CSERC) was in a formatory stage at the time in the new state of Chattisgarh. Finally, after its establishment, CSERC heard the petition of VGL, and granted permission to wheel power on 27th September 2005. As a result of this time delay for obtaining approval, the project proponent had to face considerable cost overruns.

The above mentioned regulatory barriers were one of the major obstacles for project activity implementation.

2. Technological barriers:

Lack of relevant technical background

Energy generation is not a core business of VGL - the project participant belongs to the Vandana Group of Industries. The Group is engaged mainly in manufacturing iron and steel products. The waste heat recovery based power project is a steep diversification from the core business fields to power generation where the project proponent had to meet challenges of captive power policies, delivery/non-delivery of power, wheeling of power and techno-commercial problems associated with electricity boards. The

[8] Reference: CSEB Letter to VGL, dated 10th February, 2003, Letter from VGL to CSEB dated 6th March 2003, Letter from CSEB to VGL dated 7th March 2003, Letter from VGL to Energy Secretary, Govt. of Chattisgarh dated 8th March 2003 and Letter from CSERC to VGL dated 27th September 2003.

[9] http://www.powermin.nic.in/acts_notification/pdf/The%20Electricity%20Act_2003.pdf

facility had to invite external parties to implement the project activity. Skilled professionals had to be employed and the employees of VGL were also required to develop expertise on design, construction and operation of heat recovery based power plant.

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

As mentioned earlier, the sponge-iron manufacturing sector belongs to steel industry sector with limited knowledge and exposure of complications associated with production of power. VGL 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 VGL personnel at various levels lacked relevant managerial background for project activity implementation, operation and maintenance. They were provided with training to ensure smooth operation. They had no background strength in the power sector economics and power generation sector.

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

This is demonstrated in Table 1 of Section B.2 above. VGL's project activity is a waste heat recovery based power project utilizing waste heat from sponge iron rotary kiln that uses coal as fuel. VGL would not face any regulatory barrier in case it opted for import of power from grid, since VGL purchased power from grid before the project activity was implemented. Also, VGL would not face any technological barrier like generation and synchronization of power, in case it continued to depend solely on purchase of power from grid. Therefore, it is most likely that in absence of the project activity, VGL would opt for the business-as-usual scenario, i.e. letting off the waste heat into the atmosphere and importing equivalent amount of electricity from state grid to cater to its need.

Step 4: Common Practice analysis: Based on the information about activities similar to the proposed project activity, the project proponent is supposed to carry out common practice analysis to complement and reinforce the barrier analysis. The project proponent is required to identify and discuss the existing common practice through the following sub-steps:

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

In the sponge iron sector of Chattisgarh State with similar socio-economic, environment, geographic conditions and technological circumstances there were around 65 similar plants (i.e. sponge iron manufacturing units) operating when the project was started. Of the 65 plants, only seven plants had set-up waste heat recovery based CPPs. Among them two plants (namely Prakash Industries Ltd. and Monnet Ispat Ltd.) generated power to meet their in-house consumption alone thus not undertaking additional risks associated with wheeling power through the grid. VGL's project activity would be the fourth sponge iron plant in the state to set up WHR based CPP with a provision for feeding power to the grid.

These plants have been categorised as per Table 2 summarizing the common practices adopted by sponge iron manufacturing plants located in Chattisgarh state to meet their power requirements.

Table 2: Common Practise analysis

Alternatives	Description	No. of sponge iron plants
Scenario 1	Import of Power from Grid	58
Scenario 2	Waste heat recovery based CPP for in-house consumption	03
Similar Project Activity	Waste heat recovery based CPP feeding to grid (including VGL)	04
Total no. of Sponge Iron plants in Chattisgarh state		**65**

Source: Chattisgarh Sponge Iron Manufacturers' Association

Step 4b: Discuss any similar options that are occurring

WHR based power generation feeding power to grid took place only at Jindal Steel and Power Limited (JSPL)[10], Godavari Power and Ispat Limited (GPIL) and HEG Ltd.[11] and at VGL. JSPL was exporting surplus power to the state grid and GPIL and HEG limited wheeled the surplus power to its group companies through the transmission and distribution lines of CSEB. GPIL project activity has considered CDM revenues during its implementation stage.

The fact that the project activity is not a widely observed and commonly carried out practice is thus substantiated.

Step 5: Impact of CDM registration

The project activity was started in January 2003 and was commissioned in March 2005. As mentioned in Step 4, VGL is among the first few waste heat recovery power projects in the state of Chattisgarh that is undertaking power generation through waste heat recovery and corresponding reduction of GHG emissions in the Western Regional grid. Project activity getting registered as CDM project would give instant visibility among the state utilities power ministries/departments, environment ministries/departments of the local and global benefits of the project, enabling VGL to face lesser governmental hurdles in future.

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 and would aid CSEB and CSERC to appreciate the GHG emission reduction efforts of the project proponent. This could lead to smoother wheeling transactions in future between the project proponent and utility. Further CDM fund will provide additional coverage to the risk due to regular and breakdown maintenance of waste heat recovery system, failure of project activity due to shut down of plant and loss of production in VGL.

It is ascertained that the project activity would not have occurred in the absence of the CDM simply because no policy or other incentives which exist locally to foster its development in Chattisgarh/India and without the proposed carbon financing for the project VGL would not have taken the investment risks

[10] JSPL Annual Report 2001-02

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

in order to implement the project activity. Therefore the project activity is additional. Also, the impact of CDM registration is significant with respect to running 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:

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

This CDM project covers the activities carried on for generation of electricity at VGL facility from their waste heat based CPP. The activities include recovery and utilization of waste flues gases of sponge iron kiln of VGL after complete combustion, generation of steam, generating power in turbo generator sets and finally with evacuation of power from the power plant. The produced electricity by CPP is consumed in-house in the manufacturing facility and the surplus is wheeled to the group companies through the CSEB grid.

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

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

The boundary comprises of the WHRB unit, Economiser, Steam Turbine Generator, ESP, and Ash Removal System.

