**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.<br>• 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:

>>

"Methane recovery from waste water generated from wheat straw wash at Paper manufacturing unit of Shreyans Industries Limited (SIL)" Ahmedgarh, District Sangrur, Punjab.

Version 03,

26th October 2006

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

>>

**Purpose of the Project Activity**

The project activity is the installation of a high rate Upflow anaerobic sludge blanket (UASB) digester which captures methane and burns it for generating steam in boilers. SIL's paper manufacturing unit at Ahmedgarh has an annual installed capacity of 33,000 Metric Tonnes (MT) of paper per annum. Paper manufacturing being a water intensive process produces large quantity of waste water with high percentage of chemical oxygen demand (COD). Waste stream from raw wheat straw wash which is having following characteristics is treated in existing anaerobic lagoons followed by aerobic treatment.

| Source of Waste Water | Volume ($m^3$/day) | COD (mg/lit) | Treatment |
|---|---|---|---|
| Wheat straw wash | 2000 | 7000 | Anaerobic |

Treatment in anaerobic lagoon is open to atmosphere and releases methane. Installation of UASB digester in project activity would capture methane produced due to anaerobic reactions and flare/burn it. The effluent from digester would then be treated aerobically so as to reduce the COD further to meet the statutory requirement of effluent discharge.

**Project's Contribution to Sustainable Development**

The project activity construction and commissioning of a UASB digester and associated units will give employment opportunities to labours during construction in vicinity of plant.

The existing open lagoon emanates large quantity of methane into the atmosphere which is a potent GHG. Introduction of UASB digester in project activity would capture methane, thereby mitigating emissions of GHG.

The stench which emanates from open lagoon due to anaerobic decomposition of carbonaceous material would get reduced after UASB digesters will be commissioned.

The project activity would supply biogas produced to boilers for generating heat and electricity thereby reducing rice husk requirement in the manufacturing unit which is presently being used as fuel in boilers. Reduction in rice husk quantity to be procured would reduce operational cost of the boilers and prove economical for manufacturing facility.

**A.3. Project participants:**

>>

| Name of Party involved (host indicates a host | Private and/or public entity(ies) project participants (as applicable) | Kindly indicate if the Party involved wishes to be considered as project |
|---|---|---|
| India (Host) | Shreyans Industries Limited (SIL) | 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.:**

>>
Punjab

**A.4.1.3. City/Town/Community etc:**

>>
Ahmedgarh, Sangrur District

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

>>
The project activity is located within premises of paper manufacturing unit of SIL at Ahmedgarh in Sangrur district in Punjab. The nearest airport is located at Ludhiana which is about 35 Km from the plant site. The nearest railway station at Ahmedgarh is about 3 Km from the plant. The geographic location of the plant is depicted in the following map.


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

>>

This project activity falls under Type –III " other project activities" and category H " Methane recovery " as specified in indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories.

The project activity, installation of high rate UASB reactor reduces both emissions by sources by recovering methane and directly emits less than 15 kilo tons of carbon di oxide equivalent per year and thus qualify under the above mentioned project type and category.

The project activity would capture methane in UASB reactor and stores it in gas holders. In absence of the project activity the methane generated in anaerobic lagoon would have been emitted into the atmosphere. Direct emissions attributed due to the project activity include following

- CO2 emissions related to the power used by the project activity facilities.
  (Emission factors for grid electricity has been calculated as described in category I.D)
- Methane emissions through inefficiency of the wastewater treatment and presence of degradable organic carbon in treated wastewater.
- Methane emissions from the decay of the final sludge generated by the treatment systems.
- Methane fugitive emissions through inefficiencies in capture and flare systems.

Estimation of the project and baseline emissions has been done using “Methane recovery in waste water treatment” Methodology Type-III.H. Version 03, 28th July 2006. Table given below depicts the results

| Crediting Year | Project Emissions $tCO_2$ e |
|---|---|
| 2006-2007 | 9,031 |
| 2007-2008 | 9,031 |
| 2008-2009 | 9,031 |
| 2009-2010 | 9,031 |
| 2010-2011 | 9,031 |
| 2011-2012 | 9,031 |
| 2012-2013 | 9,031 |
| 2013-2014 | 9,031 |
| 2014-2015 | 9,031 |
| 2015-2016 | 9,031 |

It is evident from table that project emissions over 10 year crediting period do not exceed 15 kilo tons/annum, hence project activity qualify as a small scale activity under Type-III activities.

SIL after considering various technology for treating low and medium strength wastewater with high volumetric loading rates decided to deploy Up Flow anaerobic sludge blanket reactor (UASB) for treating their wheat straw wash stream.

**Description**

The wheat straw wash wastewater from wet cleaning plant will be sent through a filter to clarifier unit to remove the inert materials. The clarified effluent shall then enter buffer tank (BT) to maintain pH of the digester, temperature control, and constant feed to the digester. The digester which is a large Reinforced Cement Concrete (RCC) tank is provided with a Gas, sludge and effluent separator. The effluent distribution network is placed at the bottom of the digester for ensuring proper intermingling of the influent with sludge and recycled effluent. Methane generated would be separated by gas separator and pass through a foam trap to gas holder.

**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 captures methane generated from anaerobic decomposition of wheat straw wash effluent in UASB reactor that would otherwise be released into the atmosphere from open lagoons. Although ministry of environment and forest, Government of India has stipulated standards for discharging waste water, deploying advanced technologies like UASB is not mandatory by law to achieve standards. In absence of project activity SIL would have continued treating its waste stream in existing anaerobic lagoons

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

>>

| **Years** | **Annual estimation of emission reductions in tonnes of $CO_2$ e** |
|---|---|
| 2006-2007 | 12,578 |
| 2007-2008 | 12,578 |
| 2008-2009 | 12,578 |
| 2009-2010 | 12,578 |
| 2010-2011 | 12,578 |
| 2011-2012 | 12,578 |
| 2012-2013 | 12,578 |
| 2013-2014 | 12,578 |
| 2014-2015 | 12,578 |
| 2015-2016 | 12,578 |
| **Total estimated reductions** (tonnes of $CO_2$ e) | 125,780 |
| **Total number of crediting years** | 10 |
| **Annual average over the crediting period of estimated reductions (**(tonnes of $CO_2$ e) | 12,578 |
| | |

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

>>

No public funding from parties included in Annex I is available to the project activity.

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

>>

As per appendix –c of the indicative simplified modalities and procedure for small scale CDM project activity. A project activity is considered to be a debundled component of large project activity if there is a registered small scale CDM project or request for registration by another small scale project activity

- By the same project participants;
- In the same project category and technology/measure; and
- 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.

