CLEAN DEVELOPMENT MECHANISM
SIMPLIFIED PROJECT DESIGN DOCUMENT
FOR SMALL-SCALE PROJECT ACTIVITIES (SSC-CDM-PDD)
Version 02

CONTENTS

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.

SECTION A. General description of the small-scale project activity

A.1. Title of the small-scale project activity:

ENERGY EFFICIENCY MEASURES AT CEMENT PRODUCTION PLANT IN CENTRAL INDIA

A.2. Description of the small-scale project activity:

Satna unit of Birla Corporation Limited (BCL) is one of the major cement production units in the state of Madhya Pradesh, India. The BCL – Satna facility houses Satna Cement Works (SCW) and Birla Vikas Cement Works (BVCW) at the same premise. BCL- Satna mainly produces Ordinary Portland Cement (OPC) and Portland Pozzolona Cement (PPC). The energy efficiency improvement initiative is one of such tools towards accomplishment of this mission.

Purpose:

BCL – Satna unit produces OPC grade and PPC grade cement. The process is energy intensive and consumes both thermal and electrical energy. With the growing concern of cleaner production, the company had focused on energy efficient technologies. The basic objective of the project is to reduce energy consumption per tonne of cement production through implementation of energy efficient technologies at SCW and BVCW.

The company performed an internal energy audit study and identified the possible areas where improvement can be done. The main thrust areas were identified as flow control and use of more efficient electrical drives.

Salient Features of the Project:

Project participant has implemented various technologically advanced instruments at BCL-Satna under its programme for energy efficiency improvement initiative. The efficiency improvement programme mainly consists of: -

- Installation of Variable Frequency Drives
- Replacement of existing equipments with more efficient equipments
- Optimisation in operation of equipments and controls
- Modification of processes to attain higher efficiency

Project's contribution to sustainable development

The measures taken reduce specific energy consumption for cement production. This in turn will reduce the equivalent generation of electrical energy in the grid mix and corresponding amount of GHG emission. Moreover, these efforts save the use of coal in a proportionate manner, which is a primary resource for power generation and metallurgical applications that can cater to a future demand. Reduction in generation from thermal sources helps in related pollution abatement. Some of the other sustainability issues addressed by the project are:

Social Well Being: As an enlightened corporate citizen, Birla Corporation Limited is keenly aware of its social responsibilities too, and besides providing education and health care facilities for its employees, their families and the community at large, the Group is involved in a number of philanthropic activities. It also runs schools at Satna.

Environmental Well Being: The energy efficiency measures directly reduce the power consumption by the facility and thereby reduce demand at the power generation end (which is enhanced by the T&D loss). The reduction in power generation corresponds to the reduced fuel combustion, which implies reduced GHG emission, reduced emission in transportation & mining of fuel and finally reduced SPM level.

A.3. Project participants:

Birla Corporation Limited

Contact person: Mr. V.S. Panwar, Asst. Vice President, Projects **(Details in Annex I)**

Name of party involved (host party)	Private and/or public entity (ies) project participants (as applicable	Kindly indicate if the Party involved wishes to be considred as project participant (Yes/ No)
Ministry of Environment and Forests, Government of India	Birla Corporation Limited; Unit: Satna	No

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

India

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

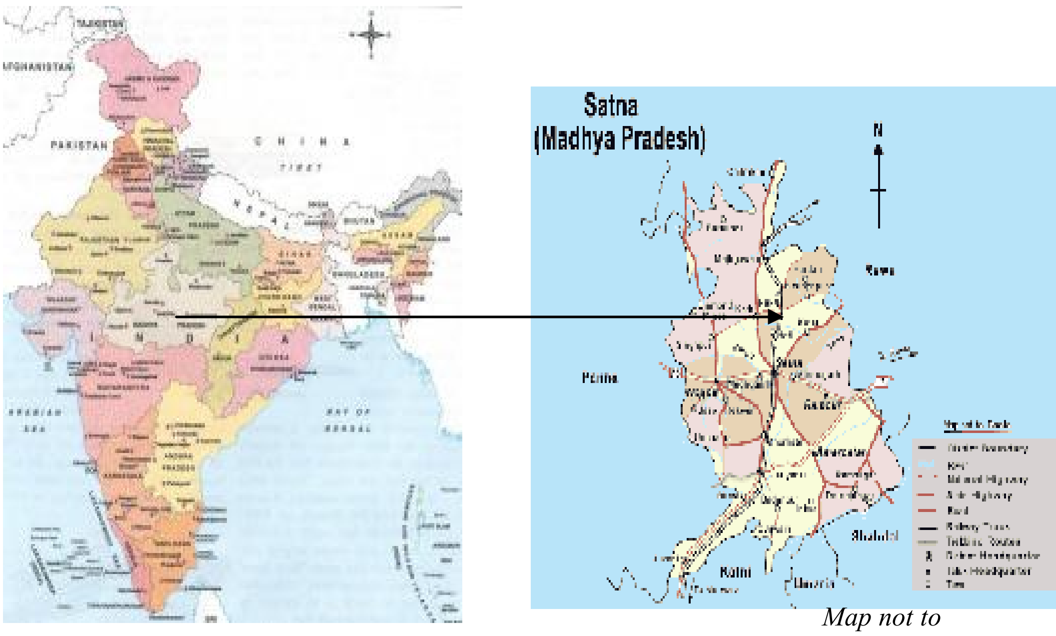
Madhya Pradesh

A.4.1.3. City/Town/Community etc:

Satna

A.4.1.4. Detail of physical location, including information allowing the unique identification of this small-scale project activity(ies):

The project is located in Satna, Madhya Pradesh, India.



Map not to scale

A.4.2. Type and category(ies) and technology of the small-scale project activity:

The project falls under the UNFCCC small scale CDM project activity under Type II with project activity involving energy efficiency measures reducing energy consumption on the demand side.

Main category-Type II [Energy Efficiency Improvement Projects]

Sub Category-D [Energy efficiency and fuel switching measures for industrial facilities]

As per Appendix B of the UNFCCC-defined simplified modalities and procedures for small-scale CDM project activities, the aggregate energy savings from the project activity primarily aimed at energy efficiency measures, may not exceed the equivalent of 15 Giga-watt hour (GWh) per year, for the project to qualify as a small-scale CDM project under Category II.D.

The project consists of industrial energy efficiency improvement measures through technological up gradation and instrumentation. It reduces energy consumption on the demand side. As the net energy consumption reduction is less than 15 GWh /annum, project falls under **small-scale** Category II.D.

Project Activity with technology details

The project includes the Energy Efficiency and process improvement measures adopted in the form of technology upgradation and instrumentation in the plants.

The following measures are included under the project -

(2000-01):

- Replacement of existing equipments with more efficient equipments

  - Kiln ESP Fan – Installation of cable and hardware of DC motor of 285 KW in place of 300 KW squirrel cage motor, along with DC panel:

  The 300 KW squirrel cage motor along with its DC panel was replaced with a DC motor of 285 KW, which resulted in the energy saving of 182160 kWh (0.21 kWh/T clinker).

- Replacement of existing equipments with more efficient equipments

  - Installation of high efficiency fan for Primary Air fan along with inverter drive panel for speed control of the fan:

  The less efficient primary air fan was replaced with a high efficiency fan along with an inverter drive for speed control, resulting in energy saving of 96252 kWh (0.11 kWh/T clinker).

- Replacement of existing equipments with more efficient equipments

  - Replacement of V4, V5A and Primary Air (PA) fan with high efficiency fans along with VVVF AC drives for speed control:

  The less efficient fans for V4, V5A and PA fan were replaced with energy efficient fans. VVVF AC drives were installed for speed *control of* these fans. Provision of inverter was made only for K-12 fan. These activities resulted in energy savings of 542850 kWh (0.65 kWh/t clinker).

- Installation of Variable Frequency Drives

  - Replacement of V5B, V6 and K-20 fans with high efficiency fans along with VVVF AC drives for speed control of these fans:

- ➢ The less efficient fans for V5B, V6 and K20 were replaced with energy efficient fans. VVVF AC drives were installed for speed control of these fans. These activities resulted in energy savings of 1147740 kWh (1.34 kWh/t clinker).

- o Modification of processes to attain higher efficiency
  - ➢ Installation of SPRS (Slip Power Recovery System) for PC fan speed control (70% to 100%):

  Earlier, a liquid rotor regulator was being used for the speed reduction of PC fan and damper control resulting in high energy consumption. A SPRS was installed for 70% to 100% speed control, which had resulted in energy savings of 533610 kWh (0.62 kWh/t Clinker).

- o Replacement of existing equipments with more efficient equipments
  - ➢ Replacement of PH fan with a high efficiency fan:

  The less efficient PH fan was replaced with a high efficiency pre-heater fan, which resulted in the energy savings of 604890 kWh (0.70 kWh/t clinker).

(2001– 02):

- o Modification of processes to attain higher efficiency
  - ➢ Modification of LKS Classifier of VRM with LV technology Classifier:

  The existing VRM 36.41 classifier technology was modified and up-graded with LV-Technology classifier. The basic idea behind LV technology was to improve aerodynamics inside the mill by directing the ground material up to the full length of modified classifier by increasing the velocity from bottom to the top by suitably modifying the cross sectional area from the bottom of the mill to the top of the classifier, thereby reducing the pressure drop and turbulence within the mill body. This has resulted in increase of mill output and reduction in specific power consumption. This activity resulted in the energy saving of 1.62 kWh/T clinker.

- o Modification of processes to attain higher efficiency
  - ➢ Installation of vortex finder vanes on top stage cyclones for reduction in differential pressure:

  The conventional immersion tube of pre-heater (PH) stage-I twin cyclone was replaced with state of the art "vortex finder vanes". Vortex finder vane reduces pressure drop across the cyclone by 30% and thereby reduces the fan power consumption. The activity had resulted in the power savings of 414624 kWh (0.5 kWh/t clinker).

  - ➢ Installation of Vortex Finder Vanes for stage-1 cyclones of PC & PH strings for reduction in differential pressure:

The conventional immersion tube of PH & PC strings stage-I twin cyclone was replaced with state of the art “Vortex Finder Vanes”. Vortex finder vane, latest technology in cyclone immersion tube, reduces the pressure drop across the cyclone by 30% and thereby saves the fan power consumption. The activity resulted in energy savings of 555660 kWh (0.62 kWh/t clinker).

- Replacement of existing equipments with more efficient equipments

  - Replacement of existing fuller pump of CM-1A, with Dense Phase System (DPS) for cement transport to Silo:

The fuller pump for transportation of cement to silo was replaced with the latest technology dense phase pump. This dense phase conveying system was installed at ground floor just below the cyclones of CM-1A, which had eliminated three air slides. The above measure has resulted in energy savings of 433620 kWh (1.509 kWh/t clinker equivalent).