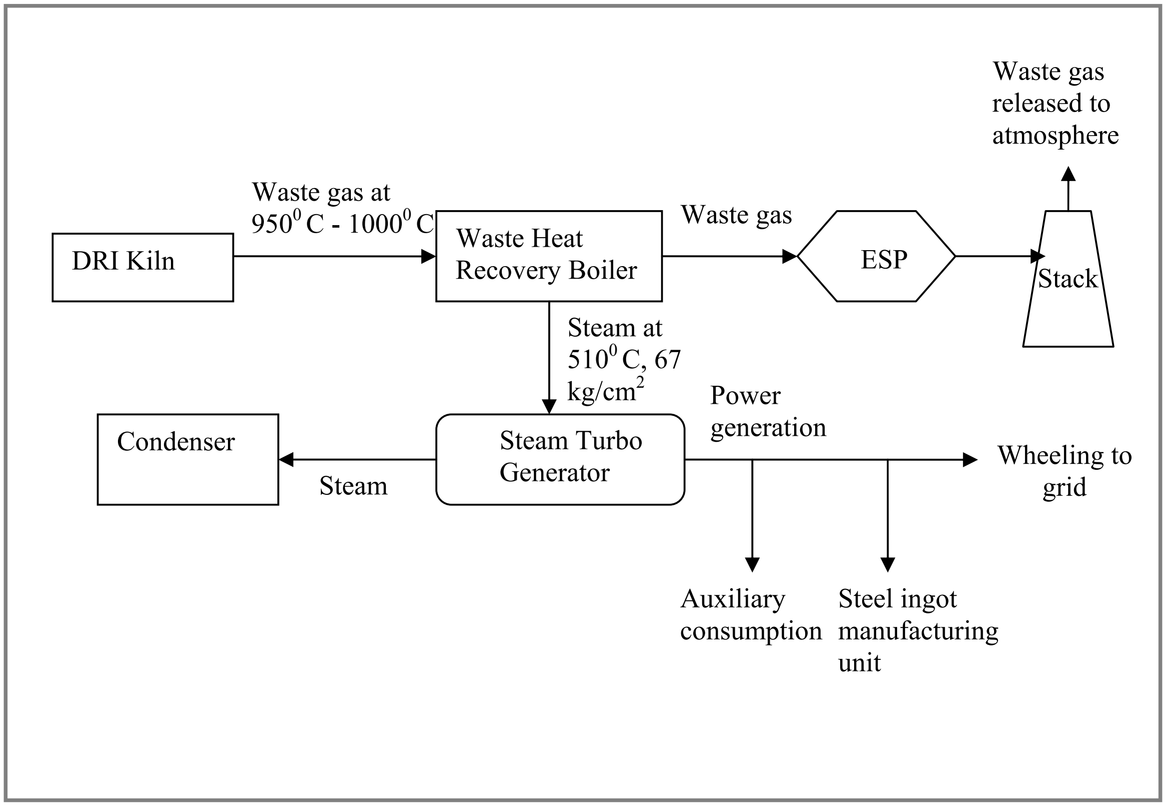

Figure 3: Project Boundary for VGL's Waste Heat based Power Project.

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

Further, for the purpose of calculation of baseline emission, Western Regional grid has been considered within the system boundary. Estimation of baseline emissions has been done based on data and information available from Western Regional Electricity Board (WREB) and Central Electricity Authority (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:

The baseline is determined as grid power supply for the project activity (refer Section B2 above). As per 'Option 2: If baseline scenario is grid power imports' of the ACM0004 methodology, baseline is calculated as per ACM0002 methodology. The net baseline emission factor was found to be 0.759 kg CO_2/ kWh. Please refer to details in Annex 3 of the PDD.

Date of completing the final draft of this baseline selection: 08/05/2006
Name of person/entity determining the baseline:
Contact Information of Participant in the Project Activity (as listed in Annex 1 of the PDD):

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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:

01/09/2003

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

25y

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

C.2.1. Renewable crediting period

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

C.2.1.2. Length of the first crediting period:

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

01/04/2005

C.2.2.2. Length:

10 y

SECTION D. Application of a monitoring methodology and plan

The monitoring procedures define a project-specific standard against which the project's performance (i.e GHG reductions) and conformance with all relevant criteria will be monitored and verified. The aim is to enable this project have a clear, credible and accurate set of monitoring, evaluation and verification procedures. The purpose of these procedures would be to direct and support continuous monitoring of project performance/ key project indicators to determine project outcomes, greenhouse gas (GHG) emission reductions.

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

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

Reference: Approved consolidated monitoring methodology ACM0004/ Version 02, Sectoral Scope: 01, 03 March 2006

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

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

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

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 WHRBs.
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}	Quantitative	Total Electricity Generated	MWh /year	Online measurement	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.
2. EG_{AUX}	Quantitative	Auxiliary consumption of Electricity	MWh /year	Online measurement	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.
3. EG_y	Quantitative	Net Electricity supplied	MWh /year	Calculated (EG_{GEN}- EG_{AUX})	Continuously	100%	Electronic/paper	Credit Period + 2 years	Calculated from the above measured parameters.

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	CO2 emission factor of the grid	tCO2/ MWh	Calculated	Simple OM, BM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated as weighted sum of OM and BM emission factors
5. $EF_{OM,y}$	Emission factor	CO2 operating margin emission factor of the grid	tCO2/ MWh	Calculated	Simple OM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated as indicated in the relevant OM baseline method above
6. $EF_{BM,y}$	Emission factor	CO2 Build Margin emission factor of the grid	tCO2/ MWh	Calculated	BM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated as [∑I Fi,y*COEFi]/ [∑mGENm,y] over recently built power plants defined in the baseline methodology
7. $F_{i,j,y}$	Fuel Quantity	Amount of each fossil fuel consumed by each power source/ plant	t or m^3/year	Calculated	Simple OM BM	Yearly	100%	Electronic	During the crediting period and two years after	Obtained from authorised latest local statistics
8. $COEF_{i,k}$	Emission factor	CO2 emission coefficient of	tCO_2/ t or m^3	Calculated	Simple OM BM	Yearly	100%	Electronic	During the crediting	Calculated based on the

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
	coefficient	each fuel type and each power source/plant							period and two years after	IPCC default value of the Emission Factor, Net Calorific Value and Oxidation Factor of the fuel used by the power plants feeding to ~~CSEB~~Western regional grid.
9. $GEN_{j,y}$	Electricity quantity	Electricity generation of each power source/plant	MWh/ year	Measured	Simple OM BM	Yearly	100%	Electronic	During the crediting period and two years after	Obtained from authorised latest local statistics

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

Emission Factor of the Grid (EF_{Grid})

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

Step 1. Calculate the Operating Margin emission factor

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

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

where

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

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

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

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

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

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

where

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

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

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

The CO_2 emission coefficient $COEF_i$ is obtained as

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

where
NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel i
$EF_{CO2,i}$ is the CO_2 emission factor per unit of energy of the fuel i
$OXID_i$ is the oxidation factor of the fuel

The Simple OM emission factor ($EF_{OM,simple,y}$) is calculated separately for the most recent three years (2002-2003, 2003-2004 and 2004-05) and an average value has been considered as the OM emission factor for the baseline ($EF_{OM,y}$).

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

where y represents the years 2002-2003 , 2003-2004 and 2004-05

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 Western Regional grid. The sample group *m* consists of either
• the five power plants that have been built most recently, or
• the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.
Project proponent should use from these two options that sample group that comprises the larger annual generation. The calculation for Build Margin emission factor is furnished below:

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

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

Step 3. Calculate the Emission Factor of the Grid (EF_{Grid})
The electricity baseline emission factor of Western regional grid, EF_y is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

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

where the weights w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM} = w_{BM} = 0.5$), and $EF_{OM,y}$ and $EF_{BM,y}$ are calculated as described in Steps 1 and 2 above and are expressed in t CO_2/MWh.
(Please refer to "Annex 3: Baseline Information" for further details on grid analysis)

Baseline Emission Calculations

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

$$= (EG_{GENy} - EG_{AUXy})$$

where,
$EG_{GEN,y}$ is the total Electricity generated for year y
$EG_{AUX,y}$ is auxiliary consumption for year y

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.):

Not applicable

D.2.3. Treatment of leakage in the monitoring plan

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

There is no leakage associated with the project activity.