Since above points are not applicable in case of SIL project activity, it can be said that the small scale project activity of SIL is not a debundled component of a large project activity, hence eligible to use simplified baseline and monitoring methodology.

## 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: "Methane recovery in waste water treatment" Methodology Type-III.H. Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories.

Version 03,

28th July 2006

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

>>
As per indicative simplified modalities and procedures for small-scale CDM project activities, project activity of SIL falls under Type–III.H. "other project activities" and category "Methane recovery". Project activity fulfils applicability criteria illustrated in section A.4.2. above, and eligible to use methodology Type-III.H. "Methane recovery in Waste Water".

Baseline scenario for the project activity is existing anaerobic treatment system with out methane recovery and combustion. Baseline emission scenario for the project activity consists of the methane generation potential of the untreated wastewater and or sludge

$BE_y = (ME_{y,ww,untreated} + ME_{y,s,untreated}) * GWP\_CH_4$

Where:

$ME_{y,ww,untreated}$ methane emission potential of the untreated wastewater in the year "y" (tonnes)

$ME_{y,ww,untreated} = Q_{y,ww} * COD_{y,ww,untreated} * B_{o,ww} * MCF_{ww,untreated}$

### 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:

>>
The project activity which would have estimated annual direct anthropogenic emissions of less than 15,000 tons of CO2 equivalent and would not be a de-bundled component of a large CDM project activity can use Type III.H. simplified baseline and monitoring methodology listed in indicative simplified modalities and procedures for small scale CDM project activity.

In absence of the project activity there would be continued emissions of methane into the atmosphere from open lagoon. Although the project activity faces barriers illustrated in paragraphs below, SIL has been implementing the project activity considering benefits that may accrue as a result of registration of the project activity as CDM project.

**Barriers to the project activity**

**Technological Barrier**

Methane generation in the UASB digester is dependent on the quantum of raw COD and subjected to ambient and wastewater temperature and their variations. The anaerobic bacterial culture in the digester which is responsible for digestion of organic matter in the waste water gets adversely affected with even 3-5$^{0}$C fluctuation in the reactor. In a country like India where high seasonal temperature variation persist installation of a temperature sensitive technology may prove risky because temperature variation may result in damaging bacterial film in the reactor and thus making digester futile.

Biogas generated in digesters mainly consist of methane, presence of hydrogen sulphide in the biogas which gets generated in anaerobic conditions makes biogas corrosive. Desulphurisation is required to remove corrosive hydrogen sulphide from biogas which would otherwise corrode digester, gasholders and boilers. Installation of a desulphurisation unit requires additional expenses which eventually reduce financial viability of a UASB technology and acts as a barrier.

**Barrier due to prevailing Practice**

The UASB technology was introduced in India in late eighties for treating waste water of high COD content. Disadvantages enumerated below associated with its operations have prevented its widespread use in Industry in India.

- Requirement of secondary treatment to bring down the COD of waste to stipulated discharge standards.
- The effluent from UASB is highly Anoxic and it exerts high immediate oxygen demand (IOD) on the receiving water body or land.

The project activity is first[1] of its kind initiative in India[2] wherein waste water from wheat straw wash would be treated in a UASB digester and gas liberated would be recovered and burnt.

**Other Barrier**

**Resource barrier**

[1] Satia Paper Mills Limited had a Biomethanation plant in Punjab which was used for treating black liquor.

[2] Source : Indian Pulp and Paper Technical Association (IPPTA),

SIL's main activity is paper manufacturing and it has considerable experience and repute in this field in the region. Employees of SIL are experienced and skilled in paper manufacturing and do not have experience in waste water treatment technologies like UASB. Commissioning of UASB digester at paper manufacturing unit for effluent treatment requires training to be imparted to SIL employee for operating UASB digester. Since, UASB technology is not a widespread technology in India there is lack of trained manpower for manning digester, operations of digester by untrained employees can be perilous to digesters operation. Hence it can be said that unavailability of trained manpower is a barrier in project implementation.

**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 for SIL activity include physical and geographical site of Effluent stream, UASB digester, Gas holders and boiler where the gas will burn. Anthropogenic baseline emissions included in the project boundary are emission from anaerobic lagoon which would have been there in absence of the project activity. Project emissions included in the project boundary are as follows:

(i) $CO_2$ emissions related to the power used by the project activity facilities.

Emission factors for grid electricity or diesel fuel use as the case may be shall be calculated as described in category I.D.

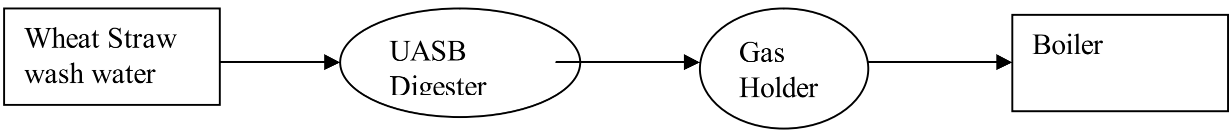
(ii) Methane emissions through inefficiency of the wastewater treatment and presence of degradable organic carbon in treated wastewater.

(iii) Methane emissions from the decay of the final sludge generated by the treatment systems.

(iv) Methane fugitive emissions through inefficiencies in capture and flare systems.

(v) Methane emissions resulting from dissolved methane in the treated wastewater effluent.

Following diagram depicts physical units included in the project boundary.




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

>>

Baseline for the project activity has been developed using methodology Type III.H. listed in simplified modalities and procedure for small scale CDM project activity.

Date of completion of Baseline: 20/04/06

Name of the person/entity determining baseline: Shreyans Industries Limited.

## 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:

>>
18/08/2005

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

>>
25 Years

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

>>
The project activity will use the fixed crediting period.

### C.2.1. Renewable crediting period:

>>
Not selected

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

>>
Not selected

### C.2.1.2. Length of the first crediting period:

>>
Not selected

### C.2.2. Fixed crediting period:

>>
10 years

### C.2.2.1. Starting date:

>>
01/09/2006

### 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:

>>

**Title**: "Monitoring Methodology for Methane Recovery from Waste Water" Type. III.H.

**Reference:** Monitoring plan for the project activity has been prepared according to the guidelines given in paragraph 8, 9, 10 and 11 of Type.III.H. simplified baseline and monitoring methodology.

Monitoring plan for the project activity includes flow of waste water entering digester, inlet COD, Outlet COD and methane recovered fuelled/flared in the project activity.

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

>>

This project activity falls under Type –III " other project activities" and category H " Methane recovery " as specified in indicative simplified baseline and monitoring methodologies for selected small scale CDM project activity categories.

