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

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Deoband Bagasse based Co-generation Power Project

Version 04

Date: 01st August 2006

A.2. Description of the project activity:

The purpose of the project activity is to utilize the available sugar mill generated bagasse to generate steam and electricity for internal use and to export the surplus electricity to the Uttar Pradesh Power Corporation Limited (UPPCL) grid (part of Northern regional grid). The project activity is 22.0 MW capacity cogeneration project at Triveni Engineering and Industries Ltd. (TEIL), Deoband plant, Uttar Pradesh.
By displacing carbon intensive grid energy with a renewable, carbon neutral energy source, the project activity reduces carbon dioxide emissions over the project life. Replicable technology, environmental, and sustainable development benefits also result from the project activity. These include: introducing efficient high pressure cogeneration technology to the Indian sugar industry; reducing power shortages in the state of Uttar Pradesh (UP) India; and, fostering sustainable economic growth through promoting energy self-sufficiency and resource conservation in India's sugarcane industry.

The project activity is unique in India due to its use of high efficiency boilers for optimizing the energy produced per unit of bagasse burned. While many sugar mills burn their bagasse wastes, in 2003 less than 14% of the mills sold electricity to the state grid and less than 1% of the approximately 500 sugar mills in the country have high pressure boiler systems (87 kg/cm^2). With the goal of obtaining carbon revenues from the avoidance of grid-based greenhouse gas (GHG) emissions, the company took the investment risks to secure financing to invest in such high efficiency cogeneration systems, thereby demonstrating the attractiveness of clean power systems to the sugar manufacturing industry in India. The project activity is highly replicable as the country's sugar mills produce vast quantities of bagasse wastes that could be far more efficiently burned to generate energy for on-and off-site use while also reducing grid based GHG emissions, which result from the country's overwhelming (70%) dependency on coal.

The project activity uses a portion of the steam-electricity to run its own cane crushing facility and cogeneration plant. The majority of the total electricity produced, is exported to the Uttar Pradesh Power Corporation Limited (UPPCL), with 16.17 MW being exported from the plant during the cane crushing season and 19.16 MW during the off-season period. The emission reductions from the project activity come from the avoidance of carbon dioxide emissions from fossil fuel use in Northern grid [1] due to the displacement by the zero carbon, bagasse residues.

Pre project scenario:

TEIL was meeting steam and power requirement of its sugar manufacturing unit with set of existing boilers and generators. Configuration of existing units are given in following tables

Description	**1 no. Water tube**	**3 nos. Water tube**	**1 no. Water tube**	**1 no. Water tube**
Steam generating capacity (tons per hour)	25	20	40	65
Steam pressure (kg/cm^2)	11.27	11.27	32	32
Steam temperature (^{0} C)	270	270	400	400

Turbine details:

Description	**2 nos. Back pressure**	**2 nos. Back pressure**	**1 no. Back pressure**
Power (kW)	3000	1500	1250
Stem inlet pressure (kg/cm^2)	30	11	11

Post project scenario

In post project scenario the steam and power requirement of sugar plant has been met by set of equipments with configuration given in following table.

Boiler details

Description	**1 no. Water tube**	**3 nos. Water tube**	**1 no. Water tube**	**1 no. Water tube**	**1 no. water tube**
Steam generating capacity (tons per hour)	25	20	40	65	120
Steam pressure (kg/cm^2)	11.27	11.27	32	32	87
Steam temperature (^{0} C)	270	270	400	400	515
Status	**stand by**	**stand by**	Operational	Operational	Project Plant-Operational

[1] Since Uttar Pradesh is a part of the Northern regional grid

Turbine details

Description	2 nos. Back pressure	2 nos. Back pressure	1 no. Back pressure	1 no extraction cum condensing turbine
Power (kW)	3000	1500	1250	22000
Steam inlet pressure (kg/cm^2)	30	11	11	84

Four numbers of 11.2 Kg/cm^2 boilers have not been used in post project scenario and steam deficiency due to this has been met by supply from Project plant. In absence of the project plant steam requirement of sugar unit would have been met by these boilers and biomass used in cogeneration unit would have been used in existing boilers for steam generation.

Project's contribution to sustainable development

The project activity engenders important local, national and global sustainable development for India.
First, the renewable energy project activity supports India's national policy to rely on clean power. The government's clean power diversification strategy includes a multi-pronged strategy focusing on reducing wastage of energy combined with the optimum use of renewable energy (RE) sources, as adopted by the project activity.
Second, the project activity substitutes, and hence decreases the future need, for primarily coal-based power generation by the grid, thereby reducing carbon dioxide (CO_2) emissions from the Indian electricity sector. As coal is supplied to meet over 70% of the country's present electricity demand and is expected to increase over time according to the Uttar Pradesh state electricity board expansion plan, diversification and energy self-reliance by the sugarcane industry creates global as well as local air pollutant benefits. The project activity positively contributes towards the reduction in demand for India's carbon intensive energy resources (like coal) as well as more efficient waste disposal and resource conservation.
Third, the project activity has contributed to the local job and income creation in rural area where cane growers (local farmers) face highly cyclical income flows. It has created steady higher value jobs and skilled workers at the cogeneration facility. Finally, with the influx of carbon financing from the Project's net emission reductions, the project activity would create a replicable model for the country's sugarcane industry to diversify its product offerings and increase its capabilities and venture into the power sector.
In summary, the project's sustainable development benefits and issues include:

- Export of 16.17 MW during sugar cane season and 19.16 MW during off-season, thereby eliminating the generation of same quantity of power using conventional fuel;

- Conserving coal, a non-renewable natural resource;
- Decreasing the growth in demand for coal, and making it available for higher-value economic applications;
- Reducing GHG emissions through the avoidance of fossil-fuel grid electricity generation;
- Contributing to an increase in the local employment in the area of skilled jobs for operation and maintenance of the cogeneration equipment;
- More efficient industry waste use;
- Capacity building through training the mill owners, farmers and power plant operators in high efficiency cogeneration and export of electricity to the grid;
- Increasing the diversity and reliance of local energy resources, and improving the transmission grid reliability through distributed energy use; and,
- Providing a highly replicable, efficient model to other sugar mills in the state and country for use of bagasse as a renewable energy resource.

A.3. Project participants:

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants(as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
India	Triveni Engineering and Industries Ltd	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

India

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

Uttar Pradesh

A.4.1.3. City/Town/Community etc:

Deoband

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

The TEIL sugar plant and the project activity are located in the complex at Deoband Village, Saharanpur District in Uttar Pradesh. The plant is located near Meerut & Saharanpur highway and is about 35 km from Saharanpur.

The project activity consists of the boiler, turbo-generator, auxiliary systems, and switchyard *etc.*, located adjacent to the sugar plant. The other requirements of the project activity including water requirement, infrastructure facilities *etc.* are also available at site. The grid electrical substation of 132 kV for power export is only 3 km from the site

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

The project activity falls under the sectoral Scope 1: Energy industries (renewable - / non-renewable sources) as per the sectoral scopes related approved methodologies and DOEs (version 19 Sep 05, 15:57)

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

Project is a grid-connected bagasse based cogeneration power plant with high-pressure steam turbine configuration.

The plant is designed to operate with boiler outlet steam configuration of 87 kg / cm^2 and 515 ^{o}C. The cogeneration cycle for the plant is designed as an energy efficient regenerative cycle. This plant will give around 7 % more power output than the most of the cogeneration plants designed with boiler outlet steam parameters of 67 kg / cm^2 and 485 ^{o}C and 23 % more than normal configuration in India of 45 kg / cm^2 and 390 ^{o}C with back pressure turbine.

Very few bagasse based cogeneration power plants are designed with above mentioned high pressure and temperature parameters in India. However the technology is well proven worldwide and is now being applied to cogeneration plants. In India also, couple of plants[2] with 87 kg / cm^2 pressure and 515 ^{0}C temperature configurations have been commissioned and are operating successfully.

The project activity is a grid-connected bagasse based cogeneration power plant with high-pressure steam generator and turbine configuration.

[2] Only four projects implemented so far with similar technology (i) Kakatia Sugars, AP; (ii) 1st Project of BCML at Balrampur, UP (iii) 2nd Project of BCML at Haidergarh, UP (iv) Bannari Amman, Sathyamangalam, TN.

The plant is designed to operate a 120 tonnes per hour (tph) nominal capacity boiler with the super heater outlet steam parameters of 87 kg/cm^2 & 515 ^{0}C and a double extraction cum condensing type turbo-generator of 22 MW capacity, using bagasse as the fuel.

The boiler is of modern design with membrane furnace walls, electrostatic precipitators for dust collection, spreader stoker and travelling grate type. The inlet feed water is at 170 ^{0}C, with the feed water heated in a high pressure feed water heaters. The deaerator outlet water temperature is 115^{0}C. The cogeneration turbine is a double extraction cum condensing machine. There is one controlled extraction at 3.0 kg/cm^2 and one uncontrolled extractions at 9 kg/cm^2.