  - Replacement of separator in coal mill circuit with an efficient grit separator:

Before the project activity, the pressure drop across the original coal mill separator was 200-250 mmWG. This had been reduced to approximately 120 mmWG after installation of modified grit separator. The earlier motor of 300 Kw/1500 rpm was replaced with 200 Kw/1000 rpm motor to address the change in reduced inlet draft of BDC fan and had resulted in saving in fan power. The activity resulted in energy savings of 237600kWh
(0.26 kWh/t clinker).

  - Replacement of raw mill vent fan and WIL circulating fan with high efficiency fans connected with VVVF AC drive inverters:

The less efficient raw mill vent fan and WIL circulating fans were replaced with high efficiency fans with VVVF AC drive inverters. The activity resulted in 558870 kWh (0.96 kWh\ t clinker) of energy savings.

(2002-03):

- Modification of processes to attain higher efficiency

  - Installation of 3-Fan System with LP Cyclones for VRM:

The pyro-processing and raw grinding system was originally designed for 2475 TPD clinker production. In 2-fan system, a part of PH flue gases from PH fan had to pass through the VRM and part of the gases was taken to coal mill. During raw mill 'OFF' condition, the gases were taken directly to ESP inlet through a by-pass circuit of VRM. The ESP fan served dual purpose as Mill fan and ESP fan both. At production level of 2475 TPD, the system was operating without any difficulty. With higher production rate and during coal mill 'OFF' condition, the kiln production was required to be reduced as raw mill was unable to take additional volume of PH flue gases.

To overcome this limitation, a 3-Fan system was installed, which had a separate mill fan to take care of VRM operation. This had facilitated in bypassing of excess PH flue gases under increased production through VRM by-pass circuit. VRM exit gases and excess PH flue gases were mixed at ESP inlet and handled by the ESP fan.

The above measure helped the project proponent to reduce energy consumption by avoiding false air entry and this has resulted in power saving in the ESP fan. This activity resulted in energy savings of 2.3 kWh/T Clinker.

- Replacement of existing equipments with more efficient equipments

  - Replacement of coal mill circulating fan, CM-1A bag dust collector (BDC) fan and CM-2&3 circulating fan with high efficiency fans along with inverters:

The less efficient circulating fan, CM-1A BDC fan and CM2 & 3 circulating fan of coal mill were replaced with high efficiency fans along with inverters, resulting in the energy savings of 633615 kWh (2.28 kWh/t clinker).

  - Replacement of existing Fuller pump of CM- 2&3 with Dense Phase System for cement transport to silo:

The fuller pump in CM-2&3 for transportation of cement to silo was consuming more power. The system was replaced with latest technology Dense Phase pump to take advantage of less maintenance cost, lower power consumption and increased availability & reliability. This Dense phase conveying system was installed in the existing fuller pump pit and was connected to existing 8" NB cement transport pipeline. Existing compressor of fuller pump had been utilised to supply pneumatic conveying air to the PD pump. Speed of the existing pump had been reduced to match the air requirement of new PD pump. The activity resulted in energy savings of 293820 kWh
(0.848 kWh/t clinker equivalent).

  - Replacement of existing FK pump of CM- 1 with Dense Phase System for cement transport to Silo:

The fuller pump in CM-1 for transportation of cement to silo was consuming more power. The system was replaced with latest technology Dense Phase pump, to take advantage of less maintenance cost, lower power consumption and increased availability & reliability. This Dense phase conveying system was installed in the existing fuller pump pit and was connected to existing 8" NB Cement transport pipeline. Existing compressor of Fuller pump has been utilised to supply pneumatic conveying air to the PD pump. Speed of the existing pump has been reduced to match the air requirement of new PD pump. The activity resulted in energy savings of 283410 kWh (2.009 kWh/ t clinker equivalent).

- Modification of processes to attain higher efficiency

  - Increase of PH exit gas down comer duct diameter from 2.8 Mtr. to 3.5 Mtr:

  The diameter of existing down comer duct (from stage-1 to PH fan) was increased from 2.8 Mtr. to 3.50 Mtr. This has resulted in pressure drop reduction by about 25mmWG and thereby saving in PH fan power by 35-40 KWh/hr. This measure has effected energy savings of 311840 KWh (0.32 kWh/T clinker).

A.4.3. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed small-scale project activity, including why the emission reductions would not occur in the absence of the proposed small-scale project activity, taking into account national and/or sectoral policies and circumstances:

The project activity includes a host of energy efficiency measures in the form of modification in the present grinding system through technology up-gradation. All these improved technology measures had helped in reducing the direct demand of electricity and indirect demand of fossil fuel (coal) in view of the fact that in absence of these measures an equivalent amount of electricity would have been drawn from the Madhya Pradesh State Electricity Board (part of western regional grid), Grid dominated by supply from thermal power plants fed by coal.

The energy efficiency measures would reduce the indirect coal combustion for the same production quantity. The reduction in specific electricity consumption for cement production reduces equivalent amount of carbon dioxide emissions into the atmosphere. The estimated emission reductions from the project activity would be around **110975 t of CO_2 equivalent during the 10 years crediting period.** (Refer to Enclosure IV for detailed calculations)

A.4.3.1 Estimated amount of emission reductions over the chosen crediting period:

Operating Years	CO_2 Emission Reductions (tones of CO_2)
2001-2002	2352
2002-2003	5909
2003-2004	11413
2004-2005	11413
2005-2006	11413
2006-2007	11413
2007-2008	11413
2008-2009	11413
2009-2010	11413
2010-2011	11413
Total estimated reductions (tonnes of CO_2 e)	110975
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	11097

A.4.4. Public funding of the small-scale project activity:

No public funding from parties included in Annex – I of Kyoto Protocol is available so far to the project.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a larger project activity:

According to **Appendix C of Simplified Modalities & Procedures for small scale CDM project activities**, ***'Debundling'*** is defined as the fragmentation of a large project activity into smaller parts. A small-scale project activity that is part of a large project activity is not eligible to use the simplified modalities and procedures for small-scale CDM project activities.

A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure;
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small- scale activity at the closest point.

In BCL-Satna's case, it clearly does not fall under the debundled category and qualifies as a small scale CDM project. It is the single such project of the promoters. The conditions in para 2 of Appendix C confirm that the small-scale project activity is not a debundled component of a larger project activity.

SECTION B. Application of a baseline methodology:

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

Title: ENERGY EFFICIENCY IMPROVEMENT PROJECTS – Demand-side energy efficiency programmes for specific technologies – Type II.D

Reference: Appendix B of the simplified modalities and procedures for small-scale CDM project activities - **Indicative Simplified Baseline And Monitoring Methodologies For Selected Small-Scale CDM Project Activity Categories**

Details of **approved methodology for baseline calculations** for small scale CDM projects of Type II.D is specified in the above-mentioned document.

B.2 Project category applicable to the small-scale project activity:

Appendix B of the simplified M&P for small-scale CDM project activities of the UNFCCC CDM website, **provides guidelines for preparation of Project Design Document (PDD) including baseline calculations**. As per this document the proposed project falls under Type II.D – Renewable electricity generation for a grid.

The project activity conforms to "Category II.D" in Appendix B. The project activity includes measures to improve the energy efficiency of cement production processes that reduces electrical energy consumption on the demand side. The reduction is within the upper cap of the small scale CDM project activity under Category II.D (i.e., up to the equivalent of 15 giga-watt-hours per year). Annual average electrical energy reduction per annum is to be of the order of 13.18 GWh. Thus the baseline methodology prescribed by the UNFCCC in Appendix B to Simplified M&P for small scale CDM projects activities belonging to Category II.D, is justifiably applicable for the project activity.

A complete analysis of Madhya Pradesh's electricity grid has been carried out along with the study of various related issues like technology scenario, policy matters, economic conditions, etc. for preparation of baseline scenario and calculation of baseline emission factor of the grid.

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 small-scale CDM project activity:

As per the decision 17/CP.7 paragraph 43, a CDM project activity is additional if anthropogenic emissions of GHGs by sources are reduced below those that would have occurred in the absence of the registered CDM project activity. The project activity includes energy efficiency improvement measures with net CO_2 emission reductions due to reduced specific electricity consumption patterns in the cement plant.

BCL-Satna decided to take up the project execution, in phases as a step towards climate change activity after Kyoto Protocol came into existence. The project activity was initiated to reduce the carbon dioxide emissions by sources and would otherwise not have been implemented due to the existence of the operational barrier(s) discussed below. The continued investment in phases has been influenced by the Clean Development Mechanism (CDM) related development at the United Nations Framework Convention on Climate Change.

Additionality test based on barriers to the project activity

Barriers to the project activity

The BCL-Satna unit was one of the first cement industries of its type in the same social, economic and regional class in the cluster, to identify the areas where the improvement in cement grinding could be adopted and electrical energy consumption and its associated emissions could be reduced. The measures adopted were a proactive step towards GHG emission reductions. The barriers to the project activity would be dealt in following two steps. In first steps, the general barriers are discussed and in step two, how BCL-SATNA has overcome these barriers to avail CDM benefits.

Step I: General barrier to Energy Efficiency projects in India[1]:

Status of Energy Efficiency in India

As per Bureau of Energy Efficiency (BEE), under Ministry of Power Govt. of India (the nodal body responsible for energy efficiency improvement in India and empowered for implementation of Energy Conservation Act 2001), there are several barriers present in Indian energy and industry sector that needs to be removed. India's energy intensity per unit of GDP is higher by 3.7 times of Japan, 1.4 times of Asia and 1.5 times of USA, indicating not only a very high energy wastage but also potential of substantial energy saving.

Industrial sector in India is a major energy user, accounting for about 48% of the commercial energy consumption. Energy saving potential is up to 30% through retrofitting in this sector. Some of the estimates made by different study reports for energy conservation in energy intensive industries are given in table below.

Table- : Scope for Energy Conservation in Energy – Intensive Industries

Data	Aluminum	Textile	Chlor Alkali	Petro chemicals	Fertilizer	Sugar	Paper	Cement
Energy Consumption (million Gcal)	30.1	52.5	20.0	5.8	112	100	26	67
Energy cost as a % of manufacturing Cost	40	13	30-35	7	60	12	25	40
Scope of energy conservation (%)	15-20	20-25	15	15	10	20	20	10

Barriers to Energy Efficiency

Considerable untapped potential exists for curbing waste of energy estimated to be of the order nearly 30 per cent of the total consumption of commercial energy. BEE observes that in spite of many efforts and benefits of energy efficiency several technical financial market and policy barriers have constrained the implementation of energy efficiency projects.