The project activity, installation of high rate UASB reactor reduces both emissions by sources by recovering methane and directly emits less than 15 kilo tons of carbon di oxide equivalent per year. It is also proved above in section A.4.5.that project activity of SIL is not a debundled component of large project activity thus qualify under the above mentioned project type and category.

### D.3 Data to be monitored:

>>

**Data to be monitored for calculating project and Baseline emissions**

| Sl.No. | Data Variable | Data unit | Source of data | Measured (m), calculated © or estimated (e) | Recording frequency | How will the data be archived? (electronic/ paper) | Comment |
|---|---|---|---|---|---|---|---|
| *D.3.1* | Flow rate of waste straw wash | $M^3$/day | Plant | M | Daily | CP+2Yr. Paper | Baseline emission calculation |
| *D.3.2* | COD (inlet) | Mg/litre | Lab | M | Daily | CP+2Yr. Paper | Baseline emission calculation |
| *D.3.3* | COD (outlet) | Mg/litre | Lab | M | Daily | CP+2Yr. Paper | Baseline emission calculation |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *D.3.4* | Electricity consumption | Million Kwh | Plant | M | Daily | CP+2Yr. Paper | Baseline emission calculation |
| *D.3.5* | Temperature of gas | $^0C$ | Plant | M | Daily | CP+2Yr. Paper | Baseline emission calculation |
| *D.3.6* | Pressure of gas | $kg/Cm^2$ | Plant | M | Daily | CP+2Yr. Paper | Baseline emission calculation |
| *D.3.7* | Volume of gas | $M^3$ | Plant | M | Daily | CP+2Yr. Paper | Baseline emission calculation |
| *D.3.8* | Quantity of Gas | Tons | Plant | C | Daily | CP+2Yr. Paper | Baseline emission calculation |
| *D.3.9* | Methane Quantity generated | Tons | Plant | C | Daily | CP+2Yr. Paper | Baseline emission calculation |
| *D.3.10* | Biogas fuelled | Tons | Plant | M | Daily | CP+2Yr. Paper | Baseline emission calculation |

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

>>

Quality control (QC) and quality assurance (QA) procedures would be undertaken for data to be monitored. (data items in tables contained in section D.3 (a to b) above, as applicable)

| **Data** | **Uncertainty level of data (High/Medium/Low)** | **Are QA/QC procedures planned for these data?** | **Explain QA/QC procedures planned for these data, or why such procedures are not necessary.** |
|---|---|---|---|
| D.3.1 | Low | Yes | Flow rate measurement is essential for calculation of both baseline and project emissions. Flow meters complying with standards should be used for monitoring. |
| D.3.2 | Medium | Yes | COD (Inlet) is a measure of methane generation potential of untreated waste water and is essential for calculating both baseline and project emissions. Analysis will be done in laboratory for measurement. Standard procedures would be used for measurement. |
| D.3.3 | Medium | Yes | COD (outlet) is a measure of methane generation potential of treated waste water from digester and is essential for calculating project emissions. Analysis will be done in laboratory for measurement. Standard procedures would be used for measurement. |
| D.3.4 | Low | Yes | Electricity consumption would be measured by meters provided at plant. |
| D.3.5 | Low | Yes | Temperature of gas is to be monitored for calculating the weight of biogas produced. |
| D.3.6 | Low | Yes | Pressure of gas is to be monitored for calculating the weight of biogas produced. |
| D.3.7 | Low | Yes | Pressure of gas is to be monitored for calculating the weight of biogas produced. |

| Data | Uncertainty level of data (High/Medium/Low) | Are QA/QC procedures planned for these data? | Explain QA/QC procedures planned for these data, or why such procedures are not necessary. |
|---|---|---|---|
| D.3.8 | Medium | No | Quantity of gas produced is computed from its volume, temperature and pressure condition. |
| D.3.9 | Medium | Yes | Methane quantity is computed from the fraction of methane present in Biogas. Methane fraction is to be calculated in laboratory. |
| D.3.10 | Low | No | Quantity of Biogas fuelled or flared gives an estimate of methane quantity flared. |

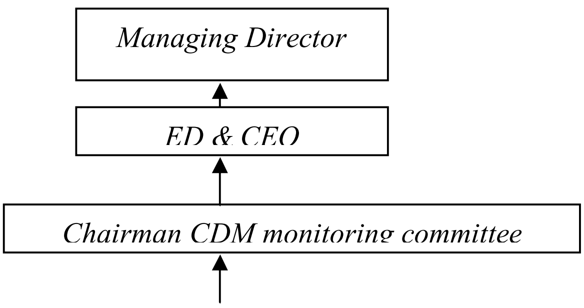
**D.5. Please describe briefly the operational and management structure that the project participant(s) will implement in order to monitor emission reductions and any leakage effects generated by the project activity:**

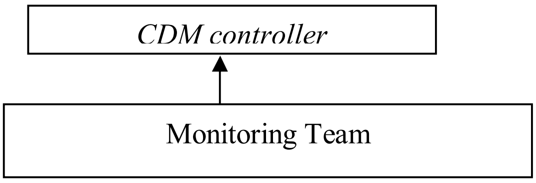
>>

SIL has planned an operation and management structure for the project activity with roles and responsibilities of individuals defined. The management would be responsible for monitoring and reporting of the parameters involved. All parameters would be monitored and reported in a transparent manner so that they can be easily verified by DOE.

SIL constituted a CDM monitoring team which would be responsible for the overall monitoring and management of the projects. CDM team comprises of monitoring supervisors having responsibility of operating and monitoring the plant. Parameters involved in the project activity at Digester, Lab and Cogeneration. Supervisor at cogeneration unit would be responsible for monitoring parameters related to co-generation", whereas supervisors at lab and digesters would take care of monitoring at lab and digesters respectively.

Daily report of the parameters monitored would be reported to *CDM controller* for verification. Chairman CDM monitoring committee would be the in charge of CDM cell and report to ED & CEO who would review the reports on monthly basis and subsequently send reports to the Managing Director. Management structure for monitoring and reporting is presented in following block diagram.






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

>>

The monitoring methodology was prepared by Shreyans Industries Limited whose contact information is given in annexure-1. SIL is the project participant for this project activity.

## SECTION E.: Estimation of GHG emissions by sources:

### E.1. Formulae used:

>>

### E.1.1 Selected formulae as provided in appendix B:

>>

GHG emission reduction for the project activity has been calculated using following formula

$ER_y = BE_y - PE_y$ – Leakages

Where

$ER_y$ = emission reductions in year 'y'

$BE_y$ = Baseline emissions
$PE_y$ = Emissions due to project activity in year 'y'

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

>>

### 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:

>>

GHG emissions due to the project activity within the project boundary include direct emissions from the following sources.