The plant is designed with all other auxiliary plant systems like

- bagasse handling system with storage and processing arrangements,
- high pressure feed water heaters,
- ash handling system,
- water treatment plant,
- compressed air system,
- air conditioning system,
- main steam, medium pressure and low pressure steam systems,
- fire protection system,
- water system which include raw water system, circulating water system, condensate system, De-Mineralised water system and service with potable water system and
- the electrical system for its successful operation.

The power is generated at 11 kV level. The internal consumption requirements for auxiliaries and equipment of the sugar plant and the cogen plant are met by stepping down voltage level to 415V. The exportable power needs to be stepped upto 132 kV and paralleled with the Northern grid at the sub-station in Deoband.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

The project activity plant uses bagasse as fuel. The bagasse being a renewable bio-mass fuel does not add any net carbon-dioxide to the atmosphere because of the carbon recycling during growth of sugar cane. Therefore, the project activity will lead to zero CO_2 on-site emissions associated to bagasse combustion. Since, the bagasse contains only negligible quantities of other elements like Nitrogen, Sulphur *etc*. release of other GHG are considered as negligible. The bagasse is expected to contain 53% moisture; this will keep the temperatures at steam generator burners low enough not to produce nitrogen oxides. Moreover, the specification of the steam generator will stipulate over fire air system with staged combustion, which will ensure reduction in nitrogen-oxide emissions.

The project activity will generate 22.0 MW power and export to Northern grid a capacity of 16.17 MW during crushing season and 19.16 MW during off-season period after meeting its auxiliary power needs. The crushing season of 175 days and non-crushing / off-season period of around 95 days is envisaged for project activity operation. No transmission and distribution losses are considered since the project is exporting power at high voltage of 132 kV at a short distance.

Therefore, a conventional energy equivalent of 927.40 million kWh for a period of 10 years would be replaced by exporting power from the project activity with CO_2 emission reduction of 854,695 tonnes over a 10 year credit period.

Without the project activity, the same energy load would have been taken-up by Northern grid mix and emission of CO_2 would have occurred due to combustion of conventional fuels like coal. Thus the project activity would help in reduction of combined margin carbon intensity of the grid. Considering the export of clean electricity to the fossil fuel dominated grid by the project activity there will be continuous GHG reductions, as it would avoid equivalent GHG emissions.

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

Years	Annual estimation of emission reductions in tonnes of CO_2 e
2004-2005	64,750
2005-2006	82,654
2006-2007	88,411
2007-2008	88,411
2008-2009	88,411
2009-2010	88,411
2010-2011	88,411
2011-2012	88,411
2012-2013	88,411
2013-2014	88,411
Total estimated reductions (tonnes of CO_2 e)	**854,695**
Total number of crediting years	10 years
Annual average over the crediting period of estimated reductions	85,470

((tonnes of CO_2 e)	

A.4.5. Public funding of the project activity:

No public funding as part of project financing from parties included in Annex I of the convention is involved in the project activity.

SECTION B. Application of a baseline methodology

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

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Title: Consolidated baseline methodology for grid-connected electricity generation from biomass residues

Reference – Approved consolidated baseline methodology ACM0006, Version 03, Sectoral Scope: 01, 19th May 2006

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

The said methodology is applicable to grid-connected and biomass residue fired electricity generation project activities, including cogeneration plants. As per the methodology, the project activity may include: "The installation of a new biomass power generation unit, which is operated next to existing power generation capacity fired with either fossil fuels or the same type of biomass residue as in the project plant **(power capacity expansion projects)**"

Further, the project activity meets the applicability criteria of consolidated methodology as under:

Criteria 1: No other biomass types than *biomass residues*, as defined above, are used in the project plant and these biomass residues are the predominant fuel used in the project plant (some fossil fuels may be co-fired)

The project activity uses only bagasse *(a biomass residue)* as a fuel in the boiler and usage of no other biomass types like municipal solid waste (MSW) as fuel in boiler is envisaged.

Criteria 2: For projects that use biomass residues from a production process (e.g. production of sugar or wood panel boards), the implementation of the project shall not result in an increase of the processing capacity of raw input (e.g. sugar, rice, logs, etc.) or in other substantial changes (e.g. product change) in this process

Implementation of the project activity has no direct/ indirect effect on the bagasse production in the facility. The bagasse production is guided by the sugar cane availability and sugar demand in the market. The sugar manufacturing process is driven by market demand and implementation of a Cogeneration power unit has no direct or indirect impact on raw processing.

Criteria 3: The biomass used by the project facility should not be stored for more than one year.

Maximum portion of the bagasse generated during crushing season (which spans over 6 to 7 months) at the sugar plant is continuously used by the project activity. A small portion of the bagasse of the plant is stored at the plant premises for use in the non-crushing period. This quantity of bagasse is not stored at the project facility for more than one year.

Criteria 4: No significant energy quantities, except from transportation of the biomass, are required to prepare the biomass residues for fuel combustion, i.e. projects that process the biomass residues prior to combustion (e.g. esterification of waste oils) are not eligible under this methodology.
The bagasse produced from the sugar mill is directly fired in the boiler and no fuel preparation or processing is done.
The project activity meets all the applicability criteria of the selected approved methodology and hence applicable in case of TEIL project activity.

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

The methodology is only applicable for the combinations of project activities and baseline scenarios.
Identification of baseline scenario
As per the methodology identification of the most plausible baseline scenario among all realistic and credible alternatives(s) is to be carried out. Steps 2 and/or 3 of the latest approved version of the "tool for the determination and assessment of additionality" should be used to assess which of these alternatives should be excluded from further consideration (e.g. alternatives where barriers are prohibitive or which are clearly economically unattractive). Where more than one credible and plausible alternative remains, as a conservative assumption, the alternative baseline scenario would be the one that results in the lowest baseline emissions as the most likely baseline scenario.
As per the methodology, realistic and credible alternatives should be separately determined regarding:

- How **power** would be generated in the absence of the CDM project activity;
- What would happen to the **biomass** in the absence of the project activity; and
- In case of cogeneration projects: how the **heat** would be generated in the absence of the project activity

For **power** generation, the realistic and credible alternatives may include:

P1 The proposed project activity not undertaken as a CDM project activity
P2 The proposed project activity (installation of a power plant), fired with the same type of biomass but with a lower efficiency of electrical generation
P3 The generation of power in an existing plant, on-site or nearby the project site, using only fossil fuels
P4 The generation of power in existing and/or new grid-connected power plants

P5 The continuation of power generation in an existing power plant, fired with the same type of biomass as co-fired in the project activity, and implementation of the project activity, not undertaken as a CDM project activity, at the end of the lifetime of the existing plant

P6 The continuation of power generation in an existing power plant, fired with the same type of biomass as (co-)fired in the project activity and, at the end of the lifetime of the existing plant, replacement of that plant by a similar new plant

Of the above alternatives P1 faces barriers as given in the subsequent section B.3., hence are excluded from further consideration. Alternative P2 is not an economically attractive alternative since it requires additional investment hence can not be a baseline. Alternative P3 is not applicable in project activity. Alternative P5 can not be the baseline scenario because implementation of the project activity at the end of lifetime of existing plant without CDM faces barrier. Alternative P6 continuation of power generation in existing power plant and its replacement by a similar new plant can not be baseline scenario because existing power plant alone can not meet the entire power requirement of the sugar manufacturing plant. The only feasible and likely alternative is P4 – "generation of power in existing and/or new grid connected power plants", and represents the most likely baseline scenario

As the proposed project activity is a **cogeneration** project so alternatives for heat generation will also have to be identified. For **heat** generation, realistic and credible alternatives may include:

H1 The proposed project activity not undertaken as a CDM project activity

H2 The proposed project activity (installation of a cogeneration power plant), fired with the same type of biomass but with a different efficiency of heat generation (e.g. an efficiency that is common practice in the relevant industry sector)

H3 The generation of heat in an existing cogeneration plant, on-site or nearby the project site, using only fossil fuels

H4 The generation of heat in boilers using the same type of biomass residues

H5 The continuation of heat generation in an existing cogeneration plant, fired with the same type of biomass as in the project activity, and implementation of the project activity, not undertaken as a CDM project activity, at the end of the lifetime of the existing plant

H6 The generation of heat in boilers using fossil fuels

H7 The use of heat from external sources, such as district heat

H8 Other heat generation technologies

Scenarios H3, H6, H7 and H8 are not applicable to TEIL project activity. Alternative H1 faces barriers, which are elaborated in section B.3. Scenario H2 is not an economically attractive option, whereas existing cogeneration plant alone can not fulfil the entire steam requirement of the plant. Most probable baseline scenario in absence of project activity is continuation of heat generation in existing boilers which does not faces any barrier.

