**MONITORING REPORT FORM (CDM-MR)***
**Version 01 - in effect as of: 28/09/2010**

## CONTENTS

**MONITORING REPORT**
**Version 01 Date: 16.04.2012**

**Demand side energy efficiency programmes for specific technologies at ITC Bhadrachalam pulp and paper making facility in India**
**UNFCCC Reference Number: 0806**
**Monitoring Period 04 (first and last days included (01/09/2010 – 31/12/2011))**

## SECTION A. General description of the project activity

### A.1. Brief description of the project activity: >>

>>

1. Purpose of the project activity and the measures taken to reduce greenhouse gas emissions;

   ITC Limited - Paperboards and Speciality Papers Division (PSPD) Bhadrachalam Unit, a part of ITC Limited, took voluntary initiatives to reduce their electrical energy consumption with an objective to contribute towards the reduction of greenhouse gases (GhG) in line with their corporate sustainable business approach.

2. Brief description of the installed technology and equipments;

   The measures adopted under the energy efficiency programme can broadly be classified into:

   a) Replacement of low efficient equipment (such as pumps, compressors, lamps) with energy efficient alternatives;

   b) Application of retrofit measures for various types of equipment through measures such as power factor improvement, and installation of energy saving devices, etc.

| **Project Description** | | |
|---|---|---|
| **Description** | **Earlier Specification** | **Project specification** |
| **Paper Machine: 1** | | |
| Replacement of 12 nos. of vacuum fans connected to 4 nos. of formers (3 fans at each) by 4 nos. of energy efficient fans (1 fan at each former). | HBBB-10-3-H2 14 m3/min, 1100 mmwc | CEMTEK SINGLE FAN 42m3/min, 700 mmwc |
| Replacement of low efficient Vacuum Pump -No. 3 at by energy efficient alternative Vacuum Pump | 12E, 105m3/h, 500 mmhg | K202M, 105m3/h, 500 mmhg |
| Replacement of double disc refiner by tri-disc refiner to reduce energy consumption in stock preparation by increasing the consecutive refining stage and improving the quality of the stock. | 1 SDM,4.5T/h, 150m3/h | 21TDR,4.5T/h 150m3/h |
| **Paper Machine:2** | | |
| Replacement of Unrefined chest pump with reduction in pump head of optimum requirement and reduce pumping energy | 133m3/h @ 33m head | 133m3/h @ 29m head |

| **Project Description** | | |
|---|---|---|
| **Description** | **Earlier Specification** | **Project specification** |
| Replacement of Refined chest pump with reduction in pump head of optimum requirement and reduce pumping energy | 183m3/h @ 17.5m head | 183m3/h @ 15m head |
| Replacement of Mixing chest pump with reduction in pump head of optimum requirement and reduce pumping energy | 181m3/h @ 14m head | 181m3/h @ 10m head |
| Replacement of Intermediate chest pump with reduction in pump head of optimum requirement and reduce pumping energy | 181m3/h @ 14m head | 181m3/h @ 10m head |
| Replacement of Machine chest pump with reduction in pump head of optimum requirement and reduce pumping energy | 200m3/h @ 24m head | 200m3/h @ 20m head |
| **Paper Machine:3** | | |
| Replacement of Mixing chest pump with reduction in pump head and flow of optimum requirement and reduce pumping energy | 56m3/h @ 29m head | 200m3/h @ 21.5m head |
| Replacement of Intermediate chest pump with reduction in pump head of optimum requirement and reduce pumping energy | 50m3/h @ 12m head | 50m3/h @ 10m head |
| Replacement of PCC pump with reduction in pump head and flow of optimum requirement and reduce pumping energy | 480m3/h @ 40m head. | 260m3/h @ 30m head |
| Replacement of SCC pump with reduction in pump head and flow of optimum requirement and reduce pumping energy | 168m3/h @ 32.5m head. | 140m3/h @ 25m head |
| Replacement of TCC pump with reduction in pump head and flow of optimum requirement and reduce pumping energy | 90m3/h @ 27.5m head | 47m3/h @ 25m head |
| **Paper Machine: 4** | | |
| Replacement of Vacuum sealing water pump with reduction in pump head and flow of optimum requirement and reduce pumping energy | 144m3/h @ 31m head | 125 m3/h @ 17m head |
| Replacement of Sand filter transfer pump with reduction in pump head of optimum requirement and reduce pumping energy | 175m3/h @ 40m head | 175 m3/h @ 15m head |
| Replacement of Cooling Tower pump with reduction in pump head and flow of optimum requirement and reduce pumping energy | 353m3/h @ 31m head | 260 m3/h @ 25m head |
| **Others** | | |

| **Project Description** | | |
|---|---|---|
| **Description** | **Earlier Specification** | **Project specification** |
| Replacement of one high flow capacity TG3 cooling water pump (CWP 1) by optimum flow capacity pump. | 2500m3/h at 27.5m head | 1250m3/h at 27.5m head |
| Replacement of higher capacity evaporator cooling water pump by lower capacity pump | 1500m3/h at 65m head | 1800m3/h at 35m head |
| **Compressors** | | |
| Replacement of 9 nos. reciprocating compressors with HOC dryers by single centrifugal compressor with refrigerant dryer. | Compressor No:1,5,7,8,9,10 CFB4:1 CFB5:1 | 1 x 95Nm3/m |
| **Fluorescent Lamps (FL)** | | |
| Replacement 3025nos of 2x40W FL tubes with copper choke by 2x22W FL tubes with electronic ballast | 2 x 40 W with Copper Choke | 2 x 22 W with Electronic ballast |
| **High Pressure Mercury Vapour Lamps (HPMV)** | | |
| | 1 x 400W HPMV | 1 x 250W<br>Metal Halide |
| **Distribution** | | |
| Installation of capacitor banks at NFL to improve power factor and reduce distribution losses | 600 Kvar | (7 x 50) Kvar<br>950 Kvar |
| Installation of capacitor banks at SFT A&B to improve power factor and reduce distribution losses | 500 KVAR | 850KVAR (7 x 50 KVAR) |
| **Harmonic Filters** | | |
| Installation of harmonic filters at PM1 and PM2 to reduce voltage distortion and power factor improvement | Not available | 450Kvar, Siemens make |
| **Variable Frequency Drives** | | |
| Installation 2 nos. of 200kw VFD for CFB4 FD fans | Not available | 2 x 250Kva, ABB make |
| Installation of 22kw VFD for PM1 horizontal chest pump. | NA | 22 kW Eurotherm |
| **Drives** | | |
| Change of drives from DC to AC during machine rebuilt & Installation of Harmonic filter | Siemens make DC drives | ABB make AC drives |
| **Controls** | | |
| Installation of electronic governor for 7.5MW unit to reduce bandwidth of frequency variation. | Model SR4 ,BHEL make Hydraulic governor | TS320 Trison make electronic governor |