(i) $CO_2$ emissions related to the power used by the project activity facilities.

Emission factors for grid electricity or diesel fuel use as the case may be shall be calculated as described in category I.D.

(ii) Methane emissions through inefficiency of the wastewater treatment and presence of degradable organic carbon in treated wastewater.

(iii) Methane emissions from the decay of the final sludge generated by the treatment systems.

(iv) Methane fugitive emissions through inefficiencies in capture and flare systems.

(v) Methane emissions resulting from dissolved methane in the treated wastewater effluent.

$$\mathbf{PE_y = PE_{y,\,power} + PE_{y,ww,treated} + PE_{y,s,final} + PE_{y,fugitive} + PE_{y,dissolved}}$$

where:

$PE_y$: project activity emissions in the year "y" (tonnes of $CO_2$ equivalent)

$PE_{y,power}$ :emissions through electricity or diesel consumption in the year "y"

$PE_{y,ww,treated}$ :emissions through degradable organic carbon in treated wastewater in year "y"

$PE_{y,s,final:}$ emissions through anaerobic decay of the final sludge produced in the year "y". If the sludge is controlled combusted, disposed in a landfill with methane recovery, or used for soil application, this term can be neglected, and the destiny of the final sludge will be monitored during the crediting period.

PEy,fugitive: emissions through methane release in capture and flare systems in year "y".

PEy,dissolved: emissions through dissolved methane in treated wastewater in year "y"

$\mathbf{PE_{y,\ power} = EF*EC}$

Where:

EF[3] = Emission factor calculated tons of $CO_2$/GwH

EC = Electricity consumed per year in Million unit

| |
|---|
| $\mathbf{PE_{y,\ power} = 896 \text{ X } 0.235 = 211 \text{ tons}}$ |

**PEy,ww,treated = Qy,ww * CODy,ww,treated * Bo,ww * MCFww * GWP_CH4**

where:

Qy,ww: volume of wastewater treated in the year "y" (m3)

CODy,ww,treated: chemical oxygen demand of the treated wastewater in the year "y" (tonnes/m3)

Bo,ww: methane generation capacity of the treated wastewater (IPCC default value of 0.25 kg $CH_4$/kg.COD)

MCFww,treated: methane conversion factor for the anaerobic decay of wastewater. (default value of 0.5 is suggested)[4]

GWP_$CH_4$ Global Warming Potential for $CH_4$ (value of 21 is used)

| |
|---|
| **PEy,ww,treated = 700000 X 0.0026 X 0.25 X 0.5 X 21 = 4778 tons** |

$\mathbf{PE_{y,s,final} = S_{y,final} * DOC_{y,s,final} * DOCF * F * 16/12 * GWP\_CH_4}$

where:

$PE_{y,s,final}$ : Methane emissions from the anaerobic decay of the final sludge generated in the wastewater system in the year "y" (tonnes of CO2 equivalent)

$S_{y,final}$ : Amount of final sludge generated by the wastewater treatment in the year y (tonnes).

$DOC_{y,s,final}$ : Degradable organic content of the final sludge generated by the wastewater treatment in the year y (mass fraction). It can be measured by sampling and analysis of the sludge produced, or the IPCC default value for solid wastes of 0.3 is used.

---

[3] Refer emission factor calculation for northern regional grid in Appendix-A.

[4] IPCC default values are 1.0 for anaerobic, and zero for aerobic systems. Here it is assumed that after the discharge of the wastewater to a river, lake, sea, etc., half of the degradable organic carbon will decay anaerobically.

DOCF: Fraction of DOC dissimilated to biogas (IPCC default value is 0.77).

F: Fraction of $CH_4$ in landfill gas (IPCC default is 0.5).

**PEy,s,final = 0 tons**

**$PE_{y,fugitive} = PE_{y,fugitive,ww} + PE_{y,fugitive,s}$**

where:

$PE_{y,fugitive,ww}$ Fugitive emissions through capture and flare inefficiencies in the anaerobic wastewater treatment in the year "y" (tonnes of $CO_2$ equivalent)

$PE_{y,fugitive,s}$ Fugitive emissions through capture and flare inefficiencies in the anaerobic sludge treatment in the year "y" (tonnes of $CO_2$ equivalent)

**$PE_{y,fugitive,ww} = (1 – CFE_{ww}) * ME_{y,ww,untreated} * GWP\_CH_4$**

where:

$CFE_{ww}$ capture and flare efficiency of the methane recovery and combustion equipment in the wastewater treatment (a default value of 0.9 shall be used, given no other appropriate value)

**$ME_{y,ww,untreated}$ methane emission potential of the untreated wastewater in the year "y" (tonnes)**

**$ME_{y,ww,untreated} = Q_{y,ww} * COD_{y,ww,untreated} * B_{o,ww} * MCF_{ww,untreated}$**

where:

$COD_{y,ww,untreated}$ Chemical oxygen demand of the wastewater entering the anaerobic treatment reactor/system with methane capture in the year "y" (tonnes/$m^3$)

$MCF_{ww,untreated}$ methane conversion factor for the anaerobic decay of the untreated wastewater (IPCC default value of 1.0 for anaerobic systems. If the untreated wastewater is discharged to the environment, the default value of 0.5 is suggested).

**$ME_{y,ww,untreated}$ = 700000 X 0.007 X 0.25 X 1 = 1225 tons**

**$PE_{y,fugitive,ww}$ = (1-0.9) X 1225 X 21 = 2573 tons**

**$PE_{y,dissolved} = Q_{y,ww} * [CH_4]_{y,ww,treated} * GWP\_CH_4$**

where:

$[CH_4]_{y,ww,treated}$ dissolved methane content in the treated wastewater (tonnes/$m^3$). In aerobic wastewater treatment default value is zero, in anaerobic treatment it can be measured, or a default value of 10e-4 tonnes/$m^3$ can be used.

**$PE_{y,dissolved}$ = 700000 X 10e-4 X 21 = 1470 tons**

**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 transfer of equipments involved in SIL project activity hence leakages are not considered.