For the use of biomass, the realistic and credible alternative(s) may include:

B1 The biomass is dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes

B2 The biomass is used for heat and/or electricity generation at the project site

B3 The biomass is used for power generation, including cogeneration, in other existing or new grid-connected power plants

B4 The biomass is used for heat generation in other existing or new boilers at other sites

B5 The biomass is used for other energy purposes, such as the generation of biofuels

B6 The biomass is used for non-energy purposes

Of the above alternatives B1 is not practiced as the biomass (bagasse) has certain market value and is not an economically attractive alternative. The biomass is currently being used at the project site for heat and electricity generation thus satisfying alternative B2. Since all the bagasse is consumed in the sugar mill of TEIL for heat and power generation and is not used at other sites or for generation or biofuels and non-energy purposes so the alternatives B3, B4, B5 and B6 have been excluded from further consideration as they are not applicable to the project activity. Thus B2 is the most credible and plausible alternative

Among all the identified alternatives, the most credible and plausible alternative that also represent the current scenario is:

Power, P4 The generation of power in existing and/or new grid-connected power plants – In the absence of the project activity TEIL would be generating and consuming the power produced in-house and no export of electricity to grid would take place; the grid based power plants would have to generate similar quantum of power in the absence of the project activity.

Biomass, B2 The biomass is used for heat and/or electricity generation at the project site – In the absence of the project activity bagasse getting generated at TEIL would continue to be used at the site for generating heat and electricity for in-house consumption.

Heat, H4 The generation of heat in boilers using the same type of biomass residues – In the absence of the project activity continuation of current practice would prevail, i.e., heat generation would be carried out in the boilers by using the bagasse generated from the sugar mill.

Thus the above alternative forms the baseline scenario. This specific combination of baseline scenario is defined for scenario 12, which states that:

"The project activity involves the installation of a new cogeneration unit, which is operated next to (an) existing power generation unit(s). The existing unit(s) are only fired with biomass and continue to operate after the installation of the new power unit. The power generated by the new power unit is fed into the grid or would in the absence of the project activity be purchased from the grid. The biomass would in the absence of the project activity be used for heat generation in boilers at the project site. This may apply, for example, where the biomass has been used for heat generation in boilers at the project site prior to the project implementation."

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

As per the selected methodology, the project proponent is required to establish that the GHG reductions due to project activity are additional to those that would have occurred in absence of the project activity as per the 'Tool for the demonstration and assessment of additionality' Annex-1 to EB 16 Report.

Step 0. Preliminary Screening based on the starting date of the project activity

TEIL wishes to have the crediting period starting prior to the registration of their project activity. TEIL is therefore required to

(a) Provide evidence that the starting date of the CDM project activity falls between 1 January 2000 and the date of the registration of a first CDM project activity, bearing in mind that only CDM project activities submitted for registration before 31 December 2005 may claim for a crediting period starting before the date of registration; and

(b) Provide evidence that the incentive from the CDM was seriously considered in the decision to proceed with the project activity.

TEIL's management took the decision of taking the project investment risks and securing the finance partially from bank funding and partially through Sugar Development Fund so as to invest in the project activity. Consideration of the incentive from the CDM has helped TEIL to decide and proceed with the project activity. TEIL chose CDM advisor to guide them through the project registration process and facilitate transaction of CERs.

The project construction started in August 2003 but CDM was taken into consideration since early stages of project development. The incentive provided by CDM was critically considered before decision making by the project proponent. There is sufficient evidence available in form of documentation clearly showing that the CDM incentive played a major role in the TEIL Management's approval of the project activity. Following are the documents available that can be shown as evidence to support that incentive from CDM was seriously considered in the decision to proceed with the project activity:

- ✓ The engagement contract dated 22nd Jan, 2003 signed with the CDM advisor.
- ✓ Correspondence regarding carbon financing made with World Bank dated 31st Jan, 2003.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define alternatives to the project activity

Alternatives to the project activity are defined in section B.2.

Sub-step 1b. Enforcement of applicable laws and regulations

Alternative scenarios defined in section B.2. above, meets all regulatory and legal requirements prevailing in India.

Step 2. Investment analysis OR

Step 3. Barrier analysis.

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

TEIL is required to determine whether the project activity faces barriers that:

(a) Prevent the implementation of this type of proposed project activity; and

(b) Do not prevent the implementation of at least one of the alternatives

through the following sub-steps:

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

The potential for power generation in UP using bagasse is estimated at 1250 MW[3] per year whereas commissioned exportable capacity as of 31st December 2003 is only 75 MW, There are several barriers due to which the above potential is not being harnessed. The project activity also had to overcome investment barriers, institutional barriers and other technological for successful implementation to bring about additional green house gas reductions.

Investment barrier

Project cost of conventional cogeneration project with low-pressure configuration for power generation with bagasse as the fuel is drastically lower, than the project cost of high-pressure configuration. High upfront cost, lack of easy and long-term financing, high project development to investment ratio, project cash flows, fuel linkage round the year *etc.* are the known investment barriers to the Indian bagasse based power projects. As per the available statistics it is evident that foreign direct investments (FDIs) in the

[3] Sources: MNES, New Delhi

sugar sector in India have been almost negligible. For the period from August 1991 to May 2002 only 13 approvals have been granted of which amounting only to 0.38% of the total amount approved[4].

Most sugarcane growers do not have the creditworthiness to obtain private sector financing for investing in high efficiency cogeneration technology due to the cyclical nature of the primary product (sugar), hence their seasonal income. The price of sugar cane in India is controlled and governed / pre-decided by government. To protect sugar cane farmers' interests a minimum sugar cane price based on the quality of sugar cane is pre-decided. Also, till year 2002 the government of India decided upon the price of sale of sugar (as per the quota).

Due to such restrictions accumulation of sufficient funds to finance a high investment and capital-intensive project, such as the project activity is a difficult proposition. Further most companies, including TEIL, have no background in selling power to the grid or other users, so seeking such financing from a private bank proves a key barrier. Thus, TEIL by investing in the higher cost, high efficiency renewable energy project is taking investment risks that many other sugar mill owners in India are not willing to bear.

TEIL's management took this decision of pursuing the project activity in the midst of the uncertainties involved with returns from the project, the transaction under the CDM and rate of CER and other institutional, technological and operational risks associated to project implementation.

Hence, TEIL has shouldered a significant investment risk and taken a pro-active approach by showing confidence in the Kyoto Protocol/CDM system.

Technological Barrier

The typical alternative to the project activity is to continue to use low or medium pressure co-generation configuration. The project activity has adopted a high pressure co-generation technology, which is new in UP and in India as well, and has low market share and less penetration than its other less efficient alternatives. The penetration of new high efficiency cogeneration technology requires greater economies of scale, trouble-free plant operation, availability of spares, availability of skilled manpower to operate the plant continuously *etc*. TEIL is the third company in UP to take the risk by looking for carbon financing to overcome the technology barrier and investing in the 87 kg/cm^2 pressure and STG of double extraction cum condensing technology. The technological barriers become even more significant considering the untapped renewable energy potential in UP using bagasse as fuel. As mentioned above the potential for power generation in UP using bagasse is estimated at 1,350 MW per year, which is roughly 15% of the current installed capacity (9,000 MW) of the grid. Also, the indigenous industry is not fully ready to supply and service all of the equipment and instrumentation necessary for reliable, efficient cogeneration, such as automatic combustion control systems with load following features and high-efficiency systems that are

[4] http://iic.nic.in/iic2_c02.htm

dual- or multi-fuel (bagasse with other biomasses and/or coal) fired[5]. Success of the CDM project will provide a trigger for replication in the other sugar mills thus further reducing the GHG emission to the atmosphere.

Barrier due to Prevailing Practice

The project activity being carried out by TEIL - implementation of high pressure boiler (87 kg/cm^2) for their cogeneration power project is among the first of its kind being carried out in the region. Most of the sugar industries operating in the region continue to use low or medium pressure boilers for co-generation purpose. Prior to the mid-1970's, the steam pressure used in the majority of boilers located in Indian sugar mills was in the range of 10-15 kg/cm^2, which subsequently increased to the prevailing average of 21 kg/cm^2. The majority of the boiler systems in Indian sugar mills operate at a pressure of 21 kg/cm^2 and temperature of 340 ^{o}C, although some mills employ 14 kg/cm^2/265 ^{o}C or 32 kg/cm^2/380 ^{o}C steam systems. In the mid-1980's, a few Indian mills installed higher pressure (42 kg/cm^2) boilers[6], this demonstrates that usage of boilers with higher pressures (87 kg/cm^2) is not a being practised in the sugar industry in the region and hence is not a prevalent practice.

Other Barriers

Institutional Barriers: TEIL project activity signed Power Purchase Agreement (PPA) with UPPCL. For their earnings the project depended on the payment from UPPCL against the sale of electricity to the grid. It was known that the condition of electricity boards in India was not very healthy and it is likely that, there would be problems with cash flows of TEIL. Total outstanding dues against Uttar Pradesh payable to central power sector units as on 31st March 2003 were 4697.31 crores[7]. TEIL was well aware of the situation but the management had to take this risk and face this institutional barrier on which they have limited or no control. This situation makes CDM funds even more critical for TEIL.