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

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

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

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

ERy = BE,y - PEy

Where,
ERy are the emissions reductions of the project activity during the year y in tons of CO_2,
BE,y are the baseline emissions due to displacement of electricity during the year y in tons of CO_2,
PEy are the project emissions during the year y in tons of CO_2 = 0, and

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

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

Contact Information of Participant in the Project Activity (as listed in Annex 1 of the PDD):

Mr. Satish Kumar
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SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

As per ACM0004, the Project Emissions are applicable only if auxiliary fuels are fired for generation startup, in emergencies, or to provide additional heat gain before entering the Waste Heat Recovery Boiler. The project activity utilizes the heat content of the waste gas available from the sponge iron kiln unit as its fuel source. Since the composition of the waste gas at the boiler inlet and the boiler outlet is identical and there are no other fuel source within the project boundary, the project activity leads to zero net GHG on-site emissions. Therefore, no project emission is considered.

E.2. Estimated leakage:

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

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

The net emission by project activity (E1+E2) is zero.

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

Algorithm used for calculation of Baseline emission has been provided in the section D.2.1.4

Sl. No.	Year	Baseline Emission Factor (kg CO2 / kWh)	Baseline Emissions (tonnes of CO_2 e)
1.	2005-2006 [Apr-Mar]	0.759	18965.2
2.	2006-2007	0.759	18965.2
3.	2007-2008	0.759	18965.2
4.	2008-2009	0.759	18965.2
5.	2009-2010	0.759	18965.2
6.	2010-2011	0.759	18965.2
7.	2011-2012	0.759	18965.2
8.	2012-2013	0.759	18965.2
9.	2013-2014	0.759	18965.2
10.	2014-2015	0.759	18965.2

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

Sl. No.	Year	Baseline Emissions (tonnes of CO_2e)	Project Activity Emissions (tonnes of CO_2e)	Estimation of emission reductions (tonnes of CO_2e)
1.	2005-2006 [Apr-Mar]	18965.2	0	18965.2
2.	2006-2007	18965.2	0	18965.2
3.	2007-2008	18965.2	0	18965.2
4.	2008-2009	18965.2	0	18965.2
5.	2009-2010	18965.2	0	18965.2
6.	2010-2011	18965.2	0	18965.2
7.	2011-2012	18965.2	0	18965.2
8.	2012-2013	18965.2	0	18965.2
9.	2013-2014	18965.2	0	18965.2
10.	2014-2015	18965.2	0	18965.2

Total Estimated Emission Reductions: **189652 t CO2 equivalent** over the 10 year crediting period.

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

Year	Estimation of project activity emission reductions (tonnes of CO_2 e)	Estimation of baseline emission reductions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of emission reductions (tonnes of CO_2e)
2005-2006	0	18965.2	0	18965.2
2006-2007	0	18965.2	0	18965.2
2007-2008	0	18965.2	0	18965.2
2008-2009	0	18965.2	0	18965.2
2009-2010	0	18965.2	0	18965.2
2010-2011	0	18965.2	0	18965.2
2011-2012	0	18965.2	0	18965.2
2012-2013	0	18965.2	0	18965.2
2013-2014	0	18965.2	0	18965.2
2014-2015	0	18965.2	0	18965.2
Total (tonnes of CO_2 e)	0	189652	0	189652

SECTION F. Environmental impacts

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

Environmental performance forms an integral part of the project proponent's endeavor towards sustainable development. Any project activity can cause impacts on environment either positive or negative depending on the type of the activity, throughout the project lifetime.

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

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

- Substantial reduction in thermal pollution. In absence of the project activity there would have been considerable amount of cooling requirement to be operated with Sponge Iron kiln. CPP primarily utilizes the heat content of the waste flue gas and thereby takes care of thermal pollution. The flue gas of temperature 950^{o}C enters the boiler system and comes out with a reduced temperature after effective heat transfer. 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.

- Negligible magnitude of the impacts during construction phase, taking into consideration the project life cycle. The impacts on air, water and land environment exist for a temporary period of time till the end of construction phase. Therefore, it does not affect the environment considerably.

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

- It has also successfully conserved the non-renewable natural resource such as coal, oil and natural gas by reducing power demand by 25 Million kWh annually on Western Regional grid.

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

SECTION G. Stakeholders' comments

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

Identification of Stakeholders

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

The stakeholders identified for the project are as under.

- Local Authority
- Local community at Siltara and Raipur
- Chhattisgarh State Electricity Board (CSEB)
- Chhattisgarh State Electricity Regulatory Commission (CSERC)
- Chhattisgarh State Renewable Energy Development Agency (CSREDA)
- Chhattisgarh Environment Conservation Board
- Environment Department, Govt. of Chhattisgarh
- Ministry of Environment and Forest (MoEF), Govt. of India
- Ministry of Non-conventional Energy Sources (MNES)
- Industry Associations like Chattisgarh Udyog Mahasangh
- Non-Governmental Organizations (NGOs)
- Consultants
- Equipment Suppliers

Several government & non-government organisations got involved with the project activity during various stages of its implementation.

VGL shared the salient information of the project activity with all the stakeholders enlisted above. VGL communicated their plan to implement the project activity to the local villagers, Village Panchayat and the NGOs to receive their comments. VGL representative also met the local NGOs and apprised them about the project activity and sought their support for the project. VGL also sent applications to all the government parties to get their opinions on the project activity and attain the necessary approvals and clearances necessary for project implementation.

G.2. Summary of the comments received:

The project proponent has consulted the key local stakeholders to their project activity and has records of communication from several of these. The comments can be summarised as positive and encouraging in view of the environmental friendliness and reduced use of fossil fuel in power generation. Socio-economic benefits from the project activity have also been appreciated.

State Pollution Control Board and Environment Department of the Government of Chhattisgarh have prescribed standards of environmental compliance and monitor the adherence to the standards. The VGL waste heat based power plant is complying with all such set standards and is also monitoring the adherence to the standards on a regular basis.

Further, state's apex body of power, CSEB have issued consent for the installation and operation of the waste heat based power plant of 4 MW capacity under section 44 of the Electricity (Supply) Act, 1948.

CSERC is a major stakeholder in the project. They hold the key of the commercial success of the project. CSERC has already cleared the project and also has consented the wheeling of power to the group companies concerns of VGL.

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

The relevant comments and important clauses mentioned in the project documents / clearances like Detailed Project Report (DPR), environmental clearance, Wheeling of Power Agreement, local clearances *etc.* were considered while preparing the CDM Project Design Document.

Comments received by stakeholders are documented and can be shown on request. As per UNFCCC requirement the PDD will be published at the validator's web site for public comments under international stakeholder consultation process.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

Till now funding from any Annex I country for the project activity is not available.