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[1] www.bee-india.org (Bureau of Energy Efficiency, Government of India)

[1] **UNITED NATIONS DEVELOPMENT PROGRAMME, Global Environment Facility , Project Document, PIMS No.** 1515, **Project Number:** IND/03/G31

[1] Environmentally sound energy efficient strategies: a case study of the power sector in India **Prof. Jyoti Parikh**, Dr. J.P. Painuly and Dr. Kankar Bhattacharya

[1] http://www.ises.org/sepconew/Pages/EE_Policy_in_Germany/1.html

[1] http://www.gefweb.org/Outreach/outreach-PUblications/Project_factsheet/India-ener-5-cc-wb-eng.pdf

(a) Lack of Awareness: The main barrier to energy conservation is the lack of awareness of industry managers of the potential gains from improved efficiency. Industries as well as the Government and customers, are yet to take into consideration factors such as tax credits, depreciation benefits, electricity price escalation, and life cycle savings of the investment.

(b) Lack of Widespread Education and Training: Shortage of widespread educational opportunities in energy management and conservation and appropriate facilities; lack of trainers and auditors.

(c) Economic and Market Distortions: Irrational response to conservation measures because of inappropriate pricing and other market distortions, or socio-economic factors.

(d) Lack of Standardization and Labeling of Equipment / devices: Slow rate of progress in achieving higher standards of energy consumption in equipment and appliances.

(e) Lack of financing: The lack of credit and the inability to obtain financing for projects are strong deterrents to investments in energy efficiency in India.

(f) Lack of Effective Co-ordination: In India, the lack of effective national-level coordination and promotion of energy conservation activities have been a major constraint to achieving energy efficiency.

In spite of having a large potential for the net energy efficiency improvement has not happened owing to the above mentioned barriers. The market potential for investments in energy efficiency measures is very large and presently only captured by about 20% in India[2].

Step II: Barriers for BCL-Satna

BCL-Satna, has been producing cements in the Satna cluster of Madhya Pradesh, India over last four decades. The company was subjected to the above said barriers. In absence of any dedicated energy managers, or specific energy management plans the company was not been able to take up major energy efficiency improvement initiatives. The organization had taken up only very small energy efficiency initiatives in the late nineties as a part of process efficiency improvements. However, the concept of Clean Development Mechanism in the late nineties has acted as an additional motivator for taking up additional risks with energy efficiency projects that influenced BCL in deciding on implementation of energy efficiency projects.

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[2] http://www.energymanagertraining.com/kaupp/Article25.pdf

Few of the major initiatives undertaken by the corporation have been published in technical journals and conferences relating to cement technology. This includes the three fan modification system that is published in International Cement Review in the year 2002. Few of other achievements are also presented in seminars/conferences indicating the uniqueness of the initiatives in the local cement industries. BCL-Satna, being the oldest plant in the region/cluster, has been able to reduce the specific consumption level due to its initiatives above common practices followed. The initiatives taken by them indirectly reflect the additional efforts put in behind the project activity. The project proponent had taken risks in investing in the projects that were not practiced in general in the cluster and were not sure about the success of the retrofit measures.

Technological Barrier:

The activity involves high risk of failure as the plants are originally designed in 1965 and the technology chosen for up-gradation are of late ninety's. The basic design of cement plants, the quality of raw material, clinker and the mill characteristics have changed over the years. The technologies adopted under the project activity and the investment made involved higher risks in comparison with capacity expansion plans to meet the demand and avail the benefit of economy of scale. The retrofit measures always have performance risks as the projected benefits in most cases are assumed rather than accurately computed. However, the project proponent had gone ahead with the implementation, risking the net production and market share.

Investment Barrier

Also it is important to note that the company had taken the decision in spite of its poor financial performance during the past 5-6 years when it was making losses. The company invested over 80 Million INR on the project activity despite its poor economic health.

Additionality test for Regulatory/Legal requirements

There was no legal binding on BCL-Satna to take up the project activity.

From the above analysis of barriers for the project activity we can conclude that the project activity is not a baseline scenario and without the project activity the pre-project phase would have continued with no reduction in the electrical energy consumption and its associated GHG emission reductions. The CDM project activity is additional and will help to reduce 110975 tonnes of CO_2 in 10 years of crediting period, calculated as per the approved baseline and monitoring methodologies of the Simplified Modalities and Procedures for Small Scale CDM Project Activities [details provided in section E].

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

The project boundary covers the cement and clinker production units. The boundary starts from raw material input to final product (cement) despatch. It also includes all form of energy inputs.

B.5. Details of the baseline and its development:

B.5.1 Specify the baseline for the proposed project activity using a methodology specified in the applicable project category for small-scale CDM project activities contained in appendix B of the simplified M&P for small-scale CDM project activities:

The detailed computations of the energy baseline (Step-I) and emission baseline (Step –2) are based on the approved simplified baseline methodologies specified in appendix B for project category Type II D. For baseline analysis, data/information was collected from the Western Regional Grid and was used as under for total emission baseline.

The baseline study is a two Step study conducted to determine the Baseline emissions over the crediting period in absence of project activity.

Step – I: Determination of Energy Baseline

Step – II (a): Choice of the grid - The current delivery system is studied for selection of a realistic grid representing the factual scenario associated with the project activity

Step – II (b): Determination of carbon intensity of the chosen grid – Western Regional Grid's Power Generation: Present generation mix, sector wise installed capacities, emission co-efficient, station heat rate and generation efficiencies are used to arrive at the net carbon intensity/baseline factor of the chosen grid.

The baseline emissions and the emission reductions from project activity are estimated based on the carbon intensity of the chosen grid and the quantum of reduced electricity consumption due to implementation of the project activity.

STEP – I: Determination of the Energy Baseline (before implementation of project activity)

POWER SAVINGS BY PROJECT ACTIVITY

The project activity will save around 13.18 million units per annum on an average.

Therefore, a conventional energy equivalent of 132 million kWh for a period of 10 years would be conserved by the project activity; an equivalent amount of electricity for the plant would have otherwise been drawn from the grid and captive power plant. Without the project activity, the same energy load would have been taken up by power plants and emission of CO_2 would have been occurred due to coal combustion (proportional to the share of thermal power in generation mix).

ENERGY BASELINE

The annual energy baseline values (annual energy consumption in absence of project activity) for the crediting years are calculated by monitoring the “power that would be consumed” and “operating hours” of the devices installed based on the guidance provided in ASM II-D of Appendix B.
The “power that would be consumed” by the device in absence of the project activity is recorded from the nameplate data or equipment’s purchase details and the “operating hours” of device are recorded using run time metering.

The proposed project activity will save electricity generation through energy efficiency measures. The emission reduction resulting from the proposed project activity will depend on the emission factor of the grid mix. Therefore it is required to select the appropriate grid where an equivalent amount of electricity will be displaced by the electricity generated from the proposed project activity.

Choice of the Grid

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

Current Delivery System

Indian power grid system (or the National Grid) is divided into five regional grids namely Northern, North Eastern, Eastern, Southern and Western Region Grids. The Western Regional Grid consists of Gujarat, Madhya Pradesh, Maharashtra, Goa and Chattisgarh state sector grids and Union Territories of Daman and Diu and Dadra and Nagar Haveli. These regional grids have independent Load Dispatch Centres (LDCs) that manage the flow of power in their jurisdiction. Power generated by state owned generation units and private owned generation units would be consumed totally by respective states. The power generated by central sector generation plants will be shared by all states forming part of the grid in fixed proportion. This central share amount has been allocated for Madhya Pradesh also. Presently, Madhya Pradesh State Electricity Department is the authority which transmits power through state grid network in Madhya Pradesh. However Madhya Pradesh Electricity Regulatory Commission has also been set up. The State is dependent on the self power generation and power allocated from the Central generating stations located in the Western and Southern regions and wheeled through the neighbouring state grids.

Grid Selection

Primarily Madhya Pradesh state grid gets power from self generation and as per its share in the central sector power projects located in various states of Western Regional Grid with a certain portion of import from Southern Regional Grid. The project proponents will therefore required to determine the carbon intensity of the grid that they are sharing, i.e. western regional grid. In practice, thus, the power inflow on these MP electricity grid lines will be reduced by an equivalent amount from the proposed project activity. The said lines are normally connected with Western Regional Grid. Thus the proposed project activity will reduce an equivalent amount of power import from the Western Regional Grid and hence the project proponents will require to use the carbon intensity of the Western Regional Grid as the baseline emission factor for baseline emission calculations over the proposed project activity's crediting period.

The details of emission factor determination is provided in Enclosure IV.

SECTION C. Duration of the project activity / Crediting period:

C.1. Duration of the small-scale project activity:

C.1.1. Starting date of the small-scale project activity:

March 2000

C.1.2. Expected operational lifetime of the small-scale project activity:

15 years

C.2. Choice of 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:

March 2000

C.2.2.2. Length:

10 years

SECTION D. Application of a monitoring methodology and plan:

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

As per Appendix B of the simplified M&P for small-scale CDM project activities for Industrial energy efficiency projects,

In the case of retrofit measures, monitoring shall consist of:

(a) Documenting the specifications of the equipment replaced:

(b) Metering the energy use of the industrial facility, processes or the equipment affected by the project activity;

(c) Calculating the energy savings using the metered energy obtained from sub-paragraph '(b)'

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

Installation of energy efficient equipments and technological up gradation at BCL-Satna units has resulted in substantial amount of reduction in specific energy consumption and thereby resulted reduction in GHG emissions. Hence, emission reduction quantity totally depends on the units of energy (kWh) saved at the grid by the Project activity.

Description of Monitoring Plan

BCL-Satna made a voluntary commitment for reducing green house gas emissions. A proper Monitoring & Verification (M&V) Plan has been developed by BCL-Satna for proper monitoring and verification of actual emission reduction.

The Monitoring and Verification (M&V) 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. It includes developing suitable data collection methods and data interpretation techniques for monitoring and verification of GHG emissions with specific focus on technical / efficiency / performance parameters.

It also allows scope for review, scrutinize and benchmark all this information against reports pertaining to M & V protocols.

The M&V Protocol provides a range of data measurement, estimation and collection options/techniques in each case indicating preferred options consistent with good practices to allow project managers and operational staff, auditors, and verifiers to apply the most practical and cost-effective measurement approaches to the project. The aim is to 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.

The project activity's revenue is based on the units (kWh) saved in comparison to the units (kWh) consumed before the implementation of the project, measured by power meters at plant. The monitoring and verification system would mainly comprise of these meters as far as power import and savings of energy is concerned.

The other project specific parameter and performance indicators are: -

- Specific electrical energy consumption by the plant
- Operating hours of the particular equipment under project activity.