It is estimated that, of the total project proponents who get approval from central/state electricity authority to establish bagasse/biomass based power project in India, only a few are successful in commissioning of the plant due to some of the above mentioned barriers. The data on the Common Practice Analysis of the bagasse-based cogeneration suggests that the barriers discussed are strong enough to hinder growth of the sector.

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

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[5] http://www.netl.doe.gov/publications/carbon_seq/articles/india.pdf

[6] Page 7 of 25 of the report "Promotion of Biomass Cogeneration with Power Export in the Indian Sugar Industry

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It has been observed in Sub-step 3a that the - project activity had its associated barriers to successful implementation. The other most realistic alternatives available to TEIL in absence of project activity were evaluated above (in section B.2.).

From the Step 1 and Step 3 we may conclude that there are alternatives as given in section B.2. that do not have any impediments preventing their implementation. However the project activity faces barriers, which would prevent TEIL from implementing the project activity as elaborated in the 'Barrier Analysis'.

Step 4-a. Common Practice Analysis

The common practice scenario tabulated below substantiates that the alternative 3 - project activity without CDM benefits is not a widespread proposition for the sugar-manufacturing units in similar socio-economic environment of Uttar Pradesh State. The alternative –1 (Cogeneration unit to meet the plant's energy requirements with no surplus power generation) is the most common practice adopted by the sugar-manufacturing units. The Indian sugar-manufacturing units have been in utilizing their bagasse in an inefficient manner by use of low-pressure boiler to generate steam and electricity only for in-house consumption.

Following data illustrates that the project is not a common practice in the proposed area of implementation.

Table B-6: Data on Co-generation practices adopted by the Sugar Industries in Uttar Pradesh	
Closed Sugar Mills	17
Alternative 1- Cogeneration unit to meet the plant's energy requirements with no surplus	*93*
Alternative 2- Cogeneration unit to meet the plant's energy requirements with some surplus	*7*
Alternative -3: Cogeneration unit to meet the plant's energy requirements with surplus power generation without CDM benefits	*0*
Cogeneration unit to meet the plant's energy requirements with surplus power generation with CDM benefits taken into consideration	*3*[8]
Total number of Sugar Mills in UP	120
(Reference : Indian Sugar Mills Association and field visits to UP)	

In India, only five[9] sugar mills from a total of more than 450 sugar mills, are operating with grid connected cogeneration unit of high pressure configuration of 87 kg/cm^2 (equivalent configuration as of project

[7] http://powermin.nic.in/indian_electricity_scenario/pdf/NR0605.pdf

[8] Apart from TEIL, Deoband the other units are (1) BCML, UP and (2) HCM, UP. These units are depended on revenues from the sale of CERs.

[9] In India, apart from the 3 UP mills other units, which have set 'Baggase-based high pressure (87 kg/cm^2) cogeneration connected to electricity grid' under the CDM are of Kakatia Sugar, AP and Bannari Amman, Sathyamangalam, TN.

activity). Out of these five cogen units, three are in Uttar Pradesh state. TEIL is the one of the forerunner project proponents in Uttar Pradesh that has pursued CDM project to bring about additional GHG reductions and avail the revenues from sale of carbon emission reductions. In absence of these CDM project activities there would be no bagasse-based cogeneration unit, which would meet the plant's energy requirements and generate surplus power to export to the grid. This shows that there is no (poor) penetration of this technology in Uttar Pradesh. In absence of the two project activities developed under CDM, the project activity occurs in 0% of the similar industries and is therefore not a common practice.

Step 5. Impact of CDM registration

The benefits and incentives expected due to approval and registration of the project activity as a CDM activity will certainly improve the sustainability of the project activity and thus its consideration before implementation helps to overcome the identified barriers (Step 3), which enables the project activity to be undertaken.

As mentioned above in Step 0, before implementation of the project activity, TEIL considered all the barriers discussed above. TEIL's management took the decision of taking the investment risks and securing the finance partially from bank funding and partially through Sugar Development Fund so as to invest in the CDM project activity after computing the proposed carbon financing.

The corporate decision to invest in the project activity was guided by the anthropogenic greenhouse gas emission reductions the project activity would result in and its associated carbon revenue the project activity would receive through sale of CERs under the Clean Development Mechanism.

It is ascertained that the project activity would not have occurred in the absence of the CDM simply because no sufficient financial assistance, policy initiatives, or other incentives exist locally to foster its development in India and without the proposed carbon funding for the project the TEIL would not have taken the risks of implementing the project activity. In such an event the Business as usual (BAU) baseline option is continued with release of carbon dioxide emissions.

As per the above-mentioned steps the project activity is additional and the anthropogenic emissions of GHG by sources will be reduced below those that would have occurred in the absence of the registered CDM project activity.

Further, with CDM project activity registration, many more sugar manufacturing industries in India would take up similar initiatives under CDM by overcoming the barriers to project activity implementation resulting in higher quantum of anthropogenic greenhouse gas emissions reductions.

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

As per the methodology, for the purpose of determining GHG emissions of the project activity the following emission sources are to be included:

- CO_2 emissions from on-site fuel consumption of fossil fuels, co-fired in the biomass power plant; and
- CO_2 emissions from off-site transportation of biomass that is combusted in the project plant.

There is no fossil fuel consumption in the power plant and off-site transportation is also not involved as the project activity would be utilising the bagasse available on-site. Thus there would be no GHG emissions due to the project activity.

For the purpose of determining the baseline, the following emission sources are included:

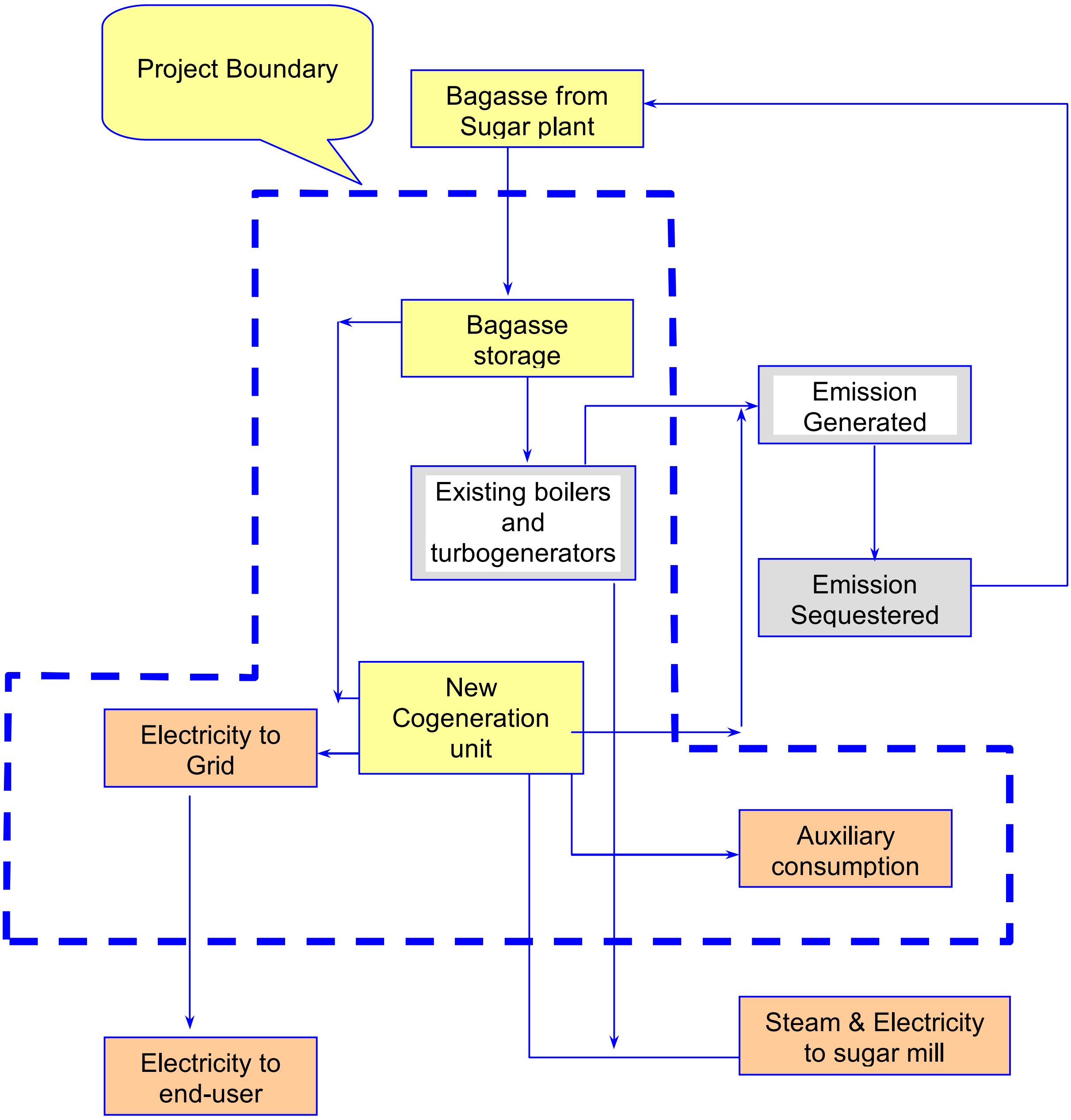
- CO_2 emissions from fossil fuel fired power plants connected to the electricity system.