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

>>

Project activity emissions[5] = **9031 tons of $CO_2$e equivalent per annum**

**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:**

>>

Baseline emissions for the project activity include methane generation emission potential of untreated wastewater and or sludge.

$$BE_y = ME_{y,ww,untreated} + ME_{y,s,untreated}$$

Where:

$BE_y$ = Baseline emissions in year 'y'

$ME_{y,ww,untreated}$ : Methane generation potential of untreated wastewater 'y'

$ME_{y,s,untreated}$ : Methane generation potential of untreated sludge 'y'

$$ME_{y,ww,untreated} = Q_{y,ww} * COD_{y,ww,untreated} * B_{o,ww} * MCF_{ww,untreated} * GWP\_CH_4$$

where:

$COD_{y,ww,untreated}$ : Chemical oxygen demand of the wastewater entering the anaerobic treatment reactor/system with methane capture in the year "y" (tonnes/$m^3$)

$MCF_{ww,untreated}$ : methane conversion factor for the anaerobic decay of the untreated wastewater (IPCC default value of 1.0 for anaerobic systems. If the untreated wastewater is discharged to the environment, the default value of 0.5 is suggested).

**$ME_{y,ww,untreated}$ = 700000 X 0.007 X 0.21 X 1 X 21 = 21609 tons**

**$ME_{y,s,untreated}$ methane emission potential of the untreated sludge in the year "y" (tonnes)**

**$ME_{y,s,untreated} = S_{y,untreated} * DOC_{y,s,untreated} * DOC_F * F * 16/12$**

where:

$S_{y,untreated}$ amount of untreated sludge generated in the year "y" (tonnes)

$DOC_{y,s,untreated}$ Degradable organic content of the untreated sludge generated in the year y (mass fraction). It can be measured by sampling and analysis of the sludge produced, or the IPCC default value for solid wastes of 0.3 is used.

**$ME_{y,s,untreated} = 0$**

**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:**

>>

Emission reduction = Baseline emissions – Project emissions

Baseline emissions = 21,609 tons CO2 equivalent per annum

Project emissions = 9,031 tons CO2 equivalent per annum

Emission reduction = 21,609 – 9,031

= 12,578tons CO2 equivalent per annum

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

>>

**Emission Reductions**

| Year | Baseline emissions (tonnes of $CO_2$ ) | Project emissions (tonnes of $CO_2$) | Leakages (tonnes of $CO_2$) | Emission reductions (tonnes of $CO_2$) |
|---|---|---|---|---|
| **2006-2007** | 21,609 | 9,031 | 0 | 12,578 |
| **2007-2008** | 21,609 | 9,031 | 0 | 12,578 |
| **2008-2009** | 21,609 | 9,031 | 0 | 12,578 |
| **2009-2010** | 21,609 | 9,031 | 0 | 12,578 |
| **2010-2011** | 21,609 | 9,031 | 0 | 12,578 |
| **2011-20012** | 21,609 | 9,031 | 0 | 12,578 |
| **2012-2013** | 21,609 | 9,031 | 0 | 12,578 |
| **2013-2014** | 21,609 | 9,031 | 0 | 12,578 |
| **2014-2015** | 21,609 | 9,031 | 0 | 12,578 |

[5] Refer CER Calculation sheet for details of Project emissions

| | | | | |
|---|---|---|---|---|
| **2015-2016** | 21,609 | 9,031 | 0 | 12,578 |
| **TOTAL** | **216,090** | **90,310** | **0** | **125,780** |

## SECTION F.: Environmental impacts:

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

>>

The project activity, setting up of UASB digester requires mandatory reporting of impacts on various environmental attributes. SIL has obtained consent from the state authorities in the form of "No Objection Certificate".

Environmental impacts reported below have been identified due to the project activity and a mitigation plan to minimize the impacts has been drafted. No major impact has been envisaged due to the project activity.

***Impacts during construction***

**Air Quality**

During construction phase there will be increase in the quantity of suspended particulate matter in the ambient air due to loose construction material like sand, gravel, cement etc. and due to the movement of construction equipments.

**Water Quality**

During construction phase due to presence of loose construction material at site there may be an increase in quantity of suspended matter in waste water washed at site. The quantity of waste water would also increase due to temporary dwellings of construction workers at site.

**Impact on Land use**

There would be no impact on the land use pattern, since the site at which UASB digester would commission is within the premises of SIL and currently it is not used for any other purpose.

**Ecological Impact**

There has been no vegetation or trees which need to be felled during construction activity hence there would be no major impact on the ecology of the surroundings at site.

***Impacts during operation***

**Air Quality**

Due to operation of the project plant methane generated from decomposition of carbon in waste water would be captured in closed UASB digester hence there will be an overall reduction in the emissions of methane into the atmosphere which would have otherwise released into the air from open lagoons of the SIL.

**Water Quality**

Due to operation of UASB digester there will be reduction in Biological Oxygen Demand (BOD) and COD of final effluent in comparison to what it would be, had the treatment of waste water been done in open lagoon.

**Impact on Land use**

There would be no impact on land use at site due to operation of UASB digester.

**Ecological Impact**

There would be no impact on the ecology due to operation of the UASB digester.

***Environmental Management Plan***

Although no major environmental impact has been envisaged due to the project activity following plan has been made to mitigate the minor impacts.

- Construction Phase impacts are temporary and limited during construction period only.
- Temporary dwellings for construction worker at site should be provided with temporary lavatories so that waste water from site can be treated along with other waste water.
- During operation phase regular monitoring of BOD and COD of effluent should be done so as to ensure that final effluent confirms with discharge standards stipulated by state pollution control board.
- Plantation would be done along the premises of Industrial unit.

## SECTION G. Stakeholders' comments:

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

>>
Stakeholder identified for the project activity include following:

- Local residents
- Employees of SIL
- Local municipality

SIL organised a meeting at its premises to brief local stakeholders identified above and to receive comments if any about the project activity. Stakeholders were invited personally by SIL officials to attend this meeting. Local language was used to communicate with stakeholders and project activity was briefed by SIL officials such that they can understand the activity and its associated impacts simply.

### G.2. Summary of the comments received:

>>
SIL briefed stakeholders identified above, about the project activity in a meeting organized at its premises in Ahmedgarh, Sangrur. Mr. Jatinder Bhola, President-Municipal council, Ahmedgarh expressed his satisfaction on steps taken by SIL and wished to know about the CDM, he further wanted to know how CDM will help in conservation of environment.

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

>>
No comments were received during local stakeholder process. Queries of Mr. Jatinder Bhola regarding the CDM cycle and the way in which it is helping in global green house emission reduction were answered satisfactorily by Mr.K.N.Tewary during the meeting.