Annex 3

BASELINE INFORMATION

For the project activity the baseline scenario was determined as 'Import of power from grid' as described in Section B2 above. As per ACM0004 methodology, for grid power supply as baseline scenario the Emission Factor for the displaced electricity system is calculated as per ACM0002 baseline methodology. The project proponent proceeds to determine the Emission Factor for the electricity system it imports power from.

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

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

The project activity hosting plant VGL is connected to Chattisgarh State Electricity Board (CSEB), a part of Western Region grid. The state sector grids of Gujarat, Madhya Pradesh, Maharashtra, Goa and Chattisgarh and union territory grids of Daman & Diu and Dadra & Nagar Haveli come under Western Region Grid. CSEB is responsible for the operation and maintenance of all power generating stations in Chattisgarh state. The Board has 1,360MW of installed capacity of which more than 85% is accounted for by thermal power (coal) and the balance is hydro power. CSEB also imports power from central government owned power plants such as NTPC Korba, Vindyachal, (Coal Based); Kawas, Gandhar (Gas Based); Kakrapara (Nuclear based) with total share of 498 MW out of which 475 MW is thermal and rest 23 MW is nuclear. Power generated by all the central generation units is being fed to the grid (Western Grid), which is accessible to the states forming part of the western grid.

Since the project activity displaces power from state (Chattisgarh) as well as central generating stations of regional grid, the project proponents will be required to use the carbon intensity of the entire Western Regional grid as the baseline emission factor for baseline emission calculations over the proposed project activity's crediting period.

Furthermore, as per ACM0002 (Version 05: dated 03 March 2006), since there is no delineation of grid boundaries provided by the Designated National Authority of the host country, the following definition of grid boundary is applicable: "*In large countries with layered dispatch systems (e.g. state/provincial/regional/national) the regional grid definition should be used. A state/provincial grid definition may indeed in many cases be too narrow given significant electricity trade among states/provinces that might be affected, directly or indirectly, by a CDM project activity.*"

Taking into consideration both the points mentioned above (i.e. the relevant grid displaced by the project activity and the guidelines for selection of the appropriate grid in large countries with layered dispatch systems like India as given in ACM0002 Version 05), the Western Regional Grid has been considered as the most representative system boundary (i.e. project electricity system) where an equivalent amount of electricity would be replaced by the implementation of the proposed project activity. The carbon intensity of the Western Region Grid would be determined to arrive at the baseline emission factor for baseline emission calculations for the project activity's crediting period.

B) Determination of the Carbon Intensity of the chosen Grid

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

Combined Margin

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

Step 1: Calculation of Operating Margin

As mentioned above the proposed project activity would have some effect on the Operating Margin (OM) of the Western regional Grid. The approved consolidated baseline methodology-ACM0004 requires the project proponent to calculate the Operating Margin (OM) emission factor following the guidelines in ACM0002 (Consolidated methodology for grid-connected electricity generation from renewable sources). As per Step 1 of ACM0002, the Operating Margin emission factor(s) ($EF_{OM,y}$) is calculated based on one of the four following methods:

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

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

'Simple OM' (1a) method is applicable to project activity connected to the project electricity system (grid) where the low-cost/must run[12] 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 proposed project activity, VGL conducted a baseline study wherein the power generation data for all power sources in the project electricity system (i.e. Western Regional Grid) have been collected from government/non-government organisations and authentic sources. The power generation mix of Western Regional Grid comprises of coal, gas and diesel based thermal power generation and hydro, wind and nuclear power generation. The actual generation data of entire Western Regional Grid is analysed for the years 2000-01, 2002-2003, 2003-2004 and 2004-2005 to arrive at the contribution of the thermal power plants and the low-cost and must run power generation sources in the Western Regional Grid mix. (Refer

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

to Table 3 given below). It was found that the average share of the low cost and must run power generation sources over most recent years was lower than 50% of the total electricity generation in the grid.

Table 3: Power Generation Mix of Western Regional Grid for most recent years[13]

Energy Source	2000-01	2001-02*	2002-03	2003-04	2004-05
Total Power Available –MkWh	156935.69	-	166558.43	171707.05	181912.79
Low cost (Hydro, wind and nuclear) – MkWh	12749.03	-	14600.27	15848.18	15020.26
Thermal (coal and gas) – MkWh	138533.16	-	143732.60	145680.20	155286.10
Purchase from other grids – MkWh	5653.20	-	8225.58	10178.67	11606.45
% of Low cost must run sources out of Total grid generation	8.12	-	8.77	9.23	8.26
% of Other grid purchase out of Total grid Generation.	3.60	-	4.94	5.93	6.38
% of Thermal sources out of Total grid generation	88.27	-	86.30	84.84	85.36
Average Low cost % for the four years - 8.59%					

* Data for 2001-02 not available

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

The Simple OM emission factor ($EF_{OM,simple,y}$) is calculated as the generation-weighted average emissions per electricity unit (tCO_2/MkWh) taking into consideration the present power generation mix excluding low cost must run hydro-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.

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

Present Power Generation Mix

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

Table 4: Power Generation Details in the Western Region for the year 2002-2003

[13] Source of generation data for the year 2000-01: CEA General Review 2000-01 2002-2003: CEA General Review (2002-2003), for 2003-2004: CEA General Review 2005 (contains data for 2003 2004) and for the year 2004-2005: WREB Annual Report (2004-2005). Data for 2001-02 is not available.

Generation Sources	Fuel	Gross MkWh Generated 2002-2003	Auxiliary Consumption (MkWh) 2002-2003	Net MkWh Generated/ Purchased 2002-2003
Generation of SEBs, Electricity Dept., Govt. Undertakings, Municipalities, Private Generating Stations, Self-generating Industries				
Total Thermal	Coal	104000.35	9245.33	94755.02
Total Thermal	Diesel	0	0	0
Total Thermal	Gas	11140.43	240.48	10899.95
Total Hydro	Hydro	8172.15	50.39	8121.76
Total Wind	Wind	878.52	0	878.52
Total Nuclear	Nuclear	0	0	0
Total from Non-Utilities	Low Cost (Assumed for conservative estimate)			2467.87
Generation from Central Sector Power Plants located in Western Region				
Total Thermal	Coal	33391.85	2769.58	30622.27
Total Thermal	Diesel	0	0	0
Total Thermal	Gas	7572.87	117.35	7455.52
Total Hydro	Hydro	0	0	0
Total Wind	Wind	0	0	0
Total Nuclear	Nuclear	6200	600	5600
Import from Central Sector Power Plants located in other Regions				
Total Thermal	Coal			3875.83
Total Thermal	Diesel			0
Total Thermal	Gas			33.37
Total Hydro	Hydro			0
Total Wind	Wind			0
Total Nuclear	Nuclear			0
Import from other Regions				

Northern Regional Electricity Board(NREB)				1124.49
Southern Regional Electricity Board (SREB)				466.82
Eastern Regional Electricity Board (EREB)				257.2