As the bagasse is not dumped or left to decay or burned in an uncontrolled manner without utilizing it for energy purposes so CH_4 emissions arising due to the same are not involved in the project and baseline emissions.

The **spatial extent** of the project boundary includes the power plant at the project site and all power plants connected physically to the electricity system that the project activity is supplying power to. Further guidance on the spatial extent of the project electricity system, including issues related to the calculation of the build margin (BM) and operating margin (OM), has been taken from "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002).

Project Site

Project activity boundary covers bagasse fuel storage, new cogeneration plant, Auxiliary units, existing boilers and turbines. The project activity uses bagasse generated from its Mill. Flow chart and project boundary is illustrated in the following Figure:


Project Boundary
Bagasse from Sugar plant
Bagasse storage
Existing boilers and turbogenerators
Emission Generated
Emission Sequestered
New Cogeneration unit
Electricity to Grid
Auxiliary consumption
Steam & Electricity to sugar mill
Electricity to end-user

Connected (Project) electricity system - Power plants connected to the electricity system

For the purpose of determining the Built Margin (BM) and operating margin (OM) emission factor, a connected electricity system is defined as an electricity system that is connected by transmission lines to the project electricity system and in which power plants that can be dispatched without significant transmission constraints.

Indian power grid system is divided into five regions namely Northern, North Eastern, Eastern, and Southern and Western Regions. The Northern Region consists of Delhi, Himachal Pradesh, Punjab, Uttar Pradesh, Haryana, Jammu & Kashmir, Rajasthan and newly formed Uttaranchal State. Each state has its own power generation plants (State Government owned) managed by respective State Electricity Boards. In addition to the state government owned power generation plants, there are central government (government of India) owned power generation plants managed by Government of India Enterprises like National Thermal Power Corporation Ltd., Nuclear Power Corporation Ltd., National Hydro Electric Power Corporation Ltd. *etc* and private owned power generation plants exporting power to the grid. Power mix may be thermal, hydro, wind, nuclear.

The project activity is connected to the UP state grid which is a part of Northern regional grid. As per the clarification given by CDM Meth panel regarding the choice of grid in its eighteenth meeting[10] for India regional grid should be the default choice for project activity for calculation of baseline emission factors (Northern regional grid in this case).

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

Please refer to section B.2 and annex 3 for baseline information. The baseline study was conducted by TEIL. Baseline study was completed on 10/10/2005.

TEIL is the project participant and contact information for TEIL is presented in Annex 1 of this document.

[10] http://cdm.unfccc.int/UserManagement/FileStorage/AM_CLAR_0POKO08YCVCDQU3XYV2LSR88RCSARA

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

June 2003.

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

20 years

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

For the project activity, the preferred crediting period opted is 10 years.

C.2.1. Renewable crediting period

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:

C.2.2.1. Starting date:

01/11/2004

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 project activity:

Title: Consolidated baseline methodology for grid-connected electricity generation from biomass residues

Reference – Approved consolidated baseline methodology ACM0006, Version 03, Sectoral Scope: 01, 12th May 2006

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

The monitoring methodology is used in conjunction with the 'Approved consolidated baseline methodology ACM0006' (Consolidated baseline methodology for grid-connected electricity generation from biomass residues). The same applicability conditions as in baseline ACM0006 apply. Project activity meets the applicability criteria of the 'Approved consolidated baseline methodology ACM0006'. (Please refer to Section B.1.1 for details).

The monitoring methodology requires monitoring of the following:

- Electricity generation from the proposed project activity;
- Data needed to recalculate the operating margin emission factor, if needed, based on the choice of the method to determine the operating margin (OM), consistent with "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002);
- Data needed to recalculate the build margin emission factor, if needed, consistent with "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002);
- Data needed to calculate, if applicable, carbon dioxide emissions from fuel combustion due to co-firing fossil fuels used in the project plant or in boilers operated next to the project plant or in boilers used in the absence of the project activity;
- Where applicable, data needed to calculate methane emissions from natural decay or burning of biomass in the absence of the project activity;
- Where applicable, data needed to calculate carbon dioxide emissions from the transportation of biomass to the project plant;
- Where applicable, data needed to calculate methane emissions from the combustion of biomass in the project plant;

- Where applicable, data needed to calculate leakage effects from fossil fuel consumption outside the project boundary;

In the TEIL project activity:

- The operating margin emission factor (Simple OM based on 3 year average) and build margin emission factor (ex ante) are fixed at the start of the project activity and hence do not require recalculation;
- There is no fossil fuel being combusted in the project activity;
- Decay or uncontrolled burning of biomass does not happen in the absence of the project activity;
- Transportation of biomass is involved in the project activity;
- Methane emissions from the combustion of biomass is not applicable; and
- There is no leakage involved in the project activity.

Thus effectively the monitoring of the following parameters will be involved in the project activity:

- Net electricity generated from the proposed project activity;
- Total electricity generated from all the power plants at the project site; and
- Quantity of bought bagasse.
- Distance from which bagasse has been brought.
- Number of truck trips.

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

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data Type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording Frequency	How will the data be archived? (electronic/ paper)	Comment
1. $BF_{i,,y}$	Mass or volume	Quantity of Biomass transported	tons	M	Continuous, annual energy balance	electronic	Quantity of biomass transported on trucks has been measured on a weigh bridge, provided with suitable scale to measure the weight. These scales shall be calibrated periodically by external agency for accuracy measurement.
2. AVDy	Distance	Average return trip distance between biomass fuel supply site and project site.	Km	M	continuous	electronic	If biomass supplied from different sites mean value of km travelled by trucks should be recorded.
3. Ny	Number	Number of truck trips	-	M	continuous	electronic	Number of truck trips are measured and recorded in

		for biomass transportation					log books for measurement.
4. EFkm, CO2	Emission factor	Average CO2 emission factor for transportation of biomass with trucks	tCO_2/Km	C	Annually		Local or national data is preferred.

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Carbon dioxide emissions from combustion of fossil fuel for transportation of biomass to the project plant (PETy)

In cases where the biomass is not generated directly at the project site, project participants shall determine CO2 emissions resulting from transportation of the biomass to the project plant. In many cases transportation is undertaken by vehicles. Project participants may choose between two different approaches to determine emissions: an approach based on distance and vehicle type (option 1) or on fuel consumption (option 2).

Option 1:

Emissions are calculated on the basis of distance and the number of trips (or the average truck load):

$PET_y = N_y \times AVD_y \times EF_{km, CO2}$

where:

Ny is the number of truck trips during the period y.

AVDy is the average return trip distance between the biomass fuel supply sites and the site of the project plant in kilometers (km),

EFkm,CO2 is the average CO2 emission factor for the trucks measured in t CO2/km, and

BFi,y is the quantity of biomass type *i* used as fuel in the project plant during the year *y* in a volume or mass unit,

TLy is the average truck load of the trucks used measured in tons or volume of biomass,

:

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data Type	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1. $EG_{project\ plant,\ y}$	Electricity Quantity	Net quantity of electricity generated in the project plant during the year y	Metering records	MWh	M	Continuous	100%	Electronic	Net quantity of electricity produced has been monitored by energy meters of class-0.2 with tolerance level of 0.5%. Separate energy meters are used for measurement of gross electricity generation and auxiliary consumption. Energy meters have been calibrated periodically as per standard procedures by accredited third party agencies.

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data Type	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
2. $EG_{total, y}$	Electricity Quantity	Total quantity of electricity generated at the project site (Including the project plant and any other plant at site existing at the start of the project activity)	Metering records	MWh	M	Continuous	100%	Electronic	Total quantity of electricity produced has been monitored by energy meters of class-0.2 with tolerance level of 0.5%. Separate energy meters are used for measurement of gross electricity generation and auxiliary consumption. Energy meters have been calibrated periodically as per standard procedures by accredited third party agencies.