**Annex 1**

## CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

| | |
|---|---|
| Organization: | Shreyans Industries Limited |
| Street/P.O.Box: | Unit: Shreyans Papers |
| Building: | -- |
| City: | Ahmedgarh, District Sangrur |
| State/Region: | Punjab |
| Postcode/ZIP: | 148021 |
| Country: | India |
| Telephone: | 91-1675-240347, 240348, 240349 |
| FAX: | 91-1675-240512 |
| E-Mail: | spm@shreyansgroup.com |
| URL: | www.shreyansgroup.com |
| Represented by: | |
| Title: | Executive Director & CEO |
| Salutation: | Mr. |
| Last Name: | |
| Middle Name: | Kumar |
| First Name: | Anil |
| Department: | - |
| Mobile: | +91-9872910658 |
| Direct FAX: | 91-1675-240512 |
| Direct tel: | 91-1675-240347 |
| Personal E-Mail: | spm@shreyansgroup.com |

**Annex 2**

## INFORMATION REGARDING PUBLIC FUNDING

No public funding from Annexure-I country has been involved in the project activity.

## Appendix A Emission factor calculation-Northern grid

### Baseline data

*Carbon emission factor of grid*

The emission coefficient for the electricity displaced is calculated in accordance with provisions of paragraph 9 of Type I Category D of 'Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories - version 09, 28th July 2006'. Northern region's present generation mix, thermal efficiency, and emission co-efficient are used to estimate the net carbon intensity/baseline factor of the chosen grid.

The emission coefficient (measured in kg $CO_2$equ/kWh) is calculated in a transparent and conservative manner as:

(a) The average of the "approximate operating margin" and the "build margin" (or combined margin)

OR

(b) The weighted average emissions (in kg $CO_2$equ/kWh) of the current generation mix.

Complete analysis of the electricity generation has been carried out for the calculation of the emission coefficient as per paragraph 9 (a) given above.

***Combined Margin***

The baseline methodology suggests that the project activity will 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 grid mix) and the build margin (i.e. weighted average emissions of recent capacity additions) of the selected grid and the baseline emission factor would therefore incorporate an average of both these elements.

*Operating Margin*

The "approximate operating margin" is defined as the weighted average emissions (in kg $CO_2$equ/kWh) of all generating sources serving the system, excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation;

The project activity would have some effect on the operating margin of the Northern region grid. The carbon emission factor as per the operating margin takes into consideration the power generation mix of 2003-2004, 2004-2005 and 2005-2006 excluding hydro, geothermal, wind, low-cost biomass, nuclear and solar generation of the selected grid, and the default value of emission factors of the fuel used for power generation.

Average efficiency of gas turbines in combined cycle works out to be 45%. Standard emission factors given in IPCC for coal and gas (thermal generation) are applied over the expected generation mix and net emission factor is determined. Carbon Emission Factor of grid as per operating margin is 1.113 kg $CO_2$/kWh electricity generation.

*Build Margin*

The "build margin" emission factor is calculated by taking the weighted average emissions (in kg $CO_2$equ/kWh) of recent capacity additions to the system, which capacity additions are defined as the greater (in MWh) of most recent 20% of existing plants or the 5 most recent plants.

The project activity will have some effect on the build margin of the Northern region grid. The baseline factor as per the build margin takes into consideration the delay effect on the future projects and assumes that the past trend will continue in the future. Capacity additions of most recent 20 % of existing plants is greater than (in MWh) 5 most recent plants hence, for our build margin calculation we have taken into consideration 20 % of most recent plants built in Northern region given below. The key parameters for calculating build margin have been assumed same as that for calculating operating margin. Carbon Emission Factor of grid as per build margin is 0.679 kg $CO_2$/kWh electricity generation.

Net Carbon Emission Factor of Grid as per combined margin = (OM + BM)/2 = **0.896 kg of $CO_2$ / kWh generation**.

**Key elements to determine baseline for the project activity**

The key elements such as variables, parameters and data sources used to determine the baseline for the project activity are tabulated below:

| S No. | Key Parameters | Data Sources | Reference |
|---|---|---|---|
| 1 | Generation of power of all the plants for the year 2001-02, 2002-03, 2003-04, 2004-05 and 2005-06 | Annual reports of Northern Region Load Dispatch Center (NRLDC) 2001-02 and 2002-03 Section 7.1, Annual reports of Northern region Electricity Board (NREB) 2003-04 – Annex-10.1.3 2004-05 – Annexure 2.7 2005-06 | http://www.nrldc.org/docs/7-1.pdf http://www.nrldc.org/docs/2001-02-section5onwards.pdf http://nreb.nic.in/Reports/Index.htm |
| 2 | Coal consumption of each coal fired power plant for the year 2003-04, 2004-05 and 2005-06 | Annual Performance review of Thermal power plant (CEA) | www.cea.nic.in |

| | | | |
|---|---|---|---|
| 3 | Calorific value of coal | NATCOM Report | http://www.natcomindia.org/natcomreport.htm |
| 4 | Calorific value of gas | Revised 1996 IPCC Guidelines for National Green house Gas Inventories: Reference Manual | www.ipcc.ch |
| 5 | Oxidation factors | Revised 1996 IPCC Guidelines for National Green house Gas Inventories: Reference Manual | www.ipcc.ch |
| 6 | Efficiency of gas based power plants supplying power to grid | MNES study titled "Baselines for Renewable Energy Projects under Clean Development Mechanism". Chapter 2, | http://mnes.nic.in/baselinepdfs/chapter2.pdf |
| 7 | Emission factor of natural gas, | Revised 1996 IPCC Guidelines for National Green house Gas Inventories: Reference Manual | Refer Note |
| 8 | Emission factor of non-coking coal | NATCOM Report, Chapter 2, page 37 | http://www.natcomindia.org/pdfs/chapter2.pdf |
| 9 | Emission factor of Eastern and Western grids | MNES study titled "Baselines for Renewable Energy Projects under Clean Development Mechanism". Chapter 2, Table 2.11b, Table 2.11d | http://mnes.nic.in/baselinepdfs/chapter2.pdf |

***Note:***

The value of emission factors are given in terms of carbon unit in Revised 1996 IPCC Guidelines for National Green house Gas Inventories: Reference Manual. It is converted in terms of $CO_2$ as shown below:

| Fuel | Emission factor | Emission factor |
|---|---|---|
| | tC/TJ | $tCO_2$/TJ |
| Natural gas | 15.3 | 56.1 ( 15.3 x 44/12) |
| Non Coking Coal | 26.13 | 95.8 ( 26.13 x 44/12) |