Summary of Power Generation Details in the Western Region for the year 2002-2003		
		Net MkWh Generated/Purchased
Generation Sources	**Fuel**	**2002-2003**
Total Thermal Generation in WR	Coal	129253.12
Total Thermal Generation in WR	Diesel	0
Total Thermal Generation in WR	Gas	18388.84
Total Hydro Generation in WR	Hydro	8121.76
Total Wind Generation in WR	Wind	878.52
Total Nuclear Generation in WR	Nuclear	5600
Total Generation from Non-Utilities in WR	Low Cost (Assumed for conservative estimate)	2467.87
Total Import from other Regions in WR		1848.51
Total Generation from all sources in WR		**166558.62**
Source: CEA General Review 2002-03		

Table 5:Power Generation Details in the Western Region for the year 2003-2004				
		Gross MkWh Generated	**Auxiliary Consumption (MkWh)**	**Net MkWh Generated/ Purchased**
Generation Sources	**Fuel**	**2003-2004**	**2003-2004**	**2003-2004**

Generation of SEBs, Electricity Dept., Govt. Undertakings, Municipalities, Private Generating Stations, Self-generating Industries				
Total Thermal	Coal	103377.75	9149.65	94228.1
Total Thermal	Diesel	0	0	0
Total Thermal	Gas	14399.21	293.27	14105.94
Total Hydro	Hydro	9282.38	55.96	9226.42
Total Wind	Wind	1521.76	0	1521.76
Total Nuclear	Nuclear	0	0	0
Total from Non-Utilities	Low Cost (Assumed for conservative estimate)			3196.81
Generation from Central Sector Power Plants located in Western Region				
Total Thermal	Coal	32685.7	2285	30400.7
Total Thermal	Diesel	0	0	0
Total Thermal	Gas	7108.91	163.45	6945.46
Total Hydro	Hydro	0	0	0
Total Wind	Wind	0	0	0
Total Nuclear	Nuclear	5700	600	5100
Import from Central Sector Power Plants located in other Regions				
Total Thermal	Coal			4188.3
Total Thermal	Diesel			0
Total Thermal	Gas			0
Total Hydro	Hydro			0
Total Wind	Wind			0
Total Nuclear	Nuclear			205.74
Import from other Regions				

NREB				1137.41
SREB				0
EREB				1450.41

Summary of Power Generation Details in the Western Region for the year 2003-2004.		
		Net MkWh Generated/Purchased
Generation Sources	**Fuel**	**2003-2004**
Total Thermal Generation in WR	Coal	128817.1
Total Thermal Generation in WR	Diesel	0
Total Thermal Generation in WR	Gas	21051.4
Total Hydro Generation in WR	Hydro	9226.42
Total Wind Generation in WR	Wind	1521.76
Total Nuclear Generation in WR	Nuclear	5305.74
Total Generation from Non-Utilities in WR	Low Cost (Assumed for conservative estimate)	3196.81
Total Import from other Regions in WR		2587.82
Total Generation from all sources in WR		**171707.05**
Source: CEA General Review 2004-05 (contains data for the year 2003-04)		

Table 6:Power Generation Details in the Western Region for the year 2004-2005				
		Gross MkWh Generated	**Auxiliary Consumption (MkWh)**	**Net MkWh Generated/ Purchased**
Generation Sources	**Fuel**	**2004-2005**	**2004-2005**	**2004-2005**
Generation of SEBs, Electricity Dept., Govt. Undertakings,				

Municipalities, Private Generating Stations, Self-generating Industries				
Total Thermal	Coal	107091.6	9583.28	97508.32
Total Thermal	Diesel	0	0	0
Total Thermal	Gas	18955.38	386.48	18568.9
Total Hydro	Hydro	10577.22	53.46	10523.76
Total Wind	Wind	0	0	0
Total Nuclear	Nuclear	0	0	0
Import from Self Generating Industries (Balco and Jindal)	Low Cost (Assumed for conservative estimate)			978.14
Generation from Central Sector Power Plants located in Western Region & in other Regions				
Total Thermal	Coal			32953.356
Total Thermal	Diesel			0
Total Thermal	Gas			6703.57
Total Hydro	Hydro			0
Total Wind	Wind			0
Total Nuclear	Nuclear			4496.51
Import from other Regions				
NREB				1093.264
SREB				1766.607
EREB				9094.757

Summary of Power Generation Details in the Western Region for the year 2004-2005

Generation Sources	**Fuel**	**Net MkWh Generated/Purchased 2004-2005**
Total Thermal Generation in WR	Coal	130461.68
Total Thermal Generation in WR	Diesel	0
Total Thermal Generation in WR	Gas	25272.47
Total Hydro	Hydro	10523.76

Generation in WR		
Total Wind Generation in WR	Wind	0
Total Nuclear Generation in WR	Nuclear	4496.51
Total Import from Self Generating Industries in WR	Low Cost (Assumed for conservative estimate)	978.14
Total Import from other Regions in WR		11954.63
Total Generation from all sources in WR		**183687.18**
Source: WREB Annual Report (2004-2005)		

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

Table 7: Data used for Simple OM emission factor

Year of offer	2002-03		2003-04		2004-05	
Generation Mix	-	-	-	-	-	
Sector	MkWh	%	MkWh	%	MkWh	%
Thermal Coal Based-Western Region	129253.12	78.47	128817.10	76.17	130461.68	75.97
Thermal Diesel Based-Western Region	0.00	0.00	0.00	0.00	0.00	0.00
Thermal Gas Based-Western Region	18388.84	11.16	21051.40	12.45	25272.47	14.72
Hydro-Western Region	8121.76	4.93	9226.42	5.46	10523.76	6.13
Wind-Western Region	878.52	0.53	1521.76	0.90	0.00	0.00
Nuclear-Western Region	5600.00	3.40	5305.74	3.14	4496.51	2.62
Import from Self Generating Industries	2467.87	1.50	3196.81	1.89	978.14	0.57
Total	164710.11	100.00	169119.23	100.00	171732.56	100.00
Total generation excluding Low-cost power generation	147641.96		149868.50		155734.15	
Generation by Coal out of Total Generation excluding Low-cost power generation	129253.12	87.54	128817.10	85.95	130461.68	83.77
Generation by Diesel out of Total Generation excluding Low-cost power generation	0.00	0.00	0.00	0.00	0.00	0.00