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data Type	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
3. $Q_{project\ plant,}$	Heat quantity	Net quantity of heat generated from firing biomass in the project plant	Meters	MWh	M	Continuous	100%	Electronic	Steam Quantity, its pressure and temperature will be monitored on continuous basis. Net quantiy of heat can be calculated from monitored parameters. Accuracy of boiler outlet steam flow meter and turbine inlet steam flow meter (a) Nozzel Accuracy: 1 to 1.5 % Full scale division (FSD) (b) Transmitter accuracy 0.1% of FSD. All Meters are calibrated by accredited external third party, as per standard procedures, periodically

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data Type	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
4.$BF_{i,y}$	Mass or Volume	Quantity of Biomass type i combusted in the project plant during year y	Metering records	Mass or Volume unit	M	Continuous	100%	Electronic	Biomass measuring device has an accuracy level of +/- 0.5% of full scale, and ranging between 0-120 TPH. All Meters have been calibrated as per standard procedures periodically. All Meters are calibrated by accredited external third party, as per standard procedures, periodically
5. NCV_i	Net calorific value	Net calorific value of biomass		Mwh/Mass or Volume unit	m or c	annually	100 %	Electronic	Net Calorific value of biomass has been measured in accredited labs by bomb calorimeter using standard procedures.

6. ε_{boiler}	Thermal energy efficiency	Average net Energy efficiency of heat generation in the boiler that is operated next to the project plant			M	Quarterly	100 %	Electronic	

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

Baseline emissions are estimated as under

Calculation of electricity baseline emission factor

An electricity baseline emission factor ($EF_{electricity,y}$) is calculated as a combined margin (*CM*), consisting of the combination of operating margin (*OM*) and build margin (*BM*) factors according to the following three steps. Calculations for this combined margin is based on data from official sources (where available) and made publicly available.

STEP 1. Calculate the Operating Margin emission factor(s)

Out of four methods mentioned in the ACM0002, Simple OM approach has been chosen for calculations since in the Northern Regional grid mix, the low-cost/must run resources constitutes less than 50% of total grid generation. Simple OM factor is calculated as under.

$EF_{OM,simple,y}$ is calculated as the average of the most recent three years (2002-2003, 2003-2004 & 2004-2005) .

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

where

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

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

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

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

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

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

where

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

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

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

The CO_2 emission coefficient $COEF_i$ is obtained as

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

where

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

$EF_{CO2,i}$ Is the CO_2 emission factor per unit of energy of the fuel i

$OXID_i$ Is the oxidation factor of the fuel

STEP 2. Calculate the Build Margin emission factor (EFBM,y) as the generation-weighted average emission factor (t CO_2/MWh) of a sample of power plants m of the grid, as follows:

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

where

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

Considered calculations for the Build Margin emission factor $EF_{BM,y}$ as ex ante based on the most recent information available on plants already built for sample group m of Northern Regional grid at the time of PDD submission. The sample group m consists of the 20 % of power plants supplying electricity to grid that have been built most recently, since it comprises of larger annual power generation. (Refer Annex 3)
Further, none of the power plant capacity additions in the sample group have been registered as CDM project activities.

STEP 3. Calculate the electricity baseline emission factor $EF_{electricity,y}$ as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

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

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

The emission reductions due to the displacement of electricity are given as:
$ER_{electricity,y} = EG_y \times EF_{electricity,y}$

where
$ER_{electricity,y}$ - Are the baseline emissions due to displacement of electricity during the year y in tons of CO_2

EG_y - Is lower amongst the following options:

1. $EG_{project\ plant,\ y}$
2. $EG_{total,\ y} - (EG_{historic,\ 3\ yr})/3$

$EF_{electricity,y}$ - Is the CO_2 baseline emission factor for the electricity displaced due to the project activity in during the year y in tons CO_2/MWh.

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

Not Applicable

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

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

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

>>

D.2.3. Treatment of leakage in the monitoring plan

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

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

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

Not applicable

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

Formula used for estimation of the total net emission reductions due to the project activity during a given year *y* is as under.

$$ER_y = ER_{heat,y} + ER_{electricity,y} + BE_{biomass,y} - PE_y - L_y$$

where

ER_y are the emissions reductions of the project activity during the year *y* in tons of CO_2,

$ER_{electricity,y}$ are the emission reductions due to displacement of electricity during the year *y* in tons of CO_2,

$ER_{heat,y}$ are the emission reductions due to displacement of heat during the year *y* in tons of CO_2,

$BE_{biomass,y}$ are the baseline emissions due to natural decay or burning of anthropogenic sources of biomass during the year y in tons of CO_2 equivalents,

PE_y are the project emissions during the year y in tons of CO_2, and

L_y are the leakage emissions during the year y in tons of CO_2.

The emission reductions due to displacement of electricity are only taken into consideration and project emissions associated with transportation of bagasse has been deducted for calculating the emission reductions which is given by:

$$ER_y = ER_{electricity,y} - PE_y$$

Emission reductions due to heat generation in TEIL project plant is zero ($ER_{heat,y}= 0$) because additional heat required in project case shall be initiated in boilers fired with same type of biomass.

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
D.2.1.1. (1)	Low	Quantity of Biomass required to transport shall be calculated and reported in log books.
D.2.1.1. (2)	Low	Distance shall be measured and recorded in log books.
D.2.1.1. (3)	Low	Numbers of truck trips are recorded in log books.
D.2.1.1. (4)	Low	IPCC data has been taken.
D.2.1.3. (1)	Medium	Net electricity production has been calculated by deducting auxiliary consumption from gross generation of the plant. Digital meters calibration procedures are planned. Daily productions details are kept in log books and electronic data base. Energy meters are of class 0.2 with tolerance of 0.5%. All Meters are calibrated by accredited external third party, as per standard procedures, periodically.

D.2.1.3. (2)	Low	Energy meters on existing turbines are calibrated on annual basis by NABL accredited labs. Electricity generation in these units are recorded and kept in log books for verification purpose.Energy meters are of class 0.2 with tolerance of 0.5%. All Meters are calibrated by accredited external third party, as per standard procedures, periodically.
D.2.1.3. (3)	Low	Heat generated will be calculated by measuring quantity of steam produced and monitoring steam parameters. Accuracy of boiler outlet steam flow meter and turbine inlet steam flow meter (a) Nozzel Accuracy: 1 to 1.5 % Full scale division (FSD) (b) Transmitter accuracy 0.1%of FSD. All Meters are calibrated by accredited external third party, as per standard procedures, periodically
D.2.1.3. (4)	Low	Quantity of biomass has been monitored. Biomass measuring device has an accuracy level of +/- 0.5% of full scale, and ranging between 0-120 TPH. All Meters have been calibrated as per standard procedures periodically. All Meters are calibrated by accredited external third party, as per standard procedures, periodically
D.2.1.3. (5)	Low	NCV value of bagasse has been measured by bomb calorimeter in a national accredited lab.
D.2.1.3. (6)	Low	Boiler efficiency has been calculated by dividing energy output of steam from boilers by total energy of biomass input in boilers.

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

TEIL has implemented an operational and management structure in order to monitor emission reductions and any leakage effects, generated by the project activity. TEIL has formed a CDM team/committee comprising of persons from relevant departments, which will be responsible for monitoring of all the parameters mentioned in this section. The CDM team also comprises of a special group of operators who are assigned the responsibility of monitoring of different parameters and record keeping. On a weekly basis, the monitoring reports are checked and discussed by the senior CDM team members/managers. In case of any irregularity observed by any of the CDM team member, it is informed to the concerned person for necessary actions. On monthly basis, these reports are forwarded at the management level.

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

Triveni Engineering and Industries Limited (TEIL)

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SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

Since the project activity uses bagasse as the fuel, the project leads to no GHG on-site emissions. The GHG emissions of the combustion process, mainly CO_2, will be consumed by sugar cane plant species, representing a cyclic process of carbon sequestration. Since, the bagasse contains only negligible quantities of other elements like Nitrogen, Sulphur *etc*. release of other GHG emissions are considered as negligible. The bagasse is expected to contain 50% moisture; this will keep the temperatures at steam generator burners low enough not to produce nitrogen oxides. Hence there is no net emission within the project boundary.

[A] Project Emissions associated with fossil fuel combustion

TEIL is required to account for CO_2 emissions from the combustion of any fossil fuels (if any) during the project activity operations, as a part of project emissions. There is no fossil fuel combustion associated with the project activity, hence there are no project emissions associated to fossil fuel combustion due to project activity implementation.

[B] Project Emissions associated with transport of bagasse fuel

The bagasse to be used as the feedstock for project activity is supplied by the nearby mills. Considering 30.5 % bagasse on an average, with crushing rate of 350 TPH of cane the bagasse generated in TEIlL, deoband sugar facility is 106.75 TPH out of which 103.00 TPH is available for usage in old and new boiler after deducting losses and bagacillo requirement. Out of 103.00 TPH, 46.72 TPH would be used in new cogeneration plant, 11.04 TPH would be saved for off season requirement and remaining would be used in old boilers. It is envisaged that approximately 29050 MT of bagasse would be purchased every year for off season operations of the cogeneration plant.