**Generation details**

The power generation of power plants falls under Northern grid region for the past three years is given below:

| Name | Type | Fuel | Generation (2003-04) GWh | Generation (2004-05) GWh | Generation (2005-06) GWh |
|---|---|---|---|---|---|
| Anta GPS | Thermal | Gas | 2775.92 | 2595.77 | 2806.84 |
| Auriya GPS | Thermal | Gas | 4247.41 | 4119.47 | 4281.67 |
| Badarpur TPS | Thermal | Coal | 5428.96 | 5462.78 | 5380.54 |
| Bairasiul | Hydro | Hydel | 687.79 | 689.67 | 790.97 |
| Bhakra Complex | Hydro | Hydel | 6956.9 | 4546.01 | 6838.78 |
| Chamera HPS | Hydro | Hydel | 2648.32 | 3452.25 | 3833.66 |
| Dadri GPS | Thermal | Gas | 5058.66 | 5527.71 | 5399.34 |
| Dadri NCTPS | Thermal | Coal | 6181.12 | 6842.52 | 6768.09 |
| Dehar | Hydro | Hydel | 3299.29 | 3150.52 | 3122.68 |
| Dhauliganga | Hydro | Hydel | - | - | 312.46 |
| Delhi | Thermal | Coal | 1164.11 | 5203.8 | 1559.10 |
| Delhi | Thermal | Gas | 5159.77 | 4091.37 | 4046.11 |
| Faridabad GPS | Thermal | Gas | 2792.58 | 3172.01 | 2954.64 |
| H.P. | Hydro | Hydel | 3666.39 | 3666.39 | 2870.48 |
| Haryana | Thermal | Coal | 6849.26 | 7192.41 | 8352.58 |
| Haryana | Hydro | Hydel | 251.73 | 251.73 | 258.30 |
| J&K | Hydro | Hydel | 851.03 | 851.03 | 1133.41 |
| J&K | Thermal | Gas | 15.41 | 23.51 | 28.31 |
| NAPS | Nuclear | Nuclear | 2959.44 | 2760.01 | 2138.45 |
| Pong | Hydro | Hydel | 1178.93 | 882.57 | 1730.70 |
| Punjab | Thermal | Coal | 14118.96 | 14390.42 | 14848.73 |
| Punjab | Hydro | Hydel | 4420.43 | 4420.43 | 4999.36 |
| Rajasthan | Thermal | Coal | 15044.48 | 17330.79 | 19903.79 |
| Rajasthan | Thermal | Gas | 201.37 | 360.7 | 432.58 |
| Rajasthan | Hydro | Hydel | 494.07 | 494.07 | 921.33 |

| | | | | | |
|---|---|---|---|---|---|
| RAPS-A | Nuclear | Nuclear | 1293.37 | 1355.2 | 1267.50 |
| RAPS-B | Nuclear | Nuclear | 2904.68 | 2954.43 | 2815.73 |
| Rihand STPS | Thermal | Coal | 7949.26 | 7988.06 | 10554.73 |
| Salal | Hydro | Hydel | 3477.42 | 3443.29 | 3480.87 |
| Singrauli STPS | Thermal | Coal | 15643.4 | 15803.34 | 15502.80 |
| SJVNL | Hydro | Hydel | 1537.92 | 1617.45 | 3867.12 |
| Tanakpur HPS | Hydro | Hydel | 510.99 | 495.17 | 483.26 |
| Tanda TPS | Thermal | Coal | 2872.81 | 3254.67 | 3329.89 |
| U.P. | Thermal | Coal | 20638.05 | 19788.21 | 19326.44 |
| U.P. | Hydro | Hydel | 2063.04 | 2063.04 | 1244.92 |
| Unchahar-I TPS | Thermal | Coal | 3252.14 | 3342.83 | 3544.89 |
| Unchahar-II TPS | Thermal | Coal | 3187.93 | 3438.28 | 3501.21 |
| Uri HPS | Hydro | Hydel | 2873.54 | 2206.71 | 2724.81 |
| Uttaranchal | Hydro | Hydel | 3452.96 | 3452.96 | 3496.87 |
| **TOTAL** | | | **168109.8** | **172681.6** | **180853.9** |

***Calculation of Operating Margin Emission Factor***

The following table gives a step by step approach for calculating the Simple Operating Margin emission factor for Northern Regional electricity grid for the most recent 3 years at the time of PDD submission i.e.2003-2004, 2004-2005 & 2005-2006.

| | **2003-04** | **2004-05** | **2005-06** |
|---|---|---|---|
| Generation by Coal out of Total Generation (GWh) | 102704.29 | 106451.00 | 112572.8 |
| Generation by Gas out of Total Generation (GWh) | 20251.12 | 19890.00 | 19949.49 |
| **Imports from others** | | | |
| Imports from WREB (GWh) | 282.02 | 1602.84 | 2153.23 |
| Imports from EREB (GWh) | 2334.76 | 3600.58 | 4112.67 |

| **Fuel 1 : Coal** | **2003-04** | **2004-05** | **2005-06** |
|---|---|---|---|
| Avg. Calorific Value of Coal used (kcal/kg) | 4593 | 4593 | 4593 |
| Coal consumption (tons/yr) | 70,397,000 | 73,279,000 | 73,279,000 |
| Emission Factor for Coal (tonne $CO_2$/TJ) | 95.8 | 95.8 | 95.8 |
| Oxidation Factor of Coal-IPCC standard value | 0.98 | 0.98 | 0.98 |
| COEF of Coal (tonne$CO_2$/ton of coal) | 1.806 | 1.806 | 1.806 |
| **Fuel 2 : Gas** | | | |
| Avg. Efficiency of power generation with gas as a fuel, % | 45 | 45 | 50 |

| | | | |
|---|---|---|---|
| Avg. Calorific Value of Gas used (kcal/kg) | 10349 | 10349 | 10349 |
| Estimated Gas consumption (tons/yr) | 3,739,808 | 3,673,119 | 3684105.1 |
| Emission Factor for Gas- IPCC standard value(tonne $CO_2$/TJ) | 56.1 | 56.1 | 56.1 |
| Oxidation Factor of Gas-IPCC standard value | 0.995 | 0.995 | 0.995 |
| COEF of Gas(tonne$CO_2$/ton of gas) | 2.419 | 2.419 | 2.419 |
| | | | |
| EF (WREB), tCO2/GWh | 910.00 | 906.00 | 884.00 |
| EF (EREB), tCO2/GWh | 1186.00 | 1178.00 | 1158.00 |
| | | | |
| **EF (OM Simple), t$CO_2$/GWh** | **1108.35** | **1116.65** | **1115.55** |
| **Average EF (OM Simple), t$CO_2$/GWh** | | | **1113.51** |