Monitoring and verification of raw material characteristics (physical characteristics)/ quality is also required to be monitored as it could influence change in efficiency of the equipments and hence the quantum of emission reduction in form of CO_2.

The project employs state of the art monitoring and control equipments that measure; record, report, monitor and control the key parameters. The monitoring system implemented comprises of microprocessor-based instruments of reputed make with desired level of accuracy. All instruments are calibrated and marked at regular intervals so that the accuracy of measurement can be ensured all the time.

Justification of choice of methodology

Project activity includes installation of modern energy efficient equipments, replacing the higher energy consuming equipments.

The monitoring activity includes:

- Monitoring of new installed equipments,
- Metering the specific electrical energy consumption by the specified equipments and
- Calculating the difference in specific electrical energy consumption after and before project implementation, which is equivalent to total energy saved at the grid.

According to UNFCCC released document (appendix B) of the simplified M&P for small-scale CDM project activities, the quantity of emission reduction unit claimed by the project would be the total electrical energy saved by the plant. Therefore it is justified to check the total consumption of power by BCL –Satna and to compare the specific energy consumed in the pre-project stage from historical data.

Project Parameters affecting Emission Reduction: -

The parameters that affect project emission are as follows:

a) Quality of material input that the equipment handle

b) Quality of energy input to the equipment

c) Operating parameter and product quality.

MPSEB and captive generation have been identified as energy baseline system at which energy is being saved by project implemented energy efficiency measures. The current generation mix of MPSEB and captive generation are being influenced by project activity; hence for baseline emission calculation data will be collected from MPSEB and captive power plants. MPSEB publishes yearly reports regarding the performance of all power generation units (which include private sector generation units and MPSEB's own generation units).

Hence, authentic data related to the measurements, recording, monitoring and control of the generation mix of the MPSEB network is ensured. The statutory financial audit of the company ensures the quality and reliability of the captive generation data.

The MPSEB report contains all information regarding type of generation like hydro, thermal, nuclear, renewable *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 generation mix and emission factors for baseline calculation for a particular year.

GHG Sources

There is no direct onsite emission from the project activity. Also there had been no additional construction work involved for project specific requirement, hence no indirect onsite emission. The indirect off-site GHG source is the emission of GHG's that are involved in the process of transportation for procurement of equipments. However, considering the life cycle assessment of the total power saved and the emissions to be avoided in the life span of 20 –25 years; emissions from the above-mentioned source are too small and hence neglected. Project positively reduces GHGs at the thermal power unit connected to the MPSEB grid as direct off -site reduction.

D.3 Data to be monitored:

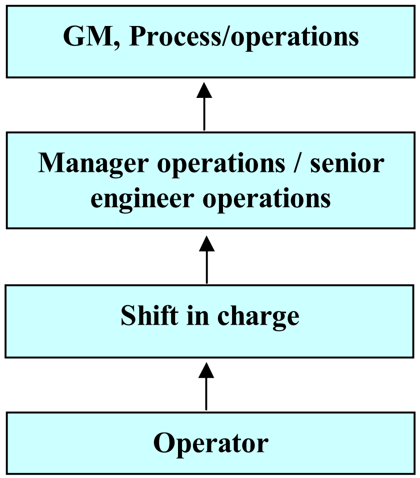
(The table below specifies the minimum information to be provided for monitored data. Please complete the table for the monitoring methodology chosen for the proposed project activity from the simplified monitoring methodologies for the applicable small-scale CDM project activity category contained in appendix B of the simplified M&P for small-scale CDM project activities.Please note that for some project categories it may be necessary to monitor the implementation of the project activity and/or activity levels for the calculation of emission reductions achieved.Please add rows or columns to the table below, as needed)

ID number	Data type	Data variable	Data unit	Will data be collected on this item? (If no, explain).	How is data archived? (electronic /paper)	For how long is data archived to be kept?	Comment
D.3.1	Energy consumption	Specific electrical energy for the activity	KWh / t of clinker	Calculated	Electronic / paper	2 years after completion of crediting period	
D.3.2	Time	Operating hours of the equipment	Hour	Measured	Electronic / paper	2 years after completion of crediting period	
D3.3	Power	Power consumption by equipment	KW	Measured/calculat ed	Electronic / paper	2 years after completion of crediting period	
D3.4	Energy	Energy Consumed by the system.	kWh	estimated	Electronic / paper	2 years after completion of crediting period	
D.3.5	Energy	Sector wise power generation (Grid)	Million kWh	Published document of WREB	Paper	Till completion of crediting period	.

D.4. Qualitative explanation of how quality control (QC) and quality assurance (QA) procedures are undertaken:

Regular calibration of energy meter has been undertaken by third party. The amount of material ground is measured. Same can be verified from silo measurement which is subjected to financial audit also.

D.5. Please describe briefly the operational and management structure that the project participant(s) will implement in order to monitor emission reductions and any leakage effects generated by the project activity:



D.6. Name of person/entity determining the monitoring methodology:

Plant professionals and Consultants of Satna Cement Works

SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

E.1.1 Selected formulae as provided in appendix B:

No specific formula has been provided in Appendix B of the simplified M&P for small-scale CDM project activities for the said project category.

E.1.2 Description of formulae when not provided in appendix B:

The project activity draws power from the Madhya Pradesh State Grid and the net effect of the project activity is reflected wholly on it. Therefore the grid scenario is analysed and calculation of anthropogenic emissions by fossil fuels during power generation is noted. The net baseline factor based on the combined margin approach is calculated considering all the plant contributing to the grid and the build margin of the most recent power plants are taken into consideration in a most conservative manner.

E.1.2.1 Describe the formulae used to estimate anthropogenic emissions by sources of GHGs due to the project activity within the project boundary:

The project activity does not result in any GHG emissions within or beyond the project boundary.

E.1.2.2 Describe the formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities

There is no leakage from the project activity. However the performance of the system may degrade over time and the efficiency may drop down which has to be taken into due account at the time of verification. This would be reflected in the specific kWh consumption across project boundary.

E.1.2.3 The sum of E.1.2.1 and E.1.2.2 represents the small-scale project activity emissions:

None.

E.1.2.4 Describe the formulae used to estimate the anthropogenic emissions by sources of GHGs in the baseline using the baseline methodology for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities:

Formulae used for estimation of the anthropogenic emissions by sources of greenhouse gases of the baseline are provided:

Calculation of Baseline Emission Factor of the grid mix

Operating Margin

Formulae:

- **Baseline Power generation**

$P_{gr} = P_{tot} - P_{lrc}$ where,

Sl. No.	Symbolic Representation	Illustration
1.	P_{tot}	Power generation by all sources of grid mix.
2.	P_{gr}	Baseline Power generation

- **Sectorwise baseline Power generation**

$P_{n\%} = \frac{P_n}{P_{gr}} x100$ And

- **Calculation of Operating Margin emission factor**

$$OM_{gr} = \sum P_{n\%}\, x\, E_n$$

Sl. No.	Symbolic Representation	Illustration
1.	OM_{gr}	OM Emission factor of baseline calculated (kg CO_2/kWh)
2.	E_n	Emission factor (actual) for each fuel type considered (e.g. coal, gas).
3.	$P_{n\%}$	Share (in %) of power generation by each fuel used (coal and gas in present scenario), out of total power generation excluding, power from low running cost plants.

➢ **Calculation of Build Margin emission factor for each source of baseline generation mix**

$$BM_{YR} = \frac{\sum (C * EF)}{C_{TOT}}$$ where

Sl. No.	Symbolic Representation	Illustration
1.	BM_{yr}	Build Margin for base year.(kg/kWh) - weighted average of emissions by recent 20% capacity additions
2.	C	Capacity (MW) of most recent capacity additions
3.	EF	CO_2 Emission factor (kg /kWh) of most recent capacity additions
4.	C_{TOT}	Summation of the Capacity (MW) of most recent capacity additions

➢ **Calculation of Combined Margin emission factor**

$$CM_{NET} = \frac{(OM_{bef} + BM_{YR})}{2}$$ where

Sl. No.	Symbolic Representation	Illustration
1.	CM_{NET}	Net Combine Margin Factor for
3.	BM_{yr}	Build Margin for base year.(kg/kWh) - weighted average of emissions by recent 20% capacity additions

The description of estimation of CO_2 emissions is as mentioned below.

Operating Margin Calculations: The weighted average emissions of the Madhya Pradesh State Electricity Board Grid (MPSEB GRID) generation mix.

- It is assumed that all the hydropower does not lead to emission of methane due to inundation of vegetation.
- The emission factors considered are as per IPCC Guideline
- Build Margin Calculations: The weighted average emissions of the recent power-generating stations
- The net emission factor is finally the average of emission of grid electricity and captive generation. (0.99 Kg CO_2/kWh for the first crediting year)

- For these calculations, the commissioning dates for the projects under operation are collected and the latest power projects are chosen.

Combined Margin Calculations: Average of the Operating Margin and Build Margin

Step by step calculation of CO_2 emissions due to burning of coal for power generation and emission reductions by project activity is as under.

Baseline Emission Calculations				
Step 1	**:**	Units substituting the grid	=	(Units conserved by the Project activity) + (T&D Loss units that have been avoided)
Step 2	**:**	CO_2 Baseline Emissions	=	Units substituting the grid x CM_{NET}

E.1.2.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:

Following formula is used to determine Emission reduction

CO_2 Emission Reduction Calculations		
Baseline Emissions	-	Project Emissions

Calculation of CERs

- The phase wise implementation of tech. Up-gradation and instrumentation during the period of 2000 – 2001, 2001 – 2002 and 2000-2003 are considered under the project.
- Data sheet for equipment performance provides information on motor kWh, Auxiliary kWh, respective kWh / t, mill running hours, cement production [Total] and raw material consumed
- kWh /unit of output is considered the key indicator keeping the property and quality of cement unchanged.

For CO_2 Reduction for nth year: Following algorithm is followed

Activity	Production	Sp. Energy Consumption reduction during the period	KWh Savings during the period	Emission Reduction
Before project implementation	B	C = 0	K = B x C	
Activity 1	B	C1	K1 = B x C1	
Activity 2	B	C2	K2 = B x C2	
Activity 3	B	C3	K3 = B x C3	$E_n = K_n * EF_n$

EF_n = Emission factor for the nth year
K_n = Net energy savings in the n th year
=(K1 +K2 + K3)
E_n = Emission reduction in the n th year.