[C] Project Emissions associated with the storage of bagasse fuel

The net increase of methane emissions associated with the storage of bagasse fuel is regarded as negligible if the bagasse is not stored for more than one year. The bagasse utilized for the project activity is stored in open piles for not more than one year. Therefore there would be no project emissions associated with the storage of bagasse fuel.

E.2. Estimated leakage:

There are no leakages involved in the project activity.

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

Total Project emissions by project activity are 1800 tonnes of CO_2 over the crediting period.

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

As per the methodology the anthropogenic emissions in the baseline for the project activity would occur due to the electricity generation by the fossil fuel intensive grid and will be given by:

$$ER_{electricity,y} = EG_y \times EF_{electricity,y}$$

Year	Estimation of Net Electricity exported, EG_y (million kWh/annum)	Estimation of Emission factor, tonnes of CO_2 /million kWh	Estimation of baseline emissions (tonnes of CO_2e)
2004-2005	70.31	923.54	64,930
2005-2006	89.69	923.54	82,834
2006-2007	95.93	923.54	88,591
2007-2008	95.93	923.54	88,591
2008-2009	95.93	923.54	88,591
2009-2010	95.93	923.54	88,591
2010-2011	95.93	923.54	88,591
2011-2012	95.93	923.54	88,591
2012-2013	95.93	923.54	88,591
2013-2014	95.93	923.54	88,591
Total (tonnes of CO_2e)	**914.60**	**923.54**	**856,492**

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

The project emissions associated with transportation of bagasse have been calculated and deducted from baseline emissions for calculating emission reductions. As per the methodology, leakages due to diversion of biomass are already considered in calculation of baseline reduction for scenario-12, hence not considered for the project activity.

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

Year	Estimation of project activity emissions (tonnes of CO_2e)	Estimation of baseline emissions (tonnes of CO_2e)	Estimation of leakage (tonnes of CO_2e)	Estimation of emission reductions (tonnes of CO_2e)
2004-2005	180	64,930	0	64,750
2005-2006	180	82,834	0	82,654
2006-2007	180	88,591	0	88,411
2007-2008	180	88,591	0	88,411
2008-2009	180	88,591	0	88,411
2009-2010	180	88,591	0	88,411
2010-2011	180	88,591	0	88,411
2011-2012	180	88,591	0	88,411
2012-2013	180	88,591	0	88,411
2013-2014	180	88,591	0	88,411
Total (tonnes of CO_2e)	**1800**	**856,492**	**0**	**854,695**

SECTION F. Environmental impacts

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

Assessment of Environmental Impact due to the project activity is carried out. A separate EIA summary report is available as Enclosure – I.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

Host party regulations require TEIL to obtain environmental clearance in the form of "No objection Certificate" from Uttar Pradesh Pollution Control Board. The site of the project is to be approved from the environmental angle and that the Environmental Management Plans are to be prepared and submitted to the pollution control board. Environmental Impact Assessment has been conducted for the project activity to understand if there are any significant environmental impacts and the study indicates that the impacts are not significant.

The following consents were obtained from the State Pollution Control Board for the bagasse based cogeneration plant:

- Consent to 'establish' and 'operate' under Section 21 of the Air (Prevention and Control of Pollution) Act, 1981 (Central Act 14 of 1981) as amended
- Consent to 'establish' and 'operate' under Section 25/26 of the Water (Prevention and Control of Pollution) Act, 1974 (Central Act 6 of 1974) as amended.

SECTION G. Stakeholders' comments

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

The stakeholders identified for the project are as under.

- Elected body of representatives administering the local area (village *Panchayat*) as well as legislative assembly
- Uttar Pradesh Power Corporation Limited (UPPCL)
- Uttar Pradesh Electricity Regulatory Commission (UPERC)
- Uttar Pradesh Pollution Control Board (UPPCB)
- Consultants
- Equipment Suppliers

Stakeholders list includes the government and non-government parties, which are involved in the project at various stages. The TEIL representative met the local villagers, elected representatives and NGOs and apprised them about the project and sought their feedbacks for the project in writing which are available for examination.

G.2. Summary of the comments received:

Local population comprises of the local people in and around the project area. The role of the local people is as a beneficiary of the project and they have pointed out the various benefits of the project. These comments are available with TEIL for reference. The local people are appreciative of the efforts taken by TEIL and have requested them to provide the ash generated from the project activity as it would serve them as good nourishment for the soil. TEIL is providing the ash from the project activity to these local people.

Uttar Pradesh Pollution Control Board (UPPCB) and Environment Department of Uttar Pradesh have prescribed standards of environmental compliance and monitor the adherence to the standards. TEIL has received the 'Consent to Operate' the plant.

State's regulatory body of power is Uttar Pradesh Electricity Commission (UPERC) and they have issued consent for the installation of co-generation power plant of 22 MW capacity.

As a buyer of the power, the UPPCL is a major stakeholder in the project. They hold the key to the commercial success of the project. Power Purchase Agreement (PPA) with UPPCL has been signed.

Project consultants were involved in the project to take care of various pre contract and post contract project activities like preparation of Detailed Project Report (DPR), preparation of basic and detailed engineering documents, preparation of tender documents, selection of vendors / suppliers, supervision of project implementation, successful commissioning and trial runs.

Equipment suppliers have supplied the equipments as per the specifications finalized for the project and were responsible for successful erection & commissioning of the same at the site.

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

No major concern was raised during the consultation with stakeholders and satisfactory answers were provided to the issues raised by them. TEIL is fulfilling the request made by the local people by providing them the ash getting generated from the project activity. The equipment suppliers have supplied the equipments as per the specifications and have not raised any comments.

The relevant comments and important clauses mentioned in the project documents/clearances like Detailed Project Report (DPR), environmental clearances, power purchase agreement, local clearance etc. were considered while preparation of CDM project design document.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Triveni Engineering & Industries Limited (TEIL)
Street/P.O.Box:	15-16, Sector 16-A
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City:	Noida
State/Region:	Uttar Pradesh
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Telephone:	+91-120-5308000
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E-Mail:	ssinha@ho.trivenigroup.com
URL:	www.trivenigroup.com
Represented by:	
Title:	Vice President – Corporate Planning
Salutation:	Mr.
Last Name:	Sinha
Middle Name:	-
First Name:	Sameer
Department:	-
Mobile:	-

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding as part of project financing from parties included in Annex I of the convention is involved in the project activity.

Annex 3

BASELINE INFORMATION

Grid Selection

In India, power is a concurrent subject between the state and the central governments therefore there are state utilities and central utilities. The electricity system in India is divided into five regions – Northern, Eastern, Western, Southern and North-Eastern Electricity Boards. The management of generation and supply of power within the regional grid is undertaken by the load dispatch centers (LDC). Different states within the regional grids meet the demand from their own generation facilities plus generation by power plants owned by the central sector i.e., National Thermal Power Corporation (NTPC) and National Hydro Power Corporation (NHPC) etc. Specific quota is allocated to different states from the central sector power plants. Depending on the demand and generation there are exports and imports of power within different states in the regional grid. The choice of a regional grid minimizes the effect of inter state power transactions which are dynamic and vary widely. The regional grids have minimal interchange of electricity between themselves therefore a regional grid can be safely considered as the relevant electricity grid rather than going for the state grid or the national grid. In this case the Northern regional grid can be clearly identified as the relevant electricity grid which is further justified based on the following facts.

The Northern Regional Electricity Board comprises of the following states namely Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab, Rajasthan, Uttar Pradesh and Uttaranchal.

TEIL will be supplying power to the Uttar Pradesh Power Corporation Limited (UPPCL). Since Uttar Pradesh comes under the northern regional electricity board so the northern grid has been taken as the baseline for which official information and characteristics is available.

Key parameters with their data sources

S No.	Key parameters	Data sources
1.	Generation data for all plants for the year 2002-03, 2003-04 and 2004-05(kWh)	Annual Reports of Northern Region Electricity Board (NREB) (http://www.nreb.nic.in/Reports/Index.htm)
2.	Coal consumption	Annual Performance Review of Thermal Power Plants; CEA (http://www.cea.nic.in/opm/per_rev.htm)
3.	Calorific value of gas	Revised 1996 IPCC guidelines for National GHG Inventories: Reference manual

4.	Calorific value of coal	NATCOM Chapter-2 GHG Inventory Information P.33 http://www.natcomindia.org/pdfs/chapter2.pdf
5.	Oxidation factors	IPCC
6.	Efficiency of gas based power plants supplying power to grid	"Study of Baseline for renewable energy projects under clean development mechanism" Ministry of Non conventional energy sources. http://mnes.nic.in/baselinerpt.htm

Calculation of electricity baseline emission factor

Step 1. Calculate the Operating Margin emission factor ($EF_{OM,y}$)

As per step 1, the Operating Margin emission factor(s) ($EF_{OM, y}$) is to be calculated based on one of the following four methods:

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

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

The Simple OM (a) method is applicable to project activity connected to the project electricity system (grid) where the low-cost/must run resources constitute less than 50% of the total grid generation in:

1) average of the five most recent years, or
2) based on long-term normal for hydroelectricity production.