3. Relevant dates for the project activity related to completion of project construction

| **Paper Machine: 1** | **Project construction completion date** |
|---|---|
| Replacement of 12 nos. of vacuum fans connected to 4 nos. of formers (3 fans at each) by 4 nos. of energy efficient fans (1 fan at each former). | 26-09-2003 |
| Replacement of low efficient Vacuum Pump -No. 3 at by energy efficient alternative Vacuum Pump | 16-02-2005 |
| Replacement of double disc refiner by tri-disc refiner to reduce energy consumption in stock preparation by increasing the consecutive refining stage and improving the quality of the stock. | 04-12-2003 |
| **Paper Machine:2** | |
| Replacement of Unrefined chest pump with reduction in pump head of optimum requirement and reduce pumping energy | 23-11-2004 |
| Replacement of Refined chest pump with reduction in pump head of optimum requirement and reduce pumping energy | 14-12-2004 |
| Replacement of Mixing chest pump with reduction in pump head of optimum requirement and reduce pumping energy | 14-12-2004 |
| Replacement of Intermediate chest pump with reduction in pump head of optimum requirement and reduce pumping energy | 23-11-2004 |
| Replacement of Machine chest pump with reduction in pump head of optimum requirement and reduce pumping energy | 14-02-2005 |
| **Paper Machine:3** | |
| Replacement of Mixing chest pump with reduction in pump head and flow of optimum requirement and reduce pumping energy | 14-12-2004 |
| Replacement of Intermediate chest pump with reduction in pump head of optimum requirement and reduce pumping energy | 25-04-2005 |
| Replacement of PCC pump with reduction in pump head and flow of optimum requirement and reduce pumping energy | 14-12-2004 |
| Replacement of SCC pump with reduction in pump head and flow of optimum requirement and reduce pumping energy | 14-12-2004 |

| | |
|---|---|
| Replacement of TCC pump with reduction in pump head and flow of optimum requirement and reduce pumping energy | 09-10-2004 |
| **Paper Machine: 4** | |
| Replacement of Vacuum sealing water pump with reduction in pump head and flow of optimum requirement and reduce pumping energy | 14-12-2004 |
| Replacement of Sand filter transfer pump with reduction in pump head of optimum requirement and reduce pumping energy | 14-12-2004 |
| Replacement of Cooling Tower pump with reduction in pump head and flow of optimum requirement and reduce pumping energy | 23-03-2005 |
| **Others** | |
| Replacement of one high flow capacity TG3 cooling water pump (CWP 1) by optimum flow capacity pump. | 01-05-2001 |
| Replacement of higher capacity evaporator cooling water pump by lower capacity pump | 24-05-2005 |
| **Compressors** | |
| Replacement of 9 nos. reciprocating compressors with HOC dryers by single centrifugal compressor with refrigerant dryer. | 14-03-2003 |
| **Fluorescent Lamps (FL)** | |
| Replacement 3025nos of 2x40W FL tubes with copper choke by 2x22W FL tubes with electronic ballast | 23-12-2004 |
| **High Pressure Mercury Vapour Lamps (HPMV)** | |
| Replacement of 100nos of HPMV lamps by metal halide lamps. | 06-05-2004 |
| **Distribution** | |
| Installation of capacitor banks at NFL to improve power factor and reduce distribution losses | 28-12-2004 |
| Installation of capacitor banks at SFT A&B to improve power factor and reduce distribution losses | 06-04-2003 |
| **Harmonic Filters** | |
| Installation of harmonic filters at PM1 and PM2 to reduce voltage distortion and power factor improvement | 20-03-2004 |
| **Variable Frequency Drives** | |
| Installation 2 nos. of 200kw VFD for CFB4 FD fans | 23-12-2004 |
| Installation of 22kw VFD for PM1 horizontal chest pump. | 30-11-2003 |
| **Drives** | |

| | |
|---|---|
| Change of drives from DC to AC during machine rebuilt & Installation of Harmonic filter | January,2001 |
| **Controls** | |
| Installation of electronic governor for 7.5MW unit to reduce bandwidth of frequency variation. | 23-08-2005 |

*Please note that the initiative "Installation of capacitor banks at SFT A&B to improve power factor and reduce distribution losses" has not been considered for emission reduction calculations for the period 01 January 2009 to 31 August 2010 due to changes in product mix at downstream paper machines.*

4. Total emission reductions achieved in this monitoring period.

   Total emission reductions achieved in the monitoring period: 24430 $tCO_2$

## A.2. Project Participants

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Parties involved indirectly are:
India (Host Country), Authorized Participants: ITC Limited - Paperboards and Speciality Papers Division (PSPD)
United Kingdom of Great Britain and Northern Ireland, Authorized Participants: ABN AMRO Bank N.V; Deutsche Bank AG

## A.3. Location of the project activity:

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The project is situated within the manufacturing complex of Paperboards & Speciality Papers Division of ITC located near Bhadrachalam town. The approximate location of the unit is 17°41'19"N latitude and 80°52'05"E longitude. The PSPD unit is located at Sarapaka Village, near Bhadrachalam town at Khammam District, Andhra Pradesh, India. The site is at a distance of 300 km from Hyderabad, the nearest city. The nearest railway station is Bhadrachalam Road at a distanced of 45 km.

## A.4. Technical description of the project

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Description of each measure:

a) Replacement of inefficient low efficient equipment (such as pumps, compressors, lamps) with energy efficient alternatives;

About twenty pumps located at various sites within the unit required were replaced with efficient and correctly rated pumps.

Similarly, the Unit changed 3025 fluorescent tube lights (FTL) of 2x44W by 2x22W FTL fittings with electronic ballast and 100 HPMV lamps with metal halide lamps to augment energy efficiency of all light fittings while providing the desired illumination.

Further, under the replacement category, PSPD Bhadrachalam replaced 9 reciprocating compressor (with heat of compression (HOC) air dryer) by one centrifugal compressor (with refrigerant dryer).

b) Application of retrofit measures for various type of equipments and through measures such as power factor improvement, and installation of energy saving devices, etc improve the power factor; to improve the power factor at various electricity consumption points, PSPD Bhadrachalam has installed:

- Two capacitor banks one each at secondary fibre treatment plant (SFT) A, B and new fibre line (NFL);
- Two harmonic filters at Paper Machine #1 and #2
- Two variable frequency drives (VFDs) one each at coal fired boiler number 4 (CFB4) and chest pump of Paper Machine #1 (PM1);
- One AC drive replacing a DC drive for Paper Machine #1 (PM1); and,
- One electronic governor for 7.5 MW turbine

**A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:**

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Title: Type II, D – Energy efficiency and fuel switching measures for industrial facilities, Version 07, Sectoral Scope 4.