The net emission reduction during crediting period $E = \sum_{n=1,10} E_n$

Determination of project energy savings:

Unit – SCW

Project Detail	Saving KWH /T Clinker	Clinker (MT)	Total Savings
Primary Air Fan along with inverter drive panel for speed control of the fan	0.110		
	0.110	**831227.00**	**91434.97**
Modification of LKS Classifier of VRM with LV_technology Classifier	1.620		
Installation of Vortex Finder Vanes on top stage Cyclones for reduction in differential pressure	0.500		
Replacement of existing FK pump of CM-1A, with Dense Phase System for Cement transport to Silo	1.780		
	3.900	**892195.00**	**3577701.95**
Installation of 3-Fan System with LP Cyclones for VRM	2.300		
High efficiency Fans for Coal mill Circulating Fan	0.130		
High efficiency Fans for CM-1A BDC Fan alongwith inverters	0.975		
High efficiency Fans for CM-2&3 Circulating Fan alongwith inverters	0.848		

Extension of PC vessel for increasing the Clinker production			
Replacement of existing FK pump of CM- 2&3, with Dense Phase System for Cement transport to Silo	0.848		
Replacement of existing FK pump of CM- 1, with Dense Phase System for Cement transport to Silo	2.009		
Increase of PH exit gas downcomer duct dia. from 2.8 Mtr. to 3.5 Mtr	0.320		
	7.428	**953721.00**	**10909119.03**

Determination of project energy savings:

Unit - BVCW

S.No.	Project Detail	Saving KWH /T Clinker	Clinker (MT)	Total Savings (kWh)
1	Kiln ESP Fan -Cable and Hardware of DC Motor of 285 Kw in place of 300 KW Sq.Cage AC Motor , alongwith DC panel.	0.210		
1	High efficiency Fans for V4, V5A and Primary Air Fan along with VVVF AC drives for speed control of these fans and provision of invertor only for K-12 Fan	0.650		
2	High efficiency Fans for V5B, V6 and K-20 Fans along with VVVF AC drives for speed control of these fans	1.340		
3	Installation of SPRS (Slip power recovery system) for PC Fan speed control (70% to 100%)	0.620		
4	Replacement of Pre-Heater Fan with a high efficiency Fan	0.700		
		3.520	**858954**	**3023518.08**
5	Installation of Vortex Finder Vanes for stage-1 Cyclones of PC & PH Strings for reduction in differential pressure	0.620		
6	Flyash feeding arrangement for WIL mill outlet instead of present system of feeding at mill inlet			
7	Installation of an efficient modified Grit Separator in place of old separator in Coal mill circuit	0.260		
8	High efficiency Fans for Raw Mill Vent Fan and WIL Circulating Fan alongwith VVVF AC drive inverters	0.360		
		1.240	**892231**	**4247019.56**
9	Enlargement of Main riser duct in PH string and Calciner height extension by 4 Mtrs			
			882910	**4202651.6**
	Total	**4.76**		

Yearwise Energy Savings Summary at BCL-Satna

Year	SCW (kWh)	BVCW(kWh)	Total(kWh)
2000-01	91434.97	3023518	3114953.1
2001-02	3577702	4247020	7824721.5
2002-03	10909119	4202652	15111771
2004-05	10909119	4202652	15111771
2005-06	10909119	4202652	15111771
2006-07	10909119	4202652	15111771
2007-08	10909119	4202652	15111771
2008-09	10909119	4202652	15111771
2009-10	10909119	4202652	15111771
2010-11	10909119	4202652	15111771
Total Energy Savings (kWh estimation			131833840

E.1.2.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:

Following formula is used to determine Emission reduction

CO_2 Emission Reduction Calculations
Baseline Emissions - Project Emissions

E.2 Table providing values obtained when applying formulae above:

Following tables indicate the baseline emission factors and emission reductions of each year, for Combined Margin.

Table E.2 – CO_2 emission reductions due to project activity

Year	Estimation of project activity emission reductions (tonnes of CO_2	Estimation of baseline emission reductions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	CO_2 Emission Reductions (tones of CO_2)
2001-2002	Nil	2352	Nil	2352
2002-2003	Nil	5909	Nil	5909
2003-2004	Nil	11413	Nil	11413
2004-2005	Nil	11413	Nil	11413
2005-2006	Nil	11413	Nil	11413
2006-2007	Nil	11413	Nil	11413

Year	Estimation of project activity emission reductions (tonnes of CO_2	Estimation of baseline emission reductions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	CO_2 Emission Reductions (tones of CO_2)
2007-2008	Nil	11413	Nil	11413
2008-2009	Nil	11413	Nil	11413
2009-2010	Nil	11413	Nil	11413
2010-2011	Nil	11413	Nil	11413
Total		110975		110975

SECTION F. Environmental impacts:

F.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

There are no negative environmental impacts from the installation of technologically upgraded energy efficiency equipment and instrumentation work. The technologies are easily transportable and installation does not require any major construction equipment. Only emissions that take place during the whole project execution are the transportation of the implemented machineries and instruments. However considering the life cycle of the project and the beneficial aspects such emissions is negligible.

Summary on Environmental Impact

The project does not have any major environmental impacts nor is the execution of an Environmental Impact Assessment required. However the beneficial aspects of the project are as follows:

The project activity results in

1) Green House Gas Abatement
2) Primary Resource Conservation and facilitating sustainable development
3) Pollution abatement in thermal power plant and its upward linkages.

SECTION G. Stakeholders' comments:

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

The main stakeholders of the project activity are the management representatives who were actively a part of decision-making. The other stakeholders are the employees of the organization who work in the plant and the family members who live in the plant campus. Although such in-house energy efficiency measures adopted by a plant does not demand an elaborate stakeholder consultation process the project proponent has involved its employees at all levels in order to ensure proper understanding of the effects of such initiatives being adopted. The benefits from such activity have also been transparently shared with the supply chain and shareholders.

G.2. Summary of the comments received:

The energy efficiency project does not have any negative impact. The projects also improved the working environment and resulted in better control of operation with reduced hazards. The emission from the captive power plant has also been reduced and local environment has been improved.

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

As per UNFCCC requirement the PDD will be published at the validator's web site for public comments.

Annex 1 : Contact Information For Participants In The Project Activity

(Please repeat table as needed)

Organization:	Birla Corporation Ltd, Unit- Satna Cement Works
Street/P.O.Box:	9/1 R. N. Mukherjee Road
Building:	Birla Building
City:	Kolkata
State/Region:	West Bengal
Postcode/ZIP:	Pin – 700 001
Country:	India
Telephone:	+91 – (033) 2213 1680 / 1688 / 1689
FAX:	+91 – (033) 2248 3239
E-Mail:	tcs@birlacorp.com
URL:	www.birlacorporation.com/cementframe.html
Represented by:	
Title:	Asst. Vice President - Projects
Salutation:	Mr.
Last Name:	Panwar
Middle Name:	S
First Name:	V
Department:	Projects – Birla Corporation Ltd
Mobile:	
Direct FAX:	+91 – (033) 2248 3239
Direct tel:	+91 – (033) 2213 1680 / 1688 / 1689
Personal E-Mail:	vspanwar@birlacorp.com

Annex 2 : Information Regarding Public Funding

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

Enclosure

Enclosure I : Abbreviations

%	Percentage
A	Ampere
ABT	Availability Based Tariff
BCL	Birla Corporation Limited
BM	Build Margin
BVCW	Birla Vikas Cement Works
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CER	Certified Emission Reduction
CM	Combined Margin
CO_2	Carbon di Oxide
CO_2 equ/kWh	Carbon di Oxide Equivalent per Kilo Watt Hour
ERU	Emission Reduction Unit
ESP	Electro Static Precipitator
GHG	Green House Gases
Hz	Hertz
IPCC	Intergovernmental Panel on Climate Change
KV	Kilo Volt
KW	Kilo Watt
kw	Kilo Watt
kWh	Kilo Watt Hour
KWH / T	Kilo Watt Hour per Tonne
LDC	Load Dispatch Centre
M & P	Modalities and Procedures
M & V	Monitoring and Verification
MoEF	Ministry of Environment and Forest
MP	Madhya Pradesh
MPSEB	Madhya Pradesh State Electricity Board
MSEB	Maharastra State Electricity Board
MW	Mega Watt
NHPC	National Hydroelectric Power Corporation
NTPC	National Thermal Power Corporation
OECD	Organization for Economic Co-operation and Development

OM	Operating Margin
PGCIL	Power Grid Corporation of India
RSEB	Rajasthan State Electricity Board
SCW	Satna Cement Works
T & D	Transmission and Distribution
tCO_2/TJ	Tonnes of Carbon di Oxide per Trillion Joule
TPS	Thermal Power Station
UPSEB	Uttar Pradesh State Electricity Board
WRED	Western Regional Electricity Grid

Enclosure II: List of References

Sl..No.	Particulars of the references
1.	Kyoto Protocol to the United Nations Framework Convention on Climate Change
2.	Website of United Nations Framework Convention on Climate Change (UNFCCC), **http://unfccc.int**
3.	UNFCCC Decision 17/CP.7: Modalities and procedures for a clean development mechanism as defined in article 12 of the Kyoto Protocol.
4.	UNFCCC, Clean Development Mechanism Simplified Project Design Document For Small Scale Project Activities (SSC-PDD) *[Version 01: 21 January, 2003]*
5.	UNFCCC document: Appendix B (contained in Annex-II to decision 21/CP8, see document FCCC/CP/2002/7/Add.3) Indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories [Version 05: 25 February 2005]
6.	http://www.energymanagertraining.com/kaupp/Article25.pdf
7.	http://www.bee-india.com
8.	http://cea.nic.in/

Enclosure IV: Baseline Information for grid emission factor determination

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 state 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[3] 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, BCL-Satna 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 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 to Table An-2 given below). It was found that the average share of the low cost and must run power generation sources over the three most recent years was lower than 50% of the total electricity generation in the grid.

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

Table An-2: Power Generation Mix of Western Regional Grid for three most recent years[4]

Energy Source	2002-03	2003-04	2004-05
Total Power Generation (MU)	166558.42	171707.05	181912.79
Total Low cost must run Power Generation (MU)	23888.02	27120.08	27989.18
Total Thermal Power Generation (MU)	142670.40	144586.97	153923.61
% of Low cost must run sources out of Total grid generation	14.34	15.79	15.39
% of Thermal sources out of Total grid generation	85.66	84.21	84.61
% Low cost must run sources out of Total grid generation - Average of the three most recent years – 15.17%			

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

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

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

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

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

BCL-Satna 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.