Generation by Gas out of Total Generation eexcluding Low-cost power generation	18388.84	12.46	21051.40	14.05	25272.47	16.23
Imports from others						
Imports from NREB	1124.49		1137.41		1093.26	
Imports from SREB	466.82		0.00		1766.61	
Imports from EREB	257.20		1450.41		9094.76	
Estimation of Baseline Emission Factor (tCO2/MkWh)						
Simple Operating Margin						
Fuel 1 : Coal						
Avg. Efficiency of power generation with coal as a fuel, %		36.732		36.576		36.487
Avg. Calorific Value of Coal used (kcal/kg)		4171		3820		3820
Estimated Coal consumption (tons/yr)		72553424		79289960		80496903
Emission Factor for Coal-IPCC standard value (tonne CO2/TJ)		96.1		96.1		96.1
Oxidation Factor of Coal-IPCC standard value		0.98		0.98		0.98
COEF of Coal (tonneCO2/ton of coal)		1.645		1.506		1.506
Fuel 2 : Diesel						
Avg. Efficiency of power generation with diesel as a fuel, %		41.707		41.707		41.707
Avg. Calorific Value of Diesel used (kcal/kg)		9760		10186		10186
Estimated Diesel consumption (tons/yr)		0		0		0
Emission Factor for Diesel-IPCC standard value (tonne CO2/TJ)		74.1		74.1		74.1
Oxidation Factor of Diesel-IPCC standard value		0.99		0.99		0.99
COEF of Diesel (tonneCO2/ton of diesel)		2.998		3.129		3.129
Fuel 3 : Gas						
Avg. Efficiency of power generation with gas as a fuel, %		45		45		45
Avg. Calorific Value of Gas used (kcal/kg)		11942		11942		11942
Estimated Gas consumption		2942817		3368913		4044423

(tons/yr)						
Emission Factor for Gas-IPCC standard value(tonne CO2/TJ)		56.1		56.1		56.1
Oxidation Factor of Gas-IPCC standard value		0.995		0.995		0.995
COEF of Gas(tonneCO2/ton of gas)		2.791		2.791		2.791
EF (OM Simple, excluding imports from other grids), tCO2/MkWh		863.87		859.68		851.08
EF (NREB), tCO2/MkWh		790.00		740.00		730.00
EF (SREB), tCO2/MkWh		770.00		760.00		740.00
EF (EREB), tCO2/MkWh		1190.00		1190.00		1180.00
EF (OM Simple), tCO2/MkWh		863.58		861.93		866.96
3 years Average EF (OM Simple), tCO2/MkWh						864.16

Step 2: Calculation of Build Margin

As mentioned above the proposed project activity would have some effect on the Build Margin (BM) of the Western Regional Grid. The approved consolidated baseline methodology-ACM0004 requires the project proponent to calculate the Build Margin (BM) emission factor following the guidelines in ACM0002 (Consolidated methodology for grid-connected electricity generation from renewable sources). As per Step 2 of ACM0002, the Build Margin emission factor ($EF_{BM,y}$) is calculated as the generation-weighted average emission factor (tCO_2/MkWh) of a sample of power plants. The methodology suggests the project proponent to choose one of the two options available to calculate the Build Margin emission factor $EF_{BM,y}$

Option 1:

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

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

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

Option 2:

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

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

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

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

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

Table 8: Sample of Power Plants for BM Calculation

Sr. No.	Power plant name / location	State	Year of commissioning	Fuel Type	Capacity of the new addition (MW)	Total Capacity (MW)	Generation of the Unit in 2004-2005 (MkWh)
1	R.P.Sagar	Madhya Pradesh		Hydro	172 (50%)		188.64
2	Jawahar Sagar	Madhya Pradesh		Hydro	99 (50%)		140.52
3	Yeoteshwar	Maharashtra		Hydro	0.08		0.00
4	Aravelam	Goa		Hydro	0.05		0.00
5	Akrimota Lignite	Gujarat	31/3/2005	Coal	125		0.00
6	Indira Sagar Unit-8	Madhya Pradesh	23/3/2005	Hydro	125	1000	0.80
7	Sardar Sarovar RBPH Unit-1	Gujarat	1/2/2005	Hydro	200		42.13
8	Sardar Sarovar RBPH Unit-1	Madhya Pradesh	1/2/2005	Hydro	200		149.65
9	Sardar Sarovar RBPH Unit-1	Maharashtra	1/2/2005	Hydro	200		71.09
10	Indira Sagar Unit-6	Madhya Pradesh	29/12/2004	Hydro	125	1000	41.74
11	Gangrel Unit-4	Chattisgarh	5/11/2004	Hydro	2.5		7.52
12	Indira Sagar Unit-7	Madhya Pradesh	27/10/2004	Hydro	125	1000	25.16
13	Gangrel Unit-3	Chattisgarh	17/10/2004	Hydro	2.5		0.00
14	Sardar Sarovar CHPH Unit-1	Gujarat	4/10/2004	Hydro	50		0.00
15	Sardar Sarovar CHPH Unit-1	Madhya Pradesh	4/10/2004	Hydro	50		0.00

Table 8: Sample of Power Plants for BM Calculation							
Sr. No.	**Power plant name / location**	**State**	**Year of commissionin g**	**Fuel Type**	**Capacity of the new addition (MW)**	**Total Capacity (MW)**	**Generation of the Unit in 2004-2005 (MkWh)**
16	Sardar Sarovar CHPH Unit-1	Maharashtra	4/10/2004	Hydro	50		0.00
17	Sardar Sarovar CHPH Unit-3	Gujarat	31/8/2004	Hydro	50		0.00
18	Sardar Sarovar CHPH Unit-3	Madhya Pradesh	31/8/2004	Hydro	50		0.00
19	Sardar Sarovar CHPH Unit-3	Maharashtra	31/8/2004	Hydro	50		0.00
20	Sardar Sarovar CHPH Unit-2	Gujarat	16/8/2004	Hydro	50		0.00
21	Sardar Sarovar CHPH Unit-2	Madhya Pradesh	16/8/2004	Hydro	50		0.00
22	Sardar Sarovar CHPH Unit-2	Maharashtra	16/8/2004	Hydro	50		0.00
23	Indira Sagar Unit-5	Madhya Pradesh	23/7/2004	Hydro	125	1000	120.09
24	Gangrel Unit-2	Chattisgarh	29/6/2004	Hydro	2.5		0.00
25	Sardar Sarovar CHPH Unit-4	Gujarat	3/5/2004	Hydro	50		0.00
26	Sardar Sarovar CHPH Unit-4	Madhya Pradesh	3/5/2004	Hydro	50		0.00
27	Sardar Sarovar CHPH Unit-4	Maharashtra	3/5/2004	Hydro	50		0.00
28	Gangrel Unit-1	Chattisgarh	2/4/2004	Hydro	2.5		0.00
29	Indira Sagar Unit-4	Madhya Pradesh	28/3/2004	Hydro	125	1000	138.18
30	Indira Sagar Unit-3	Madhya Pradesh	27/2/2004	Hydro	125	1000	314.87
31	Sardar Sarovar CHPH Unit-5	Gujarat	15/2/2004	Hydro	50		0.00
32	Sardar Sarovar CHPH Unit-5	Madhya Pradesh	15/2/2004	Hydro	50		0.00
33	Sardar Sarovar CHPH Unit-5	Maharashtra	15/2/2004	Hydro	50		0.00
34	Indira Sagar Unit-2	Madhya Pradesh	18/1/2004	Hydro	125	1000	390.83
35	Indira Sagar Unit-1	Madhya Pradesh	1/1/2004	Hydro	125	1000	300.20
36	Dhuvaran CCCP ST	Gujarat	22/9/2003	Gas	38.77	133.6	194.42