This methodology also refers to AMS –I.D- Grid connected renewable electricity generation, version 09, Sectoral Scope 1, for grid emission calculation.

**A.6. Registration date of the project activity:**

>>

19/02/2007

**A.7. Crediting period of the project activity and related information (start date and choice of crediting period):**

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Fixed crediting period: 01/01/2006 – 31/12/2015

**A.8. Name of responsible person(s)/entity (ies):**

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| | |
|---|---|
| Organization: | ITC Limited – Paperboards & Speciality Papers Division, Unit: Bhadrachalam |
| Street/P.O.Box: | 106 Sardar Patel Road |
| Building: | |
| City: | Sarapaka near Bhadrachalam town |
| State/Region: | Andhra Pradesh |
| Postfix/ZIP: | Secunderabad- 500003 |
| Country: | India |
| Telephone: | 91-40- 27846561/ 62 |
| FAX: | 91-40-27811954 |
| E-Mail: | sanjay.singh@itc.in |
| URL: | |
| Represented by: | |
| Title: | Mr. |
| Salutation: | MD, CEO |
| Last Name: | Singh |
| Middle Name: | |
| First Name: | Sanjay |
| Department: | Paperboards & Speciality Papers Division, Unit: Bhadrachalam |
| Mobile: | |
| Direct FAX: | |
| Direct tel: | |
| Personal E-Mail: | |

## SECTION B. Implementation of the project activity

### B.1. Implementation status of the project activity

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Project start date: The real action on the project was initiated during August 2000 as per the registered PDD.

Initiative wise commissioning dates are mentioned under section A.1.

**Initiatives not considered for issuance during the period 01/09/2010 to 31/12/2011:**

SFT-A&B together could not be operated on a continuous basis at full load for 3 days during the monitoring period and hence baseline data could not be captured.

**Initiatives described in the registered PDD but not implemented during the project period:**
The following initiatives though described in the registered PDD have not been implemented during the project period:

1) **PM1 - Fan pump (4*660m$^3$/h at 15m head) not implemented:** The fan pumps supply pulp to the paper machine at a high flow rate of 660 m$^3$/h. Due to this high flow rate there is an enormous risk associated with the increment of the pump head from 13 m to 15m in terms of disturbance in formation of sheets in the paper machine. Due to apprehension of such downstream malfunctioning, this initiative, though considered during PDD preparation was not implemented afterwards.

2) **PM1 – PDD mentions 13 Nos of vacuum fans to be replaced, but only 12 Nos have been actually implemented:** PM 1 has 4 formers each having 3 vacuum fans. The project proposal (Capex) mentions replacement of 3 vacuum fans in each former by a single fan and hence there are 12 fans and not 13 fans to be replaced. However, the PDD mentions 13 fans due to typo error.

3) **PM3 - Machine chest pump not implemented**- Machine chest pump of PM3 has a rated power savings of 2.67 KW and energy savings to the tune of 0.02 GWh. Monitoring of this minimal savings would have been extremely difficult and hence the PP decided not to go for the implementation of the initiative.

4) **Compressors – PDD mentions 10 Nos of compressors to be changed, whereas only 9 Nos have been changed during the project:** The compressor house has 10 compressors (6 instrument compressors and 4 service compressors).The project (Capex) proposal mentions replacement of 5 instrument and 2 service compressors and also mentions replacement one compressor each of coal fired boilers IV and V i.e. a total of 9 compressors were originally proposed to be replaced and the same was also implemented. However, the PDD mentions 10 compressors due to typo error.

5) **Harmonic filter PM1 - Implemented, but the Emission Reduction is counted along with the Drives (DC to AC conversion):** The role of the harmonic filters is to reduce the harmonics in the distribution lines from the transformer to the drives and hence reducing the distribution losses ultimately resulting in reduced power consumption by the drives. Again, conversion from DC to AC power supply also has effect on reduction of power consumption by the drives and it is practically not possible to separately monitor and distinguish the reduction in power consumption by the drives due to the installation of the harmonic filters. Hence the PP has not considered the emission reductions due to the implementation of harmonic filters separately.

However, omission of the above mentioned measures from implementation under the project activity does not affect the additionality of the project in terms of investment, technological and prevailing practice barriers as discussed in the registered PDD.

1. The information regarding the actual operation of the project activity during this monitoring period, including information on special events, for example overhaul times, downtimes of equipment, exchange of equipment, etc.

   Initiative wise calculation of Emission Reductions (Please refer to "CDM ENCON #0806" for details) has considered the actual operating hours of project equipments (e.g. pumps, compressors etc.) considering the all downtimes, overhaul times of the project equipments.

2. Events or situations that occurred during the monitoring period, which may impact the applicability of the methodology and how the issues resulting from these events or situations are being addressed.

   There has been no event during the operational phase of the project activity that may impact the applicability of the methodology.

## B.2. Revision of the monitoring plan

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Monitoring plan has been revised. The date of approval of the revised monitoring plan is 16/03/2008 and is available at http://cdm.unfccc.int/Projects/DB/DNV-CUK1166082720.69/view

## B.3. Request for deviation applied to this monitoring period

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No deviation has been applied to this monitoring period

## B.4. Notification or request of approval of changes

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There has been no notification or request of approval of changes from the project activity as described in the registered CDM-PDD.

## SECTION C. Description of the monitoring system

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| ID number | Monitoring Protocol Followed- data generation, aggregation, recording and reporting |
|---|---|
| $\sum \mathbf{Equ_i}$<br>Numbers of devices replaced/ retrofitted of group "i" where "i" refers to pumps, lamps, compressors., etc | Recorded once prior to the implementation of the project measures |
| **For measure involve replacement of lamps across the mill** | |
| $\sum \mathbf{P_{ibase,}}$ (kW)<br>Rated Power of the device replaced/ retrofitted at the baseline | Recorded once during the project implementation.<br>Reference - Third party report by MKRC |
| $\sum \mathbf{P_{j,Prj}}$ (kW)<br>Rated Power of the device installed as the project measures | Recorded once during the project implementation.<br>Reference - Third party report by MKRC |
| $\mathbf{O_{hrs}}$ (hrs)<br>Operating/ running hours of the replaced device | Burning hours of the lamps replaced is measured daily through Running Hour (RH) meter and monthly final integrator reading is recorded. |