[4] Source of generation data for the year 2002-2003: CEA General Review (2002-2003)
Source of generation data for the year 2003-2004: CEA General Review 2005 (contains data for 2003-2004)
Source of generation data for the year 2004-2005: WREB Annual Report (2004-2005)

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 An-3: Generation Details in the Western Region for the year 2002-2003				
State	**Fuel**	**Gross MU Generated**	**Auxiliary Consumption (MU)**	**Net MU Generated**
		2002-2003	**2002-2003**	**2002-2003**
Gujarat				
State Electricity Boards				
Thermal	Coal	22051.81		
Thermal	Diesel	0.00		
Thermal	Gas	211.90		
Hydro	Hydro	588.45		
Wind	Wind	0.00		
Electricity Departments/ Govt. Undertakings/ Municipalities				
Thermal	Coal	3398.00		
Thermal	Diesel	0.00		
Thermal	Gas	1826.10		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Nuclear	Nuclear	0.00		
Private Generating Stations				
Thermal	Coal	5072.42		
Thermal	Diesel	0.00		
Thermal	Gas	3786.31		
Hydro	Hydro	0.00		
Wind	Wind	179.366		
Non-Utilities				
Self Generating Industries	Low Cost (Assumed for conservative estimate)			1452.00
Total Thermal	**Coal**	30522.23	3029.67	**27492.56**
Total Thermal	**Diesel**	0.00	0.00	**0.00**
Total Thermal	**Gas**	5824.31	117.97	**5706.34**
Total Hydro	**Hydro**	588.45	7.14	**581.31**
Total Wind	**Wind**	179.37	0.00	**179.37**
Total Nuclear	**Nuclear**	0.00	0.00	**0.00**

Total from Non-Utilities	**Low Cost (Assumed for conservative estimate)**			**1452.00**
Madhya Pradesh				
State Electricity Boards				
Thermal	Coal	13680.86		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	1771.34		
Wind	Wind	0.00		
Electricity Departments/ Govt. Undertakings/ Municipalities				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Nuclear	Nuclear	0.00		
Private Generating Stations				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	32.52		
Non-Utilities				
Self Generating Industries	Low Cost (Assumed for conservative estimate)			0.00
Total Thermal	**Coal**	13680.86	1314.99	**12365.87**
Total Thermal	**Diesel**	0.00	0.00	**0.00**
Total Thermal	**Gas**	0.00	0.00	**0.00**
Total Hydro	**Hydro**	1771.34	4.68	**1766.66**
Total Wind	**Wind**	32.52	0.00	**32.52**
Total Nuclear	**Nuclear**	0.00	0.00	**0.00**
Total from Non-Utilities	**Low Cost (Assumed for conservative estimate)**			**0.00**
Chattisgarh				
State Electricity Boards				
Thermal	Coal	7593.22		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	276.95		
Wind	Wind	0.00		

Electricity Departments/ Govt. Undertakings/ Municipalities				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Nuclear	Nuclear	0.00		
Private Generating Stations				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Non-Utilities				
Self Generating Industries	Low Cost (Assumed for conservative estimate)			666.25
Total Thermal	**Coal**	7593.22	735.02	**6858.20**
Total Thermal	**Diesel**	0.00	0.00	**0.00**
Total Thermal	**Gas**	0.00	0.00	**0.00**
Total Hydro	**Hydro**	276.95	0.49	**276.46**
Total Wind	**Wind**	0.00	0.00	**0.00**
Total Nuclear	**Nuclear**	0.00	0.00	**0.00**
Total from Non-Utilities	**Low Cost (Assumed for conservative estimate)**			**666.25**
Maharashtra				
State Electricity Boards				
Thermal	Coal	50304.19		
Thermal	Diesel	0.00		
Thermal	Gas	2795.07		
Waste Heat Recovery (From Uran-WHR)	Waste Gas	1096.10		
Hydro	Hydro	4185.21		
Wind	Wind	0.00		
Electricity Departments/ Govt. Undertakings/ Municipalities				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		

Wind	Wind	0.00		
Nuclear	Nuclear	0.00		
Private Generating Stations				
Thermal	Coal	1899.85		
Thermal	Diesel	0.00		
Thermal	Gas	1151.90		
Hydro	Hydro	1350.20		
Wind	Wind	666.63		
Non-Utilities				
Self Generating Industries	Low Cost (Assumed for conservative estimate)			349.62
Total Thermal	**Coal**	52204.04	4165.65	**48038.39**
Total Thermal	**Diesel**	0.00	0.00	**0.00**
Total Thermal	**Gas**	3946.97	86.04	**3860.93**
Total Waste Heat Recovery	**Waste Gas**	1096.10	33.74	**1062.36**
Total Hydro	**Hydro**	5535.41	38.08	**5497.33**
Total Wind	**Wind**	666.63	0.00	**666.63**
Total Nuclear	**Nuclear**	0.00	0.00	**0.00**
Total from Non-Utilities	**Low Cost (Assumed for conservative estimate)**			**349.62**
Goa				
State Electricity Boards				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Electricity Departments/ Govt. Undertakings/ Municipalities				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Nuclear	Nuclear	0.00		
Private Generating Stations				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	273.05		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Non-Utilities				

Self Generating Industries	Low Cost (Assumed for conservative estimate)			0.00
Total Thermal	**Coal**	0.00	0.00	**0.00**
Total Thermal	**Diesel**	0.00	0.00	**0.00**
Total Thermal	**Gas**	273.05	2.73	**270.32**
Total Hydro	**Hydro**	0.00	0.00	**0.00**
Total Wind	**Wind**	0.00	0.00	**0.00**
Total Nuclear	**Nuclear**	0.00	0.00	**0.00**
Total from Non-Utilities	**Low Cost (Assumed for conservative estimate)**			**0.00**
D&N Haveli				
State Electricity Boards				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Electricity Departments/ Govt. Undertakings/ Municipalities				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Nuclear	Nuclear	0.00		
Private Generating Stations				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Non-Utilities				
Self Generating Industries	Low Cost (Assumed for conservative estimate)			0.00
Total Thermal	**Coal**	0.00	0.00	**0.00**
Total Thermal	**Diesel**	0.00	0.00	**0.00**
Total Thermal	**Gas**	0.00	0.00	**0.00**
Total Hydro	**Hydro**	0.00	0.00	**0.00**
Total Wind	**Wind**	0.00	0.00	**0.00**
Total Nuclear	**Nuclear**	0.00	0.00	**0.00**

Total from Non-Utilities	**Low Cost (Assumed for conservative estimate)**			**0.00**
Daman & Diu				
State Electricity Boards				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Electricity Departments/ Govt. Undertakings/ Municipalities				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Nuclear	Nuclear	0.00		
Private Generating Stations				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Non-Utilities				
Self Generating Industries	Low Cost (Assumed for conservative estimate)			0.00
Total Thermal	**Coal**	0.00	0.00	**0.00**
Total Thermal	**Diesel**	0.00	0.00	**0.00**
Total Thermal	**Gas**	0.00	0.00	**0.00**
Total Hydro	**Hydro**	0.00	0.00	**0.00**
Total Wind	**Wind**	0.00	0.00	**0.00**
Total Nuclear	**Nuclear**	0.00	0.00	**0.00**
Total from Non-Utilities	**Low Cost (Assumed for conservative estimate)**			**0.00**
Central Sector Share in Western Region				
Total Thermal	**Coal**	33391.85	2769.58	**30622.27**
Total Thermal	**Diesel**	0.00	0.00	**0.00**
Total Thermal	**Gas**	7572.87	117.35	**7455.52**
Total Hydro	**Hydro**	0.00	0.00	**0.00**
Total Wind	**Wind**	0.00	0.00	**0.00**

Total Nuclear	**Nuclear**	6200.00	600.00	**5600.00**
Import from other Regions	Low Cost (Assumed for conservative estimate)			**5757.51**
Total Thermal Generation in WR	Coal	137392.20	12014.91	125377.29
Total Thermal Generation in WR	Diesel	0.00	0.00	0.00
Total Thermal Generation in WR	Gas	17617.20	324.09	17293.11
Total Generation from Waste Heat in WR	Waste Gas	1096.10	33.74	1062.36
Total Hydro Generation in WR	Hydro	8172.15	50.39	8121.76
Total Wind Generation in WR	Wind	878.52	0.00	878.52
Total Nuclear Generation in WR	Nuclear	6200.00	600.00	5600.00
Total Generation from Non-Utilities in WR	Low Cost (Assumed for conservative estimate)			2467.87
Total Import from other Regions in WR	Low Cost (Assumed for conservative estimate)			5757.51
Total Generation in WR (including Gen. from SEBs, Electricity Dept., Govt. Undertakings, Municipalities, Private Generating Stations and Central Sector Share)				**158333.04**
Total Generation from Non-Utilities in WR				**2467.87**
Total Import from other Regions in WR				**5757.51**
Gross Generation from all sources in WR				**166558.42**
20% of Gross Generation from all sources in WR				**33311.683**
Source: CEA General Review (2002-2003)				

Table An-4: Generation Details in the Western Region for the year 2003-2004				
State	**Fuel**	**Gross MU Generated**	**Auxiliary Consumption (MU)**	**Net MU Generated**
		2003-2004	**2003-2004**	**2003-2004**
Gujarat				
State Electricity Boards				
Thermal	Coal	20402.49		
Thermal	Diesel	0.00		
Thermal	Gas	934.10		
Hydro	Hydro	859.34		
Wind	Wind	0.00		
Electricity Departments/ Govt. Undertakings/ Municipalities				
Thermal	Coal	3398.00		
Thermal	Diesel	0.00		
Thermal	Gas	788.62		
Hydro	Hydro	0.00		
Wind	Wind	113.20		
Nuclear	Nuclear	0.00		
Private Generating Stations				
Thermal	Coal	4593.80		
Thermal	Diesel	0.00		
Thermal	Gas	7041.99		
Hydro	Hydro	0.00		
Wind	Wind	138.30		
Non-Utilities				
Self Generating Industries	Low Cost (Assumed for conservative estimate)			2217.38
Total Thermal	**Coal**	28394.29	2732.84	**25661.45**
Total Thermal	**Diesel**	0.00	0.00	**0.00**
Total Thermal	**Gas**	8764.71	163.97	**8600.74**
Total Hydro	**Hydro**	859.34	6.77	**852.57**
Total Wind	**Wind**	251.50	0.00	**251.50**
Total Nuclear	**Nuclear**	0.00	0.00	**0.00**
Total from Non-Utilities	**Low Cost (Assumed for conservative estimate)**			**2217.38**
Madhya Pradesh				
State Electricity Boards				
Thermal	Coal	13168.47		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		