**List of power plants considered for calculating build margin**

During 2005-06, the total power generation in northern grid region was 180,853.94 GWh. Twenty % of total generation is about 36,170.79 GWh. The recently commissioned power plant whose summation of power generation is about 37,608.63 GWh is considered for the calculation of Build margin. The list is tabulated below:

| S. No. | Plant | Date of commissioning | MW | Generation of the unit in 2005-2006 (GWh) | Fuel Type |
|---|---|---|---|---|---|
| 1 | Dhauliganga unit-I | 2005-2006 | 70 | 78.61 | Hydro |
| 2 | Dhauliganga unit-II | 2005-2006 | 70 | 78.61 | Hydro |
| 3 | Dhauliganga unit-III | 2005-2006 | 70 | 78.61 | Hydro |
| 4 | Dhauliganga unit-IV | 2005-2006 | 70 | 78.61 | Hydro |
| 5 | Rihand Stage - II unit I | 2004-2005 | 500 | 2593.70 | Coal |
| 6 | Panipat # 7 | 2004-2005 | 250 | 921.46 | Coal |
| 7 | Panipat # 8 | 2004-2005 | 250 | 1613.95 | Coal |
| 8 | Chamera HEP-II (Unit 1) | 2003-2004 | 100 | 567.67 | Hydro |
| 9 | Chamera HEP-II (Unit 2) | 2003-2004 | 100 | 567.67 | Hydro |
| 10 | Chamera HEP-II (Unit 3) | 2002-2003 | 100 | 567.67 | Hydro |
| 11 | SJVPNL | 2003-2004 | 1500 | 4104.25 | Hydro |
| 12 | Baspa-II (Unit 3) | 2003-2004 | 100 | 389.87 | Hydro |
| 13 | Suratgarh-III (Unit-5) | 2003-2004 | 250 | 2033.40 | Coal |
| 14 | Kota TPS-IV (Unit-6) | 2003-2004 | 195 | 1695.70 | Coal |
| 15 | Baspa-II (Unit 1 & 2) | 2002-2003 | 200 | 779.74 | Hydro |
| 16 | Pragati CCGT (Unit II) | 2002-2003 | 104.6 | 728.29 | Gas |
| 17 | Pragati CCGT (Unit III) | 2002-2003 | 121.2 | 843.86 | Gas |
| 18 | Ramgarh CCGT Stage -II (GT-2) | 2002-2003 | 37.5 | 146.80 | Gas |
| 19 | Ramgarh CCGT Stage -II (GT-2) | 2002-2003 | 37.8 | 147.97 | Gas |

| | | | | | |
|---|---|---|---|---|---|
| 20 | Upper Sindh Extn (HPS)(1) | 2001-2002 | 35 | 68.52 | Hydro |
| 21 | Suratgarh stage-II (3 & 4) | 2001-2002 | 500 | 3844.81 | Coal |
| 22 | Upper Sindh Stage II (2) | 2001-2002 | 35 | 68.52 | Hydro |
| 23 | Malana-1 & 2 | 2001-2002 | 86 | 337.79 | Hydro |
| 24 | Panipat TPS Stage 4 (Unit-6) | 2000-2001 | 210 | 1688.29 | Coal |
| 25 | Chenani Stage III (1,2,3) | 2000-2001 | 7.5 | 3.88 | Hydro |
| 26 | Ghanvi HPS (2) | 2000-2001 | 22.5 | 69.71 | Hydro |
| 27 | RAPP (Unit-4) | 2000-2001 | 220 | 1432.17 | Nuclear |
| 28 | Ranjit Sagar (Unit-1,2,3,4) | 2000-2001 | 600 | 2012.84 | Hydro |
| 29 | Gumma HPS | 2000-2001 | 3 | 6.59 | Hydro |
| 30 | Faridabad CCGT (Unit 1) (NTPC) | 2000-2001 | 144 | 986.70 | Gas |
| 31 | Suratgarh TPS 2 | 1999-2000 | 250 | 2112.17 | Coal |
| 32 | RAPS-B (2) | 1999-2000 | 220 | 1432.17 | Nuclear |
| 33 | Uppersindh-2 HPS #1 | 1999-2000 | 35 | 68.52 | Hydro |
| 34 | Faridabad GPS 1 & 2 (NTPC) | 1999-2000 | 286 | 1959.71 | Gas |
| 35 | Unchahar-II TPS #2 | 1999-2000 | 210 | 1732.60 | Coal |
| 36 | Unchahar-II TPS #1 | 1998-1999 | 210 | 1767.20 | Coal |

Built Margin Emission Factor is calculated as per the following table:

| | | |
|---|---|---|
| **Considering 20% of Gross Generation** | | |
| **Sector** | | |
| Thermal Coal Based | 20003.28 | |
| Thermal Gas Based | 4813.33 | |
| Hydro | 9927.69 | |
| Nuclear | 2864.33 | |
| **Total** | 37608.63 | |
| **Built Margin** | - | - |
| **Fuel 1 : Coal** | | |
| Avg. calorific value of coal used in Northern Grid, kcal/kg | | 4593 |
| Coal consumption, tons/yr | | 12952313 |
| Emission factor for Coal,tonne $CO_2$/TJ | | 95.8 |
| Oxidation factor of coal ( IPCC standard value) | | 0.98 |
| COEF of coal (tonne$CO_2$/ton of coal) | | 1.806 |
| **Fuel 2 : Gas** | | |
| Avg. efficiency of power generation with gas as a fuel, % | | 45 |
| Avg. calorific value of gas used, kcal/kg | | 10349 |
| Estimated gas consumption, tons/yr | | 888886 |
| Emission factor for Gas (as per standard IPCC value) | | 56.1 |
| Oxidation factor of gas ( IPCC standard value) | | 0.995 |
| COEF of gas(tonne$CO_2$/ton of gas) | | 2.419 |
| | | |
| **EF (BM), t$CO_2$/GWh** | | **679.00** |

Therefore the **net baseline emission factor** as per combined margin

**(OM + BM)/2 =** 0.896 kg $CO_2$/kWh.

## Appendix B

### Abbreviations

| | |
|---|---|
| **UASB** | Up flow Anaerobic Sludge Blanket |
| **$CO_2$** | Carbon dioxide |
| **GHG** | Green House Gases |
| **INR** | Indian National Rupee |
| **IPCC** | Inter Governmental Panel on Climate Change |
| **kg** | Kilogram |
| **km** | Kilometre |
| **kW** | Kilowatt |
| **kWh** | Kilowatt - hour |
| **MW** | Mega Watt |
| **PDD** | Project design document |
| **SIL** | Shreyans Industries Limited |
| **tph** | Tonnes per hour |
| **UNFCCC** | United Nations Framework Convention on Climate Change |
| **DOE** | Designated Operational Entity |