| ID number | Monitoring Protocol Followed- data generation, aggregation, recording and reporting |
|---|---|
| **For measures involve replacement of equipments that are operated without significant change of connected load** | |
| $\sum \mathbf{P_{p,base}}$ (kW)<br>Actual energy consumed by the equipments at the baseline | Baseline energy consumption was recorded based on a month of observation on continuous basis through installed energy meters prior to project installation. |
| $\sum$ **Energy$_{project}$** (kWh)<br>Actual energy consumed by the equipments after the implementation of the project measure | Project energy consumption is measured through dedicated energy meters and monthly integrated consumption are recorded in IMIS Report |
| **O-hrs$_{, actual}$** (hrs)<br>Operating/ running hours of the equipments based on operating hours of the parent machine or equipment (such as pumps connected to paper machine, VFDs connected to fans, and the Compressors that are included in the project boundary) | Monthly operating hours of the equipment is derived based on operating hours of the parent machine or equipment as given below<br>O-hrs$_{, actual}$ = 24hours * days in month – machine/ equipment downtime reported in IMIS monthly reports |
| **For the measures that involves installation of power correction equipments operated at variable connected load** | |
| **Energy$_{base}$ (kWh)**<br>Actual energy consumed by the load connected to the common line without equipment 'i' (in switched off mode) for any 3 consecutive days of continuous operation in a month | As the baseline is dynamic, it is established through measurement during project period. Baseline energy is measured for 3 consecutive days in every month keeping the project equipment in the switched off mode.<br>Actual consumption is derived as the difference in the energy meter reading between the first day when the equipment is taken off and the final 3$^{rd}$ day (i.e. considering 72 operating hours) when the project equipment is again connected to the line. |
| **O-hrs$_{corresponding,3}$ (hrs)**<br>Corresponding operating hours for the 3 consecutive days for baseline monitoring when the equipment 'i' is not connected to the load | During the recording of baseline energy consumption, hours for which the project equipment was taken-off during the month is recorded and reported as O-hrs$_{corresponding,3}$ |
| **Energy$_{project}$ (kWh)**<br>Actual energy consumed by the load connected to the common line with equipment 'i' | Energy consumed by the project measure during the time when the project equipment was on-line is measured by subtracting the energy consumed during 3 days when the project equipment was taken off-line from the total integrated monthly energy reading at the dedicated energy meter. |
| **O-hrs$_{actual}$ (hrs)**<br>Operating/ running hours of the equipments based on operating hours of the parent machine or equipment (such as Capacitor banks connected to NFL fibre lines, harmonic filter connected to paper machine, and electronic governor connected to the generator) | Determined based on the operating hours of the parent equipment/ machine as given below<br><br>O-hrs$_{, actual}$ = 24hours * days in month – machine/ equipment downtime reported in IMIS monthly reports |
| **O-hrs$_{corresponding,}$ (hrs)**<br>Corresponding operating hours for the month when the equipment 'i' is switched on | Operating hours by the project measure during the time when the project equipment was on-line is measured by subtracting the 3 |

| ID number | Monitoring Protocol Followed- data generation, aggregation, recording and reporting |
|---|---|
| | days corresponding operating hours when the project equipment was taken off-line from the actual operating hours of the load determined based on operating hours of the parent equipment |
| **$F_{base}$ (Hz)**<br>Frequency at which the TG2 was being operated in absence of the electronic governor | The frequency at which the TG2 was operated prior to the implementation of the project measure has been recorded and reported in the approval for capital investment (Capex 744/24) for the project measure. |
| **$F_{project}$ (Hz)**<br>Frequency at which the TG2 is operated inline with the electronic governor | The frequency at which the TG2 is operated is recorded on daily basis and monthly average is derived from the daily measurement. |
| ***Others*** | |
| $E_{grid}$ **&** $E_{inhouse}$ (GWh)<br>Electricity imported from the grid and generated in-house | This is recorded from on daily basis from the dedicated energy meter and monthly consumption is reported in IMIS report. |
| ***EFy*** ($tCO_2/GWh$)<br>$CO_2$ emission factor of current generation mix of the grid | The combined emission factor 'EFy' has two components:<br>a) the grid emission factor $EF_{grid}$<br>b) the in-house emission factor $EF_{in\text{-}house}$<br><br>$EF_{grid}$ is calculated as per the revised monitoring plan (ex-ante) using equation (6) and $EF_{in\text{-}house}$ is calculated as per the revised monitoring plan year-on-year basis using equation (7 and 8).<br><br>The monitoring details of $EF_y$ are given in the table below. |
| **$FF_i$** (MT)<br>Annual quantity of fossil fuel (coal & diesel) utilized by the project | Coal & Diesel consumed by the plant for generation of electricity is recorded on daily basis and reported in IMIS report on monthly basis |
| **$NCV_{FF,i}$** (kcal/kg)<br>Average gross calorific value of fossil fuels (coal & diesel) | Net calorific value of the coal and diesel used for generation of electricity has been derived on the basis of analysis. |

**The monitoring system for EFy:**

| ID number | Data type | Data variable | Data unit | Measured (m), calculated (c) or estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | For how long is archived data to be kept? | Comment |
|---|---|---|---|---|---|---|---|---|---|
| ***EFgrid*** | Emission factor | $CO_2$ emission factor of generation | $tCO_2/$ | C | Once during PDD | 100% | Paper | -do- | Project has calculated emission |

| ID number | Data type | Data variable | Data unit | Measured (m), calculated (c) or estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | For how long is archived data to be kept? | Comment |
|---|---|---|---|---|---|---|---|---|---|
| | | mix of the grid | | | | | | | factor of the grid according to the given formulae (4) described in Section E |
| ***EFin-house*** | Emission factor | $CO_2$ emission factor of current generation mix of the unit (in-house) | $tCO_2$/ | C | Annual | 100% | Paper | -do- | Emission factor fir the in-house electricity would be calculate based on equation no. 5 |
| ***EFy*** | Emission factor | $CO_2$ emission factor of current mix of the electricity being used by the measures included in the project activity | $tCO_2$/ | C | Annual | 100% | Paper | -do- | Emission factor of current mix of the electricity being used by the measures included in the project activity would be calculate based on equation no. 3 |

**Calculation procedure followed:**

***Formulae Applied***

**For measure involve replacement of lamps across the mill**

$$EB_y = \Sigma_i ((P_{base,i} - P_{project,i}) * O_{hrs,\ actual}) \quad (1)$$

Where,

$\mathbf{EB_y}$ = Annual energy saved by the project (GWh/yr)

$\mathbf{\Sigma_i}$ = the sum over the group of "i" devices replaced (lamps), for which the replacement is operating during the year, implemented as part of the project.

$\mathbf{P_{base,i}}$ = power used by the devices/ equipment of the group of "i" devices replaced (lamps) **(at the baseline)** (kW).

$\mathbf{P_{project,i}}$ = power used by the devices/ equipment of the group of "i" devices (lamps)newly installed **(at the project scenario)** (kW).