Table 8: Sample of Power Plants for BM Calculation							
Sr. No.	Power plant name / location	State	Year of commissioning	Fuel Type	Capacity of the new addition (MW)	Total Capacity (MW)	Generation of the Unit in 2004-2005 (MkWh)
37	Dhuvaran CCCP GT	Gujarat	4/6/2003	Gas	67.85	133.6	340.25
38	Bansagar (Stage-III) Unit-3	Madhya Pradesh	2/9/2002	Hydro	20	60	26.47
39	Bansagar (Stage-II) Unit-2	Madhya Pradesh	1/9/2002	Hydro	15	30	34.77
40	Bansagar (Stage-II) Unit-1	Madhya Pradesh	28/8/2002	Hydro	15	30	33.33
41	Hazira CCGP-GSEL Surat	Gujarat	31/3/2002	Gas	52.1	156.1	386.23
42	Majalgaon Unit-1	Maharashtra	1/1/2002	Hydro	0.75	2.25	0.00
43	Majalgaon Unit-2	Maharashtra	1/1/2002	Hydro	0.75	2.25	0.00
44	Majalgaon Unit-3	Maharashtra	1/1/2002	Hydro	0.75	2.25	0.00
45	Karanjavan	Maharashtra	26/10/2001	Hydro	3	3	0.00
46	Hazira CCGP-GSEL Surat	Gujarat	16/10/2001	Gas	52	156.1	377.78
47	Hazira CCGP-GSEL Surat	Gujarat	30/9/2001	Gas	52	156.1	387.36
48	Bansagar (Stage-III) Unit-2	Madhya Pradesh	25/8/2001	Hydro	20	60	24.68
49	Bansagar (Stage-III) Unit-1	Madhya Pradesh	18/7/2001	Hydro	20	60	24.51
50	Dudhganga Unit-1	Maharashtra	27/2/2001	Hydro	12	24	62.03
51	Khaparkheda Unit-4	Maharashtra	7/1/2001	Coal	210	840	1354.05
52	Khaparkheda Unit-3	Maharashtra	31/5/2000	Coal	210	840	1463.92
53	Koyna (Stage-IV) Unit-4	Maharashtra	3/5/2000	Hydro	250	1000	223.01
54	Dudhganga Unit-2	Maharashtra	31/3/2001	Hydro	12	24	0.00
55	Koyna (Stage-IV) Unit-3	Maharashtra	3/3/2000	Hydro	250	1000	718.46
56	Vindhyachal STPS Unit-VIII	Central Share	February'2000	Coal	500	2260	3586.90
57	Koyna (Stage-IV) Unit-2	Maharashtra	25/11/1999	Hydro	250	1000	265.68

Table 8: Sample of Power Plants for BM Calculation							
Sr. No.	Power plant name / location	State	Year of commissioning	Fuel Type	Capacity of the new addition (MW)	Total Capacity (MW)	Generation of the Unit in 2004-2005 (MkWh)
58	Sanjay Gandhi Unit-IV	Madhya Pradesh	23/11/1999	Coal	210	840	1332.96
59	Rajghat Unit-3	Madhya Pradesh	3/11/1999	Hydro	7.5	22.5	13.71
60	GIPCL-Surat Lignite	Gujarat	November'1999	Lignite	250	250	1627.53
61	Rajghat Unit-1	Madhya Pradesh	15/10/1999	Hydro	7.5	22.5	18.75
62	Rajghat Unit-2	Madhya Pradesh	29/9/1999	Hydro	7.5	22.5	10.89
63	Warna Unit-2	Maharashtra	1/9/1999	Hydro	8	16	28.34
64	Reliance Salgaonkar	Goa	14/8/1999	Gas	48	48	138.36
65	Koyna (Stage-IV) Unit-1	Maharashtra	20/6/1999	Hydro	250	1000	526.76
66	Surya CDPH	Maharashtra	4/6/1999	Hydro	0.75	0.75	0.00
67	Bhandardara Stage-II	Maharashtra	19/5/1999	Hydro	34	44	36.71
68	Dhabol	Maharashtra	13/5/1999	Gas	740	740	0.00
69	Terwanmedhe	Maharashtra	31/3/1999	Hydro	0.2	0.2	0.09
70	Vindhyachal STPS Unit-VII	Central Share	March'1999	Coal	500	2260	3560.31
71	Sanjay Gandhi Unit-III	Madhya Pradesh	28/2/1999	Coal	210	840	1412.06
72	Surya	Maharashtra	1/1/1999	Hydro	6	6	13.88
73	Dimbhe	Maharashtra	17/10/1998	Hydro	5	5	9.02
74	Warna Unit-1	Maharashtra	16/9/1998	Hydro	8	16	28.34
75	Kadana Unit-IV	Gujarat	27/5/1998	Hydro	60	240	96.71
76	Gandhinagar Unit-5	Gujarat	17/3/1998	Coal	210	210	1423.01
77	Bhimgarh Unit-2	Madhya Pradesh	10/3/1998	Hydro	1.2		0.00
78	Bhimgarh Unit-1	Madhya	17/2/1998	Hydro	1.2		0.00

Table 8: Sample of Power Plants for BM Calculation							
Sr. No.	Power plant name / location	State	Year of commissioning	Fuel Type	Capacity of the new addition (MW)	Total Capacity (MW)	Generation of the Unit in 2004-2005 (MkWh)
		Pradesh					
79	Manikodh	Maharashtra	9/2/1998	Hydro	6	6	4.08
80	Kadana Unit-III	Gujarat	1/2/1998	Hydro	60	240	94.74
81	GPEC	Gujarat	1998	Gas	655		3565.16
82	GIPCL	Gujarat	Nov-97	Gas	160		1098.91
83	Chandrapur Unit-7	Maharashtra	1/10/1997	Coal	500	2340	3113.62
84	Kutch Lignite Unit-3	Gujarat	31/3/1997	Lignite	75	215	423.25
85	Satpura Unit-2	Madhya Pradesh	9/2/1997	Hydro	0.5		0.00
86	Chargaon	Madhya Pradesh	7/2/1997	Hydro	0.8		0.00
87	Tilwara	Madhya Pradesh	2/1/1997	Hydro	0.25		0.00
88	Tata (H) Bhira PSU	Maharashtra	1997	Hydro	150		577.93
89	Essar Gas	Gujarat	1997	Gas	515 (300MW to GEB)		3327.73
90	Satpura Unit-1	Madhya Pradesh	9/2/1996	Hydro	0.5		0.00
91	Kakrapar Unit-2	Central Share	1995	Nuclear	220	440	1106.27
92	Dahanu (BSES) Unit-2	Maharashtra	29/3/1995	Coal	250		2001.27
Total							**37025.64**
20% of Total generation in the most recent year i.e. 2004-2005							**36382.56**
Coal							**21298.88**
Gas							**9816.20**
Hydro							**4804.29**
Nuclear							**1106.27**