Hydro	Hydro	2632.37		
Wind	Wind	1.24		
Electricity Departments/ Govt. Undertakings/ Municipalities				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Nuclear	Nuclear	0.00		
Private Generating Stations				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Non-Utilities				
Self Generating Industries	Low Cost (Assumed for conservative estimate)			0.00
Total Thermal	**Coal**	13168.47	1302.99	**11865.48**
Total Thermal	**Diesel**	0.00	0.00	**0.00**
Total Thermal	**Gas**	0.00	0.00	**0.00**
Total Hydro	**Hydro**	2632.37	5.73	**2626.64**
Total Wind	**Wind**	1.24	0.00	**1.24**
Total Nuclear	**Nuclear**	0.00	0.00	**0.00**
Total from Non-Utilities	**Low Cost (Assumed for conservative estimate)**			**0.00**
Chattisgarh				
State Electricity Boards				
Thermal	Coal	7617.49		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	298.94		
Wind	Wind	0.00		
Electricity Departments/ Govt. Undertakings/ Municipalities				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Nuclear	Nuclear	0.00		
Private Generating Stations				

Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Non-Utilities				
Self Generating Industries	Low Cost (Assumed for conservative estimate)			614.27
Total Thermal	**Coal**	7617.49	749.40	**6868.09**
Total Thermal	**Diesel**	0.00	0.00	**0.00**
Total Thermal	**Gas**	0.00	0.00	**0.00**
Total Hydro	**Hydro**	298.94	0.64	**298.30**
Total Wind	**Wind**	0.00	0.00	**0.00**
Total Nuclear	**Nuclear**	0.00	0.00	**0.00**
Total from Non-Utilities	**Low Cost (Assumed for conservative estimate)**			**614.27**
Maharashtra				
State Electricity Boards				
Thermal	Coal	42177.67		
Thermal	Diesel	0.00		
Thermal	Gas	2877.71		
Waste Heat Recovery (From Uran-WHR)	Waste Gas	1128.52		
Hydro	Hydro	4155.73		
Wind	Wind	602.39		
Electricity Departments/ Govt. Undertakings/ Municipalities				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Nuclear	Nuclear	0.00		
Private Generating Stations				
Thermal	Coal	12019.83		
Thermal	Diesel	0.00		
Thermal	Gas	1426.00		
Hydro	Hydro	1336.00		
Wind	Wind	666.63		
Non-Utilities				

Self Generating Industries	Low Cost (Assumed for conservative estimate)			365.16
Total Thermal	**Coal**	54197.50	4364.42	**49833.08**
Total Thermal	**Diesel**	0.00	0.00	**0.00**
Total Thermal	**Gas**	4303.71	89.97	**4213.75**
Total Waste Heat Recovery	**Waste Gas**	1128.52	35.28	**1093.23**
Total Hydro	**Hydro**	5491.73	42.82	**5448.91**
Total Wind	**Wind**	1269.02	0.00	**1269.02**
Total Nuclear	**Nuclear**	0.00	0.00	**0.00**
Total from Non-Utilities	**Low Cost (Assumed for conservative estimate)**			**365.16**
Goa				
State Electricity Boards				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Electricity Departments/ Govt. Undertakings/ Municipalities				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Nuclear	Nuclear	0.00		
Private Generating Stations				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	202.27		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Non-Utilities				
Self Generating Industries	Low Cost (Assumed for conservative estimate)			0.00
Total Thermal	**Coal**	0.00	0.00	**0.00**
Total Thermal	**Diesel**	0.00	0.00	**0.00**
Total Thermal	**Gas**	202.27	4.05	**198.22**
Total Hydro	**Hydro**	0.00	0.00	**0.00**
Total Wind	**Wind**	0.00	0.00	**0.00**
Total Nuclear	**Nuclear**	0.00	0.00	**0.00**

Total from Non-Utilities	**Low Cost (Assumed for conservative estimate)**			**0.00**
D&N Haveli				
State Electricity Boards				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Electricity Departments/ Govt. Undertakings/ Municipalities				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Nuclear	Nuclear	0.00		
Private Generating Stations				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Non-Utilities				
Self Generating Industries	Low Cost (Assumed for conservative estimate)			0.00
Total Thermal	**Coal**	0.00	0.00	**0.00**
Total Thermal	**Diesel**	0.00	0.00	**0.00**
Total Thermal	**Gas**	0.00	0.00	**0.00**
Total Hydro	**Hydro**	0.00	0.00	**0.00**
Total Wind	**Wind**	0.00	0.00	**0.00**
Total Nuclear	**Nuclear**	0.00	0.00	**0.00**
Total from Non-Utilities	**Low Cost (Assumed for conservative estimate)**			**0.00**
Daman & Diu				
State Electricity Boards				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		

Electricity Departments/ Govt. Undertakings/ Municipalities				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Nuclear	Nuclear	0.00		
Private Generating Stations				
Thermal	Coal	0.00		
Thermal	Diesel	0.00		
Thermal	Gas	0.00		
Hydro	Hydro	0.00		
Wind	Wind	0.00		
Non-Utilities				
Self Generating Industries	Low Cost (Assumed for conservative estimate)			0.00
Total Thermal	**Coal**	0.00	0.00	**0.00**
Total Thermal	**Diesel**	0.00	0.00	**0.00**
Total Thermal	**Gas**	0.00	0.00	**0.00**
Total Hydro	**Hydro**	0.00	0.00	**0.00**
Total Wind	**Wind**	0.00	0.00	**0.00**
Total Nuclear	**Nuclear**	0.00	0.00	**0.00**
Total from Non-Utilities	**Low Cost (Assumed for conservative estimate)**			**0.00**
Central Sector Share in Western Region				
Total Thermal	**Coal**	32685.70	2285.00	**30400.7**
Total Thermal	**Diesel**	0.00	0.00	**0.00**
Total Thermal	**Gas**	7108.91	163.45	**6945.46**
Total Hydro	**Hydro**	0.00	0.00	**0.00**
Total Wind	**Wind**	0.00	0.00	**0.00**
Total Nuclear	**Nuclear**	5700.00	600.00	**5100.00**
Import from other Regions	Low Cost (Assumed for conservative estimate)			**6981.86**
Total Thermal Generation in WR	Coal	136063.45	11434.65	124628.80
Total Thermal Generation in WR	Diesel	0.00	0.00	0.00
Total Thermal Generation in WR	Gas	20379.60	421.44	19958.17

Total Generation from Waste Heat in WR	Waste Gas	1128.52	35.28	1093.23
Total Hydro Generation in WR	Hydro	9282.38	55.96	9226.42
Total Wind Generation in WR	Wind	1521.76	0.00	1521.76
Total Nuclear Generation in WR	Nuclear	5700.00	600.00	5100.00
Total Generation from Non-Utilities in WR	Low Cost (Assumed for conservative estimate)			3196.81
Total Import from other Regions in WR	Low Cost (Assumed for conservative estimate)			6981.86
Total Generation in WR (including Gen. from SEBs, Electricity Dept., Govt. Undertakings, Municipalities, Private Generating Stations and Central Sector Share)				**161528.38**
Total Generation from Non-Utilities in WR				**3196.81**
Total Import from other Regions in WR				**6981.86**
Gross Generation from all sources in WR				**171707.05**
20% of Gross Generation from all sources in WR				**34341.41**
Source: CEA General Review 2005 (contains data for 2003-2004)				

Table An-5: Generation Details in the Western Region for the year 2004-2005

State	**Fuel**	**Gross MU Generated**	**Auxiliary Consumption (MU)**	**Net MU Generated**
		2004-2005	**2004-2005**	**2004-2005**
Gujarat				
Total Thermal	Coal	30120.94	2933.63	27187.31
Total Thermal	Diesel	0.00	0.00	0.00
Total Thermal	Gas	13366.83	261.59	13105.24
Total Hydro	Hydro	873.19	7.07	866.12
Total Wind	Wind	0.00	0.00	0.00

Total Nuclear	Nuclear	0.00	0.00	0.00
Madhya Pradesh				
Total Thermal	Coal	13502.55	1414.69	12087.86
Total Thermal	Diesel	0.00	0.00	0.00
Total Thermal	Gas	0.00	0.00	0.00
Total Hydro	Hydro	3737.85	7.31	3730.54
Total Wind	Wind	0.00	0.00	0.00
Total Nuclear	Nuclear	0.00	0.00	0.00
Chattisgarh				
Total Thermal	Coal	7924.98	782.82	7142.16
Total Thermal	Diesel	0.00	0.00	0.00
Total Thermal	Gas	0.00	0.00	0.00
Total Hydro	Hydro	382.64	0.00	382.64
Total Wind	Wind	0.00	0.00	0.00
Total Nuclear	Nuclear	0.00	0.00	0.00
Maharashtra				
Total Thermal	Coal	55543.13	4452.14	51090.99
Total Thermal	Diesel	0.00	0.00	0.00
Total Thermal	Gas	4003.55	40.71	3962.84
Toatl WHR	Waste Gas	1446.64	84.18	1362.46
Total Hydro	Hydro	5583.54	39.08	5544.46
Total Wind	Wind	0.00	0.00	0.00
Total Nuclear	Nuclear	0.00	0.00	0.00
Goa				
Total Thermal	Coal	0.00	0.00	0.00
Total Thermal	Diesel	0.00	0.00	0.00
Total Thermal	Gas	138.36	0.00	138.36
Total Hydro	Hydro	0.00	0.00	0.00
Total Wind	Wind	0.00	0.00	0.00
Total Nuclear	Nuclear	0.00	0.00	0.00
D&N Haveli				
Total Thermal	Coal	0.00	0.00	0.00
Total Thermal	Diesel	0.00	0.00	0.00
Total Thermal	Gas	0.00	0.00	0.00
Total Hydro	Hydro	0.00	0.00	0.00
Total Wind	Wind	0.00	0.00	0.00
Total Nuclear	Nuclear	0.00	0.00	0.00
Daman & Diu				
Total Thermal	Coal	0.00	0.00	0.00
Total Thermal	Diesel	0.00	0.00	0.00
Total Thermal	Gas	0.00	0.00	0.00
Total Hydro	Hydro	0.00	0.00	0.00
Total Wind	Wind	0.00	0.00	0.00

Total Nuclear	Nuclear	0.00	0.00	0.00
Central Sector Share in Western Region				
Total Thermal	Coal			32505.28
Total Thermal	Diesel			0.00
Total Thermal	Gas			6703.57
Total Hydro	Hydro			0.00
Total Wind	Wind			0.00
Total Nuclear	Nuclear			4496.51
Import from other Regions	Low Cost (Assumed for conservative estimate)			**10628.31**
Import from Self Generating Industries (Balco and Jindal)	Low Cost (Assumed for conservative estimate)			**978.14**
Total Thermal Generation in WR	Coal			130013.60
Total Thermal Generation in WR	Diesel			0.00
Total Thermal Generation in WR	Gas			23910.01
Total Generation from WHR in WR	Waste Gas			1362.46
Total Hydro Generation in WR	Hydro			10523.76
Total Wind Generation in WR	Wind			0.00
Total Nuclear Generation in WR	Nuclear			4496.51
Total Import from other Regions in WR	Low Cost (Assumed for conservative estimate)			10628.31
Total Import from Self Generating Industries in WR	Low Cost (Assumed for conservative estimate)			978.14
Total Generation in WR (including Gen. from all the States, Union Territories and Central Sector Share)				**170306.34**
Total Import from other Regions in WR				**10628.31**

Total Import from Self Generating Industries in WR				**978.14**
Gross Generation from all sources in WR				**181912.79**
20% of Gross Generation from all sources in WR				**36382.558**
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 An-6: Data used for Simple OM emission factor

$COEF_{i,j\ y}$- is the CO_2 emission coefficient of fuel i (tCO_2 / mass or volume unit of the fuel), taking into account the Net Calorific Value (energy content) per mass or volume unit of a fuel i (NCV_i), the CO_2 emission factor per unit of energy of the fuel i($EF_{CO2,i}$), and the oxidation factor of the fuel i ($OXID_i$).