$\mathbf{O_{hrs,\ actual}}$ = the actual annual burning hours of the devices of the group of "i" devices (lamps) replaced or retrofitted. (Hours)

**For measures involve replacement of equipments that are operated without significant change of connected load**

$$EB_y = \Sigma_i ((P_{base,i} - P_{project,i}) * O_{hrs,\ actual}) \quad (2)$$

$$\mathbf{P_{project,i} = Energy_{project}/O_{hrs,\ actual}} \quad \mathbf{(2a)}$$

Where,

$\mathbf{EB_y}$ = Annual energy saved by the project (GWh/yr)
$\mathbf{\Sigma_i}$ = the sum over the group of "i" devices retrofitted (pumps, fans, etc), for which the replacement is operating during the year, implemented as part of the project.
$\mathbf{P_{base,i}}$ = power used by the devices/ equipment of the group of "i" devices retrofitted (pumps, fans, etc) **(at the baseline)** (kW), recorded based on a period of one month monitoring prior to the implementation of the project (ex-ante baseline fixation).
$\mathbf{P_{project,i}}$ = average hourly power used by the devices/ equipment of the group of "i" devices newly installed **(at the project scenario)** (kW).
$\mathbf{Energy_{project}}$ = monthly electricity consumed by the devices/ equipment of the group of "i" for the project monitoring period (kWh)
$\mathbf{O_{hrs,\ actual}}$ = the actual monthly operating hours of the devices of the group of "i" devices replaced or retrofitted. (Hours)

**<u>For the measures that involves installation of power correction equipments operated at variable connected load</u>**

$$EBy = \Sigma_i\ (P_{base,i} - P_{project,i}) * O_{hrs,\ actual} \qquad (3)$$

Where: -

$\mathbf{P_{base,i}}$ = power used by the devices/ equipment of the group of "i" devices retrofitted (pumps, fans, etc) **(at the baseline)** (kW) and calculated as **($\mathbf{Energy_{base}}$/ $\mathbf{O\text{-}hrs_{corresponding,3}}$) (3a)**

$\mathbf{Energy_{base}}$ - Total electricity consumed during the three consecutive days of continuous operation in a month without the harmonic filter/ capacitor bank (in switched off mode) (kWh).

$\mathbf{O\text{-}hrs_{corresponding,\ 3}}$ - Corresponding operating hours for the 3 consecutive days of continuous operation for baseline establishment
$\mathbf{O\text{-}hrs_{actual}}$ – Actual operating hours in the given month.

$$P_{project} = (Energy_{project} / O_{hrs,\ corresponding}) \qquad (3,\ a)$$

Where:

$\mathbf{P_{project}}$ = Energy consumed at project ($Energy_{project}$, kWh) and is the monthly recording of the metered energy consumed by the equipment with harmonic filter/ capacitor bank (less 3 days of the month for baseline energy measurement) and recording the corresponding operating hours of the equipment during the month (kW).

$O_{hrs,\ corresponding}$ - Corresponding operating hours for the month less 3 consecutive days of baseline monitoring

**<u>Only for Electronic Governor</u>**

$$P_{base} = P_{project} * (F_{base} / F_{project})^3 \qquad (3,b)$$

Where

$\mathbf{P_{base}}$ = Power generated at baseline (kWh)
$\mathbf{P_{project}}$ = (kWh) is the recorded monthly generation by the TG with electronic governor at a frequency of $\mathbf{F_{project}}$ (Hz) (recorded monthly average).
$\mathbf{F_{base}}$ = (Hz) is recorded before installation of electronic governor based on monitoring for a period of month (49.89). Note - Power is proportional to cube of frequency.

**Leakage** is calculated as the sum of devices of group "i" replaced or retrofitted of power "$p_i$" multiplied by average annual operation hours "$o_i$" of the devices.

$$EL_y = \Sigma_i(Equi_i * O_{hrs}) \quad (4)$$

Where,
***ELy*** = Annual leakage (kWh/yr)
$\Sigma_i$ = the sum over the group of "i" devices retained and used, for which the replacement is not operating during the period, implemented as part of the project.
**Equ$_i$** = the rated power of devices of the group of "i" devices replaced or retrofitted for which the replacement is not operating during the period (kW).
**O$_{hrs}$** = the average annual operating hours of the devices of the group of "i" devices replaced or retrofitted. (Hours)

$$ERy = (EB,y - EL,y) * EFy \quad (5)$$

Where:
**ER$_y$** = Emission Reduction from the project ($tCO_2$ equ)
**EBy** = Annual energy saved by the project in kWh per year
**ELy** = Annual leakage from the project in kWh per year
**EF$_y$** = Emission Factor of the electricity mix of the unit ($tCO_2$/GWh)

*Where:*

$$EFy = (EFgrid * Egrid + EFin\text{-}house * Ein\text{-}house) / (Egrid + Ein\text{-}house) \quad (6)$$

Where:
**EF$_y$** = Emission Factor of the electricity mix of the unit ($tCO_2$/GWh)
**EF$_{grid}$** = Emission Factor for the grid electricity used ($tCO_2$/GWh) - fixed ex-ante during PDD preparation
**E$_{grid}$** = Total grid electricity imported in the year 'y' (GWh)
**E$_{in\text{-}house}$** = Total in-house electricity generated in the year 'y' (GWh)
**EF$_{in\text{-}house}$** = Emission Factor for the in-house electricity used ($tCO_2$/GWh) monitored ex-post

*Where:*

$$EF_{in\text{-}house} = FF_{i,y} * COEF_{FF,i} / E_{in\text{-}house} \quad (7)$$

Where:
$FF_{i,y}$ = Amount of fossil fuel by type 'i' required to generate electricity in the year 'y' (MT)
The $CO_2$ emission coefficient $COEF_i$ is obtained as [1]

$$COEF_{FF,i} = NCV_{FF,i} * EF_{CO2}, FF_{,i} * OXID_{FF,i} \quad (8)$$

Where:
$NCV_{FF,i}$ = Net calorific value (kcal per mass or volume unit) of the fossil fuel
$OXID_{FF,i}$ = Oxidation factor of the fossil fuel (IPCC default)
$EFCO_{2,FF,i}$ = $CO_2$ emission factor per unit of energy of the fossil fuel (IPCC default) [2]

**Organizational structure, roles and responsibilities of personnel, and emergency procedures for the monitoring system:**

ITC PSPD had deputed a team of qualified engineers to conceive, install and make operational the whole project. The General Manager (production) would be assisted by his group of service and maintenance managers to implement the monitoring plan. The management structure for this project would be integrated with the ISO system in vogue at the plant.