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

Table 9: Data used for BM emission factor

Parameter		
Considering 20% of Gross Generation (MkWh)	36382.56	
Sector	MkWh	%

Thermal Coal Based-Western Region	21298.88	57.52
Thermal Diesel Based-Western Region	0.00	0.00
Thermal Gas Based-Western Region	9816.20	26.51
Hydro-Western Region	4804.29	12.98
Wind-Western Region	0.00	0.00
Nuclear-Western Region	1106.27	2.99
Import from other Regions	0.00	0.00
Import from Self Generating Industries	0.00	0.00
Total	37025.64	100.00
Generation by Coal out of Total Generation	21298.88	57.52
Generation by Diesel out of Total Generation	0.00	0.00
Generation by Gas out of Total Generation	9816.20	26.51
Built Margin	-	-
Fuel 1 : Coal		
Avg. efficiency of power generation with coal as a fuel, %		36.487
Avg. calorific value of coal used in UPPCL, kcal/kg		3820
Estimated coal consumption, tonnes/yr		13141742
Emission factor for Coal (IPCC),tonne CO2/TJ		96.1
Oxidation factor of coal (IPCC standard value)		0.98
COEF of coal (tonneCO2/ton of coal)		1.506
Fuel 2 : Diesel		
Avg. Efficiency of power generation with diesel as a fuel, %		41.707
Avg. Calorific Value of Diesel used (kcal/kg)		10186
Estimated Diesel consumption (tons/yr)		0
Emission Factor for Diesel-IPCC standard value (tonne CO2/TJ)		74.1
Oxidation Factor of Diesel-IPCC standard value		0.99
COEF of Diesel (tonneCO2/ton of diesel)		3.129
Fuel 3 : Gas		
Avg. Efficiency of power generation with gas as a fuel, %		45
Avg. Calorific Value of Gas used (kcal/kg)		11942
Estimated Gas consumption (tons/yr)		1570914
Emission Factor for Gas- IPCC standard value(tonne CO2/TJ)		56.1
Oxidation Factor of Gas-IPCC standard value		0.995
COEF of Gas(tonneCO2/ton of gas)		2.791
EF (BM) (tCO2/MkWh)		653.06

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

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

The most recent 3-years (2002-2003, 2003-2004 & 2004-2005) average of the Simple OM and the BM of the base year i.e. 2004-2005 are considered. This is presented in the table below.

Table 10: Data used for Baseline Emission Factor		
Parameters	**Values (ton of CO_2/MkWh)**	**Remarks**
OM, $EF_{OM,y}$ (ton of CO_2/MkWh)	864.16	Average of most recent 3-years (2002-2003, 2003-2004 & 2004-2005) values
BM, $EF_{BM,y}$ (ton of CO_2/MkWh)	653.06	Value of the base year i.e. 2004-2005
Baseline Emission Factor, EF_y (ton of CO_2/MkWh)	**758.61**	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 VGL facility situated beside the project unit is utilized.

D) Baseline Emission

In absence of the project activity there will be emission as per the carbon intensity of the grid (0.759 kg CO_2/ kWh) from the Western Regional grid. Based on the Combined Margin Method detailed above, (see Enclosure – I for calculations) the project activity will reduce 189652 tonnes of CO_2 equivalent in the entire 10 year crediting period.

Data Source for grid emission factor calculation :

- Generation Figures: CEA General Review (2002-03) and CEA General Review – 2005 (Contains data for 2003-04) and WREB Annual Report (2004-05)
- Regional Grid Emission Factor : MNES baseline data (http://mnes.nic.in/baselinepdfs/annexure5.pdf)
- Avg. Coal Calorific Value – CEA General Review (2002-03 and 2005)
- Efficiency Value of Coal based Thermal Power Plants from Regional Design Heat Rate Values for 2002-03 and 2003-04 from CEA Performance Review for Thermal Power Plants.
- Efficiency of Combined Cycle Gas Based Power Plants: http://www.cercind.org/pet22002407.html
- IPCC 1996 Revised Guidelines and the IPCC Good Practice Guidance- http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1wb1.pdf

Annex 4

MONITORING PLAN

The monitoring plan for the CDM project activity has been developed in order to determine the baseline emissions and the project emissions (if any) over the entire credit period. The net units of electricity generated needs to be monitored by power meters at the plant. The instrumentation and control system for

the power plant is designed with adequate instruments to control and monitor the various operating parameters for safe and efficient operation of the waste heat recovery boiler and the turbo generator unit. The project activity has employed the state-of-the-art monitoring and control equipment that will measure, record, report, monitor and control various key parameters like total power generated, power used for auxiliary consumption, flow rate, temperature and pressure parameters of the waste gas, steam generated and steam sent to turbine to generate power.

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

The actual amount of CO_2 reduction however depends on the generation mix and production scenario of the grid that is taken into consideration in the grid emission factor calculation. The project does not have a direct control on the baseline. But since the baseline parameters like actual generation mix in million kWh 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 CEA report contains all information regarding type of generation like hydro, thermal etc., installed capacity, de-rated capacity, performance of generating unit, actual generation, capacity additions during the year, etc. which can be used for verification of the generation mix and emission factors for baseline calculation for a particular year.

Project Parameters affecting Emission Reduction Claims:

Monitoring:

The CDM mechanism stands on the quantification of emission reduction and keeping the track of the emissions reduced. The project activity would reduce the carbon dioxide whereas an appropriate monitoring system would ensure this reduction is quantified and helps maintaining the required level. Also a monitoring system brings about the flaws in the system if any are identified and opens up the opportunities for improvement.

The general monitoring principles are based on:

- Frequency
- Reliability
- Registration and Reporting

Frequency of Monitoring

Since the emission reduction units from the project activity would be determined by the number of electrical units generated, it becomes important for the project activity to monitor the net electricity production on the real time basis. An on-line monitoring system would be in place to monitor and record the net electricity generated. This would also ensure the smooth operation of the plant.

Reliability

The amount of emission reduction units is proportional to the net energy generation from the project activity. Since the reliability of the monitoring system is governed by the accuracy of the measurement system and the quality of the equipment to produce the result.

- All measuring instruments must be calibrated by third party/ government agency once in a year for ensuring reliability of the system.
- The Standard Testing Laboratory (under Central/State Government) verifies the reliability of the meter reading; thereby ensuring the monitored results are highly reliable.

According to the state electricity board's (grid operator) regulations also, the annual calibration and verification of electricity meters is mandatory for all power generating units.
We may therefore conclude that the reliability of the results would be ensured by the project proponent both as a statutory requirement and for the project activity. Moreover, the net electricity generation value would be included in the financial audit report (statutory requirement) that would be published in the annual report of the company.

Registration and Reporting:
Registration of data would be on-line in the control cabin through a microprocessor. However, hourly data logging would be there in addition to software memory. Daily, weekly and monthly reports would be prepared stating the generation. In addition to the records maintained by VGL, CSEB would also monitor the power wheeled to the grid and certify the same.

No other project specific indicators are identified that affect the emission reductions claims.

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