Parameters	**2002-2003**			**2003-2004**			**2004-2005**			**Source**
	Coal	**Gas**	**Diesel**	**Coal**	**Gas**	**Diesel**	**Coal**	**Gas**	**Diesel**	
NCV_i (kcal/kg)	4171	11942	9760	3820	11942	10186	3820	11942	10186	Coal: CEA General Review 2002-2003 & 2005 Gas: 1996 IPCC Guidelines Diesel: CEA General Review 2002-2003 & 2005
$EF_{CO2,i}$ (tonne CO_2/TJ)	96.1	56.1	74.1	96.1	56.1	74.1	96.1	56.1	74.1	IPCC 1996 Revised Guidelines and the IPCC Good Practice Guidance
$OXID_i$	0.98	0.995	0.99	0.98	0.995	0.99	0.98	0.995	0.99	Page 1.29 in the 1996 Revised IPCC Guidelines
$COEF_{i,j\ y}$(tonne of CO_2/ton of fuel)	**1.642**	**2.786**	**2.992**	**1.503**	**2.786**	**3.123**	**1.503**	**2.786**	**3.123**	**Calculated as per Equation (2) of ACM0002**

$F_{i,j,y}$ - Fuel Consumption – is the amount of fuel consumed by relevant power sources j (where j – power sources delivering electricity to the grid, not including low-operating cost and must-run power plants and including imports from the grid). The Fuel Consumption is calculated based on total generation of the relevant power sources (j) ($\Sigma_j GEN_{j,y}$) , efficiency of power generation with fuel source i ($E_{i,j}$)and the Net Calorific Value (energy content) per mass or volume unit of a fuel i (NCV_i).

$GEN_{j,y}$ is the electricity (MU) delivered to the grid by source j, j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports from the grid. The j power sources would also include electricity imports from the Central Generating Stations since the net imports from CGS exceed 20% of the total generation in the project electricity system – Western Regional Grid.

Parameters	**2002-2003**			**2003-2004**			**2004-2005**			**Source**
	Coal	**Gas**	**Diesel**	**Coal**	**Gas**	**Diesel**	**Coal**	**Gas**	**Diesel**	
$\Sigma_j GEN_{j,y}$ (MU)	125377.29	17293.11	0	124628.80	19958.17	0	130013.60	23910.01	0	Refer to Tables An-3, 4 and 5: Power Generation Data of Enclosure II-

Efficiency of power generation with fuel source in % ($E_{i,j}$) -The most important parameter in calculating the 'Fuel consumption' by relevant power sources is the thermal efficiency of the power plant with fuel source i. The methodology requires the project proponent to use technology provider's nameplate power plant efficiency or the anticipated energy efficiency documented in official sources. The design efficiency is expected to be a conservative estimate, because under actual operating conditions plants usually have lower efficiencies and higher emissions than the nameplate performance would imply. The efficiency of power generation with fuel source is calculated using the most conservative Design Station Heat Rate Value.

Parameters	**2002-2003**			**2003-2004**			**2004-2005**			**Source**
	Coal	**Gas**	**Diesel**	**Coal**	**Gas**	**Diesel**	**Coal**	**Gas**	**Diesel**	
Station Heat Rate (Design Values)	2341.3	1911	2062	2351.3	1911	2062	2357	1911	2062	Coal: CEA-Performance Review of Thermal Power Stations 2002-03, 2003-04 & 2004-05 -Section 13 Gas: Petition No. 22/99; IA No.27/1999 AND IA No.18/2000 Diesel:

										http://mnes.nic.in/baselinepdfs/annexure2c.pdf
Ei,j (%)	36.732	45	41.707	36.576	45	41.707	36.487	45	41.707	Calculated using Station Heat Rate Values
NCV_i (kcal/kg)	4171	11942	9760	3820	11942	10186	3820	11942	10186	Coal: CEA General Review 2002-2003 & 2005 Gas: 1996 IPCC Guidelines Diesel: CEA General Review 2002-2003 & 2005
$F_{i,j,y}$ is the amount of fuel i (in a mass or volume unit, here tonnes/yr) consumed by relevant power sources j in year(s) y										
Parameters	**2002-2003**			**2003-2004**			**2004-2005**			**Source**
	Coal	**Gas**	**Diesel**	**Coal**	**Gas**	**Diesel**	**Coal**	**Gas**	**Diesel**	
$F_{i,j,y}$ (tons/yr)	70377811	2767463	0	76711963	3193960	0	80220433	3826385	0	Calculated
$\Sigma_j GEN_{j,y}$ (MU)	142670.40			144586.97			153923.61			Refer to Tables An-3, 4 and 5: Power Generation Data of Enclosure II-
$EF_{OM,simple,y}$ (ton ofCO_2/MU)	**863.81**			**859.20**			**852.80**			Calculated
3-years average of $EF_{OM,simple,y}$ (ton ofCO_2/MU)	**858.60**									Average of the most recent three years' Simple OM

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/MU) of a sample of power plants. The methodology suggests the project proponent to choose one of the two options available to calculate the Build Margin emission factor $EF_{BM,y}$

Option 1:

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

(a) The five power plants that have been built most recently, or

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

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

Option 2:

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

(a) the five power plants that have been built most recently, or

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

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

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

The following Table An-7 presents the key information and data used to determine the BM emission factor.

Table An-7: 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 (MU)
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	Lignite	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
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
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
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 Pradesh	17/2/1998	Hydro	1.2		0.00
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 Gross 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 An-8: Data used for BM emission factor				
Parameters	**2004-2005**			**A. SOURCE**
	Coal	**Gas**	**Diesel**	
$COEF_{i,m,}$- is the CO_2 emission coefficient of fuel i (tCO_2 / mass or volume unit of the fuel), taking into account the Net Calorific Value (energy content) per mass or volume unit of a fuel i (NCV_i), the CO_2 emission factor per unit of energy of the fuel i ($EF_{CO2,i}$), and the oxidation factor of the fuel i ($OXID_i$).				
NCV_i (kcal/kg)	3820	11942	10186	Coal & Diesel: CEA General Review 2005 Gas: 1996 IPCC Guidelines
$EF_{CO2,i}$ *(tonne CO_2/TJ)*	96.1	56.1	74.1	IPCC 1996 Revised Guidelines and the IPCC Good Practice Guidance
$OXID_i$	0.98	0.995	0.99	Page 1.29 in the 1996 Revised IPCC Guidelines
$COEF_{i,m}$ (tonne of CO_2/ton of fuel)	**1.503**	**2.786**	**3.123**	**Calculated as per Equation (2) of ACM0002**
Where NCV_i ,$EFCO_{2,i}$ $OXID_i$, $COEF_{i,m}$ are analogous to the variables described for the simple OM method above for plants in the sample group m.				
Parameters	**2004-2005**			**B. SOURCE**
	Coal	**Gas**	**Diesel**	
$F_{i,m,y}$ - Fuel Consumption – is the amount of fuel consumed by relevant power sources m (where m – power sources which are a part of the sample group m delivering electricity to the grid). The Fuel Consumption is calculated based on total generation of the relevant power sources (m) ($\Sigma_m GEN_{m,y}$) , efficiency of power generation with fuel source i ($E_{i,m}$)and the Net Calorific Value (energy content) per mass or volume unit of a fuel i (NCV_i).				
$\Sigma GEN_{m,y}$ *(MU)*	21298.88	9816.20	0	Refer to Table An-7 Power Generation Data for Calculation of Built Margin of Enclosure II
Station Heat Rate (Design Values)	2357	1911	2062	Coal: CEA Performance Review of Thermal Power Stations 2004-05 Section 13 Gas: Petition No. 22/99; IA No.27/1999 AND IA No.18/2000 Diesel: http://mnes.nic.in/baselinepdfs/annexure2c.pdf
Avg. efficiency of power generation with fuel source as (in %)	36.487	45	41.707	Calculated using Station Heat Rate Values
NCVi (kcal/kg)	3820	11942	10186	Coal & Diesel: CEA General Review 2005 Gas: 1996 IPCC Guidelines
$F_{i,m,y}$ (tons/yr)	13141742	1570914	0	Calculated
Where $GEN_{m,y}$ *(MU)* , NCV_i ,$F_{i,m,y}$, are analogous to the variables described for the simple OM method above for plants in the sample group m.				
Parameters	**2004-2005**			**C. SOURCE**

ΣGENm,y (MU)	37025.64	Refer to Table An-7 Power Generation Data for Calculation of Built Margin of Enclosure II-.
Where $GEN_{m,y}$ is analogous to the variables described for the simple OM method above for plants in the sample group m.		
BM, $EF_{BM,y}$ (ton of CO_2/MU)	**651.82**	Calculated

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

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

The most recent 3-years (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 An-9: Data used for Baseline Emission Factor

Parameters	**Values (ton of CO_2/MU)**	**Remarks**
OM, $EF_{OM,y}$ (ton of CO_2/MU)	858.60	Average of most recent 3-years (2002-2003, 2003-2004 & 2004-2005) values
BM, $EF_{BM,y}$ (ton of CO_2/MU)	**651.82**	Value of the base year i.e. 2004-2005
Baseline Emission Factor, EF_y (ton of CO_2/MU)	**755.21**	Calculated

The baseline emissions are arrived at based on the above mentioned baseline emission factor calculated as Combined Margin and the power consumption of the equipments in the project boundary in absence of the project activity.

Based on the Combined Margin Method detailed above, (see section E for calculations) the project activity would reduce 110975 tonnes of CO_2 in 10 year of credit period. Since, the project activity is not a baseline scenario, without project activity there will be emission as per the carbon intensity of the grid (0.755 Kg CO_2/kWh). Therefore the project activity reduces the net energy demand at the generation sources in the system boundary.