1 The density of Diesel in ER calculation sheet is 0.83 from CEA Database Version 5

2 Conversion factor from Calorie to Joule is 1Cal = 4.186J from http://www.engineeringtoolbox.com/unit-converter-d_185.html#Energy

Monitoring Approach

The general monitoring principles are based on:

⇒ The frequency of monitoring of the critical parameters according to the approved methodology ACM0006The reliability of the data monitored
⇒ The archiving of the data collected

Frequency of monitoring

The project developer has installed all metering facilities within the plant premises. The measurements are monitored and controlled on a continual basis per day in a Distributed Control System (DCS). In case of non-availability of data from DCS due to unforeseen situations, the desired data shall be logged in log sheets by operator duly authenticated by head of plant

Reliability of the data

Measurement devices are mostly of digital type meters, having best accuracy and has been procured from reputed manufacturers. Since the reliability of the monitoring system is governed by the accuracy of the measurement system and the quality of the equipment for reproducibility, all instruments are calibrated once a year for ensuring reliability of the system. All instruments carry tag plates, which indicate the date of calibration and the date of next calibration. Therefore it ensures the monitoring system is highly reliable.

Archiving of data

Daily and monthly archives are maintained as per the requirement. Integrated database on critical parameters are maintained as on-line database.

## SECTION D. Data and parameters

| **D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors** | |
|---|---|
| **Data / Parameter:** | $\sum Equ_i$ |
| Data unit: | Number |
| Description: | Numbers of devices replaced/ retrofitted of group "i" where "i" refers to pumps, lamps, compressors., etc |
| Source of data used: | Plant Records |
| Value(s) : | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline and Project |
| Additional comment: | - |

| **Data / Parameter:** | $\sum P_{ibase}$ |
|---|---|
| Data unit: | Kw |
| Description: | Rated Power of the device replaced/ retrofitted at the baseline |
| Source of data used: | Plant Records- Third party report by MKRC |

| | |
|---|---|
| Value(s) : | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline |
| Additional comment: | Only for lamps |

| | |
|---|---|
| **Data / Parameter:** | $\sum P_{j,Prj}$ |
| Data unit: | kW |
| Description: | Rated Power of the device installed as the project measures |
| Source of data used: | Plant Records- Third party report by MKRC |
| Value(s) : | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project |
| Additional comment: | Only for lamps |

| | |
|---|---|
| **Data / Parameter:** | $\sum P_{p,base}$ |
| Data unit: | kW |
| Description: | Actual energy consumed by the equipments at the baseline |
| Source of data used: | Plant Records- Daily for a period of one month prior to the implementation of the project measure |
| Value(s) : | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline |
| Additional comment: | For measures involve replacement of equipments that are operated without significant change of connected load<br>Equipments – Pumps, VFDs, Drives, Compressors |

| | |
|---|---|
| **Data / Parameter:** | $F_{base}$ |
| Data unit: | kW |
| Description: | Actual energy consumed by the equipments at the baseline |
| Source of data used: | Plant Records- Daily for a period of one month prior to the implementation of the project measure |
| Value(s) : | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline |
| Additional comment: | For measures involve replacement of equipments that are operated without significant change of connected load<br>Equipments – Pumps, VFDs, Drives, Compressors |

| **Data / Parameter:** | $COEF_{FFi}$ |
|---|---|
| Data unit: | $tCO_2/TJ$ |
| Description: | $CO_2$ emission co-efficient of each fuel (i) type use in-house |
| Source of data used: | IPCC default |
| Value(s) : | Coal- 89.5<br>Diesel-72.6 |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline, Project and leakage– Used for calculation of grid EF |
| Additional comment: | - |

| **Data / Parameter:** | $EF_{grid}$ |
|---|---|
| Data unit: | $tCO_2/GWh$ |
| Description: | $CO_2$ emission factor of current generation mix of the grid |
| Source of data used: | Calculated based on data on $\sum_k GEN_{k,y}$, FFi, COEFi<br>available from regional load despatch centre for the year 2004-2005 :<br>$EF_{grid} = [FF_i * COEF_i * 44/12] / [\sum_k GEN_{k,y}]$ |
| Value(s) : | 941 |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline, Project and leakage |
| Additional comment: | - |

| **D.2. Data and parameters monitored** | |
|---|---|
| **Data / Parameter:** | **$O_{hrs}$** |
| Data unit: | Hrs |
| Description: | Operating/ running hours of the replaced device (only for lamps) |
| Measured /Calculated /Default: | Measured |
| Source of data: | Plant records |
| Value(s) of monitored parameter: | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | Please refer to "annexure 1.xls" for details of monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) |
| Measuring/ Reading/ Recording frequency: | Daily |
| Calculation method (if applicable): | Not applicable |

| | |
|---|---|
| QA/QC procedures applied: | Monitoring equipments are calibrated at regular intervals as per the ISO system in place at the plant |

| **Data / Parameter:** | $\sum Energy_{project}$ |
|---|---|
| Data unit: | kWh |
| Description: | Actual energy consumed by the equipments after the implementation of the project measure (For measures involve replacement of equipments that are operated without significant change of connected load) |
| Measured /Calculated /Default: | Measured |
| Source of data: | IMIS Report |
| Value(s) of monitored parameter: | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | Please refer to "annexure 1.xls" for details of monitoring equipment (type, accuracy class, serial number, calibration frequency, dates of calibrations covering the entire monitoring period, validity) |
| Measuring/ Reading/ Recording frequency: | Measured continually and recorded monthly |
| Calculation method (if applicable): | Not applicable |
| QA/QC procedures applied: | Monitoring equipments are calibrated at regular intervals as per the ISO system in place at the plant |

| **Data / Parameter:** | $O_{-hrs,actual}$ |
|---|---|
| Data unit: | Hours |
| Description: | Operating/ running hours of the equipments based on operating hours of the parent machine or equipment (such as capacitor banks connected to NFL & SFT fibre lines, harmonic filter connected to paper machine, and electronic governor connected to the generator) |
| Measured /Calculated /Default: | Measured – shift wise downtimes are monitored and recorded and then subtracted from 24 hours to get the actual hours of operation. The summation of daily operating hours is compiled as monthly figure. |
| Source of data: | IMIS Report |
| Value(s) of monitored parameter: | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last | NA |

| | |
|---|---|
| calibration, validity) | |
| Measuring/ Reading/ Recording frequency: | Monthly |
| Calculation method (if applicable): | Not applicable |
| QA/QC procedures applied: | Monitoring is carried out as per the ISO system in place at the plant |

| | |
|---|---|
| **Data / Parameter:** | $Energy_{base}$ |
| Data unit: | kWh |
| Description: | Actual energy consumed by the load connected to the common line without equipment 'i' (in switched off mode) for any 3 consecutive days of continuous operation in a month<br>Equipment 'i' – Capacitor bank, harmonic filter (For the measures that involves installation of power correction equipments operated at variable connected load) |
| Measured /Calculated /Default: | Measured |
| Source of data: | Down loaded Data from Load Manager |
| Value(s) of monitored parameter: | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | Please refer to "annexure 1.xls" for details of monitoring equipment (type, accuracy class, serial number, calibration frequency, dates of calibrations covering the entire monitoring period, validity)<br>) |
| Measuring/ Reading/ Recording frequency: | Monthly reporting-Measured for any 3 consecutive days in a month |
| Calculation method (if applicable): | Not applicable |
| QA/QC procedures applied: | Monitoring equipments are calibrated at regular intervals as per the ISO system in place at the plant |

| | |
|---|---|
| **Data / Parameter:** | $O\text{-}hrs_{corresponding,3}$ |
| Data unit: | Hours |
| Description: | Corresponding operating hours for the 3 consecutive days for baseline monitoring when the equipment 'i' is not connected to the load |
| Measured /Calculated /Default: | Measured |
| Source of data: | Down loaded Data from Load Manager. |
| Value(s) of monitored parameter: | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project |
| Monitoring equipment (type, | Please refer to "annexure 1.xls" for details of monitoring equipment |

| | |
|---|---|
| accuracy class, serial number, calibration frequency, date of last calibration, validity) | (type, accuracy class, serial number, calibration frequency, dates of calibrations covering the entire monitoring period, validity) |
| Measuring/ Reading/ Recording frequency: | Monthly reporting-Measured for any 3 consecutive days in a month |
| Calculation method (if applicable): | Not applicable |
| QA/QC procedures applied: | Monitoring is carried out as per the ISO system in place at the plant |

| **Data / Parameter:** | $Energy_{project}$ |
|---|---|
| Data unit: | kWh |
| Description: | Actual energy consumed by the load connected to the common line with equipment 'i'Equipment 'i' – Capacitor bank, harmonic filter (For the measures that involves installation of power correction equipments operated at variable connected load) |
| Measured /Calculated /Default: | Measured |
| Source of data: | Down loaded Data from Load Manager |
| Value(s) of monitored parameter: | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | Please refer to "annexure 1.xls" for details of monitoring equipment (type, accuracy class, serial number, calibration frequency, dates of calibrations covering the entire monitoring period, validity) |
| Measuring/ Reading/ Recording frequency: | Monthly (less 3 days) then extrapolated for the total hours of operation in month |
| Calculation method (if applicable): | Not applicable |
| QA/QC procedures applied: | Monitoring equipments are calibrated at regular intervals as per the ISO system in place at the plant |

| **Data / Parameter:** | $O\text{-}_{hrs,actual}$ |
|---|---|
| Data unit: | Hours |
| Description: | Operating/ running hours of the equipments based on operating hours of the parent machine or equipment (For the measures that involves installation of power correction equipments operated at variable connected load such as Capacitor banks connected to NFL, harmonic filters connected to paper machine, and electronic governor connected to the generator) |
| Measured /Calculated /Default: | Measured - shift wise downtimes are monitored and recorded and then subtracted from 24 hours to get the actual hours of operation. The summation of daily operating hours is compiled as monthly figure. |
| Source of data: | IMIS Report |

| | |
|---|---|
| Value(s) of monitored parameter: | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | NA |
| Measuring/ Reading/ Recording frequency: | Monthly |
| Calculation method (if applicable): | Not applicable |
| QA/QC procedures applied: | Monitoring is carried out as per the ISO system in place at the plant |

| | |
|---|---|
| **Data / Parameter:** | $O\text{-}_{hrs,corresponding}$ |
| Data unit: | Hours |
| Description: | Corresponding operating hours for the month when the equipment 'i' is switched on |
| Measured /Calculated /Default: | Measured |
| Source of data: | IMIS Report |
| Value(s) of monitored parameter: | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | NA |
| Measuring/ Reading/ Recording frequency: | Monthly-Measured for days in a month corresponding to measurement *Of* $Energy_{project}$*:* shift wise downtimes are monitored and recorded and then subtracted from 24 hours to get the actual hours of operation. The summation of daily operating hours is compiled as monthly figure. |
| Calculation method (if applicable): | Not applicable |
| QA/QC procedures applied: | Monitoring is carried out as per the ISO system in place at the plant |

| | |
|---|---|
| **Data / Parameter:** | $F_{project}$ |
| Data unit: | Hz |
| Description: | Frequency at which the TG2 is operated in line with the electronic governor (Only for electronic governor) |
| Measured /Calculated | Measured |

| | |
|---|---|
| /Default: | |
| Source of data: | Log Books |
| Value(s) of monitored parameter: | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | Please refer to "annexure 1.xls" for details of monitoring equipment (type, accuracy class, serial number, calibration frequency, dates of calibrations covering the entire monitoring period, validity) |
| Measuring/ Reading/ Recording frequency: | Monthly |
| Calculation method (if applicable): | Not applicable |
| QA/QC procedures applied: | Monitoring equipments are calibrated at regular intervals as per the ISO system in place at the plant |

| | |
|---|---|
| **Data / Parameter:** | $E_{grid}$ |
| Data unit: | GWh |
| Description: | Electricity imported from the grid |
| Measured /Calculated /Default: | Measured |
| Source of data: | IMIS report |
| Value(s) of monitored parameter: | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | Please refer to "annexure 1.xls" for details of monitoring equipment (type, accuracy class, serial number, calibration frequency, dates of calibrations covering the entire monitoring period, validity) |
| Measuring/ Reading/ Recording frequency: | Annual |
| Calculation method (if applicable): | Not applicable |
| QA/QC procedures applied: | Monitoring equipments are calibrated at regular intervals as per the ISO system in place at the plant |

| | |
|---|---|
| **Data / Parameter:** | $E_{inhouse}$ |
| Data unit: | GWh |
| Description: | Electricity generated in-house |
| Measured /Calculated /Default: | Measured |
| Source of data: | IMIS report |
| Value(s) of monitored | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and |

| | |
|---|---|
| parameter: | "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | Please refer to "annexure 1.xls" for details of monitoring equipment (type, accuracy class, serial number, calibration frequency, dates of calibrations covering the entire monitoring period, validity) |
| Measuring/ Reading/ Recording frequency: | Annual |
| Calculation method (if applicable): | Not applicable |
| QA/QC procedures applied: | Monitoring equipments are calibrated at regular intervals as per the ISO system in place at the plant |

| **Data / Parameter:** | $FF_{i,}$ |
|---|---|
| Data unit: | MT |
| Description: | Annual quantity of coal utilized by the project |
| Measured /Calculated /Default: | Measured |
| Source of data: | IMIS report |
| Value(s) of monitored parameter: | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | Please refer to "annexure 1.xls" for details of monitoring equipment (type, accuracy class, serial number, calibration frequency, dates of calibrations covering the entire monitoring period, validity) |
| Measuring/ Reading/ Recording frequency: | Monthly |
| Calculation method (if applicable): | Not applicable |
| QA/QC procedures applied: | Monitoring equipments are calibrated at regular intervals as per the ISO system in place at the plant |

| **Data / Parameter:** | $NCV_{FFi}$ |
|---|---|
| Data unit: | kCal/kg |
| Description: | Average gross calorific value of coal |
| Measured /Calculated /Default: | Calculated |
| Source of data: | IMIS report |
| Value(s) of monitored parameter: | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission | Project |

| | |
|---|---|
| calculations) | |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | Please refer to "annexure 1.xls" for details of monitoring equipment (type, accuracy class, serial number, calibration frequency, dates of calibrations covering the entire monitoring period, validity) |
| Measuring/ Reading/ Recording frequency: | Monthly |
| Calculation method (if applicable): | The NCV will be determined based the followi[3]ng formula –<br>NCV = GCV – 10.2*Moisture % |
| QA/QC procedures applied: | Monitoring is carried out as per the ISO system in place at the plant |

| **Data / Parameter:** | $EF_{inhouse}$ |
|---|---|
| Data unit: | $tCO_2/GWh$ |
| Description: | Emission Factor for the in-house electricity generation |
| Measured /Calculated /Default: | Calculated |
| Source of data: | IMIS report |
| Value(s) of monitored parameter: | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | NA |
| Measuring/ Reading/ Recording frequency: | Monthly |
| Calculation method (if applicable): | $EF_{in\text{-}house} = FF_{i,y} * COEF_{FF,i} / E_{in\text{-}house}$ |
| QA/QC procedures applied: | Monitoring equipments are calibrated at regular intervals as per the ISO system in place at the plant |

| **Data / Parameter:** | $EF_y$ |
|---|---|
| Data unit: | $tCO_2/GWh$ |
| Description: | $CO_2$ emission factor of current mix of the electricity (in house and grid) being used by the measures included in the project activity |
| Measured /Calculated /Default: | Calculated |
| Source of data: | IMIS report |
| Value(s) of monitored parameter: | Please refer to "BCHM Encon M & V Results_16.04.2012.xls" and "CDM ENCON #0806" for details |

[3] The GCV value used in the NCV calculation is taken from ITC's Central Laboratory. The GCV is determined by following a standard procedure in accordance with the book titled "Coal After Nationalisation" published by M/s. Coal India Ltd. The instruments used in this procedure are Digital Balance (for measuring mass of sample at different stages of analysis), Hot Air Oven (for drying of the fuel sample to find out moisture content), & Muffle Furnace (for burning the sample & finding out ash content).

| | |
|---|---|
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | NA |
| Measuring/ Reading/ Recording frequency: | Annually |
| Calculation method (if applicable): | $EFy = (EF_{grid} * E_{grid} + EF_{in\text{-}house} * E_{in\text{-}house}) / (E_{grid} + E_{in\text{-}house})$ |
| QA/QC procedures applied: | Monitoring is carried out as per the ISO system in place at the plant |

## SECTION E. Emission reductions calculation

### E.1. Baseline emissions calculation

>>

Please refer to excel spreadsheet BCHM Encon M & V Results_16.04.12.xls for details of formulae used and initiative wise description of calculation of baseline emissions

### E.2. Project emissions calculation

>>

Please refer to excel spreadsheet BCHM Encon M & V Results_16.04.12.xls for details of formulae used and initiative wise description of calculation of project emissions

### E.3. Leakage calculation

>>

Please refer to excel spreadsheet BCHM Encon M & V Results_16.04.12.xls for details of formulae used and initiative wise description of calculation of leakage emissions

### E.4. Emission reductions calculation / table

>>

Formulae used to calculate emission reductions:

$ER_y = (EB,_y – EL,_y) * EF_y$

Where:

$ER_y$ = Emission Reduction from the project ($tCO_2$ equ)
$EB,_y$ = Annual energy saved by the project in kWh per year
$EL,_y$ = Annual leakage from the project in kWh per year
$EF_y$ = Emission Factor of the electricity mix of the unit ($tCO_2/GWh$)

For 01/09/2010 to 31/12/2010:

$EB_y$ = 3486695 kWh
$EL,_y$ = 41378 kWh
$EF_y$ = 1428 $tCO_2/GWh$

$ER_y$ = (3486695- 41378)/10^6* 1428 = 4920 $tCO_{2e}$

For 01/01/2011 to 31/12/2011

$EB_y$ = 15453306 kWh
$EL_{,y}$ = 20643 kWh
$EF_y$ = 1264 $tCO_2$/GWh

$ER_y$ = (15453306 - 20643)/10^6* 1264 = 19510 tCO2e

Total Emission Reductions achieved during the monitoring period:

| Year | Baseline Emission ($tCO_2e$) | Total Electricity saved (GWh) | Project Emission (tCO2e) | Leakage (tCO2e) | Total Emission Reduction (tCO2e) |
|---|---|---|---|---|---|
| 01/09/2010-31/12/2010 | 4980 | 3.5 | 0 | 59 | 4920 |
| Year | Baseline Emission ($tCO_2e$) | Total Electricity saved (GWh) | Project Emission (tCO2e) | Leakage (tCO2e) | Total Emission Reduction (tCO2e) |
| 01/01/2011-31/12/2011 | 19536 | 15.5 | 0 | 26 | 19510 |
| Year (Total) | Baseline Emission ($tCO_2e$) | Total Electricity saved (GWh) | Project Emission (tCO2e) | Leakage (tCO2e) | Total Emission Reduction (tCO2e) |
| 01/09/2010- 31/12/2011 | 24516 | 18.9 | 0 | 85 | 24430 |

## E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

>>

| Item | Values applied in ex-ante calculation of the registered CDM-PDD | Actual values reached during the monitoring period |
|---|---|---|
| **Emission reductions ($tCO_2e$)** | 21505 for 12 months i.e. 18673 extrapolated for 16 months | 01/09/2010 to 31/12/2010-4920<br>01/01/2011 to 31/12/2011- 19510<br><br>i.e. 24430 for the entire monitoring period 01/09/2010 to 31/12/2011 |

## E.6. Remarks on difference from estimated value in the PDD

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There has been a 14.8 % decrease in CER on an average during the period (01/09/2010 to 31/12/2011) on account of decrease in the emission factor of the electricity mix. The decrease in the emission factor is owing to use of higher percentage of Black Liquor Solids , a biomass residue, in the fuel mix of the in –house cogeneration plant due to the installation and full load operation of the new Soda Recovery Boiler. Also, besides full load operation of the soda recovery boiler, another new boiler fired with biomass residues of plantations has been installed which has also impacted the in-house emission factor of electricity leading to reduction of the emission factor of the electricity mix.

**History of the document**

| Version | Date | Nature of revision |
|---|---|---|
| 01 | EB 54, Annex 34<br>28 May 2010 | Initial adoption. |
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