The Average OM (d) methods can only be used

- where low-cost/must run resources constitute more than 50% of the total grid generation and detailed data to apply option (b) is not available, and
- where detailed data to apply option (c) above is unavailable.

To select the appropriate methodology for the determination of $EF_{OM, y}$ for the project activity the Northern Regional Electricity Grid was chosen as the Project Electricity System. The power generation data for the Northern grid was analysed. It was found that the low cost/must run resources comprising of hydro, geothermal, wind, low-cost biomass, nuclear and solar generation constituted less than 50% to the total grid generation. The data on the power generation by various sources is given in the Table B-1.

Table B-1: Power generation mix of Northern Grid for five years

Energy Source	2000-01	2001-02	2002-03	2003-04	2004-05
Total Power Generation (MU)	134492.7	140515.2	154544.34	168109.84	172681.58
Total Thermal Power Generation	99766.38	104339.7	115985.83	122955.41	126341.00
Total Low Cost Power Generation	34726.33	36175.51	37723.02	44681.92	46340.58
Thermal % of Total grid generation	74.18	74.26	75.05	73.14	73.16
Low Cost % of Total grid generation	**25.82**	**25.74**	**24.41**	**26.58**	**26.84**
% of Low Cost generation out of Total grid generation - Average of the five most recent years 26.69%					**25.88**

Since the low cost/must run system constitute less than 50% of the total power generation in the Northern grid therefore Simple OM (a) method has been used for the calculation of Baseline Emission factor.

The Simple OM emission factor ($EF_{OM,\ simple,\ y}$) is calculated as the generation weighted average per electricity unit (tCO_2/MU) of all generating sources serving the project electricity system, not including low-operating cost/must run plants. The generation data for various power generating stations for the most recent three years are presented in Annex 3.

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

1. A 3-year average, based on the most recent statistics available at the time of PDD submission, or
2. The year in which project generation occurs, if $EF_{OM,\ y}$ is updated based on ex post monitoring.

Here the Simple OM emission factor has been calculated based on the first method (3-year average).
The following Table presents the key information and data used to determine the Simple OM emission factor.

Table B-2 Data used for Simple OM emission factor

Generation Details (2002-2003)					
Name	**Type**	**Fuel**	**Installed Capacity (MW)**	**Generation (Million kWh)**	**Coal Consumption (000' tonnes)**
Badarpur TPS	Thermal	Coal	720	5267.22	3554
Singrauli STPS	Thermal	Coal	2000	16174.32	10213
Rihand STPS	Thermal	Coal	1500	7734.09	4787
Dadri NCTPS	Thermal	Coal	840	6041.46	4005
Unchahar-I TPS	Thermal	Coal	420	3039.51	
Unchahar-II TPS	Thermal	Coal	420	3103.97	4153

Tanda TPS	Thermal	Coal	440	2211.46	1990
Anta GPS	Thermal	Gas	413	2757.73	
Auriya GPS	Thermal	Gas	652	4268.68	
Dadri GPS	Thermal	Gas	817	5211.55	
Faridabad GPS	Thermal	Gas	430	2702.02	
Bairasiul	Hydro	Hydel	198	671.67	
Salal	Hydro	Hydel	690	3142.07	
Tanakpur HPS	Hydro	Hydel	120	421.56	
Chamera HPS	Hydro	Hydel	840	2253.53	
Uri HPS	Hydro	Hydel	480	2448.16	
RAPS-A	Nuclear	Nuclear	300	1439.31	
RAPS-B	Nuclear	Nuclear	440	3398.83	
NAPS	Nuclear	Nuclear	440	3580.38	
Bhakra Complex	Hydro	Hydel	1479.5	6531.01	
Dehar	Hydro	Hydel	990	3253.10	
Pong	Hydro	Hydel	396	763.85	-
Delhi	Thermal	Coal	382.5	1455.83	1202
Delhi	Thermal	Gas	612.4	2035.15	-
Haryana	Thermal	Coal	1540	5867.03	4598
Haryana	Hydro	Hydel	48	245.75	-
H.P.	Hydro	Hydel	709	1598.25	-
J&K	Hydro	Hydel	309.15	407.09	-
J&K	Thermal	Gas	175	67.36	-
Punjab	Thermal	Coal	2130	13576.98	9001
Punjab	Hydro	Hydel	1148.3	3525.55	-
Rajasthan	Thermal	Coal	2295	13826.40	11133
Rajasthan	Thermal	Gas	113.8	218.92	-
Rajasthan	Hydro	Hydel	432	60.78	-
U.P.	Thermal	Coal	4102	20426.15	16287
U.P.	Hydro	Hydel	518.6	1391.30	-
Uttaranchal	Hydro	Hydel	986.85	3426.31	-
TOTAL				**154544.34**	**70923.00**

Generation Details (2003-2004)					
Name	**Type**	**Fuel**	**Installed Capacity (MW)**	**Generation (Million kWh)**	**Coal Consumption (000' tonnes)**
Badarpur TPS	Thermal	Coal	720	5428.96	3605
Singrauli STPS	Thermal	Coal	2000	15643.40	9742
Rihand STPS	Thermal	Coal	1500	7949.26	4742
Dadri NCTPS	Thermal	Coal	840	6181.12	4136
Unchahar-I TPS	Thermal	Coal	420	3252.14	
Unchahar-II TPS	Thermal	Coal	420	3187.93	4396
Tanda TPS	Thermal	Coal	440	2872.81	2331
Anta GPS	Thermal	Gas	413	2775.92	-
Auriya GPS	Thermal	Gas	652	4247.41	

Dadri GPS	Thermal	Gas	817	5058.66	
Faridabad GPS	Thermal	Gas	430	2792.58	
Bairasiul	Hydro	Hydel	198	687.79	
Salal	Hydro	Hydel	690	3477.42	
Tanakpur HPS	Hydro	Hydel	120	510.99	
Chamera HPS	Hydro	Hydel	840	2648.32	
Uri HPS	Hydro	Hydel	480	2873.54	
RAPS-A	Nuclear	Nuclear	300	1293.37	
RAPS-B	Nuclear	Nuclear	440	2904.68	
NAPS	Nuclear	Nuclear	440	2959.44	
Bhakra Complex	Hydro	Hydel	1479.5	6956.90	
Dehar	Hydro	Hydel	990	3299.29	
Pong	Hydro	Hydel	396	1178.93	
SJVNL HEP	Hydro	Hydel	1500	1164.11	
Delhi	Thermal	Coal	382.5	1537.92	1268
Delhi	Thermal	Gas	612.4	5159.77	-
Haryana	Thermal	Coal	1540	6849.26	5213
Haryana	Hydro	Hydel	48	251.73	-
H.P.	Hydro	Hydel	709	3666.39	-
J&K	Hydro	Hydel	309.15	851.03	-
J&K	Thermal	Gas	175	15.41	-
Punjab	Thermal	Coal	2130	14118.96	9461
Punjab	Hydro	Hydel	1148.3	4420.43	-
Rajasthan	Thermal	Coal	2295	15044.48	9461
Rajasthan	Thermal	Gas	113.8	201.37	-
Rajasthan	Hydro	Hydel	432	494.07	-
U.P.	Thermal	Coal	4102	20638.05	16042
U.P.	Hydro	Hydel	518.6	2063.04	-
Uttaranchal	Hydro	Hydel	986.85	3452.96	-
TOTAL				**168109.84**	**70397.00**

Generation Details (2004-2005)					
Name	**Type**	**Fuel**	**Installed Capacity (MW)**	**Generation (Million kWh)**	**Coal Consumption (000' tonnes)**
Badarpur TPS	Thermal	Coal	720	5462.78	3732
Singrauli STPS	Thermal	Coal	2000	15803.34	10336
Rihand STPS	Thermal	Coal	1500	7988.06	4768
Dadri NCTPS	Thermal	Coal	840	6842.52	4432
Unchahar-I TPS	Thermal	Coal	420	3342.83	
Unchahar-II TPS	Thermal	Coal	420	3438.28	4604
Tanda TPS	Thermal	Coal	440	3254.67	2596
Anta GPS	Thermal	Gas	413	2595.77	-

Auriya GPS	Thermal	Gas	652	4119.47	
Dadri GPS	Thermal	Gas	817	5527.71	
Faridabad GPS	Thermal	Gas	430	3172.01	
Bairasiul	Hydro	Hydel	198	689.67	
Salal	Hydro	Hydel	690	3443.29	
Tanakpur HPS	Hydro	Hydel	120	495.17	
Chamera HPS	Hydro	Hydel	840	3452.25	
Uri HPS	Hydro	Hydel	480	2206.71	
RAPS-A	Nuclear	Nuclear	300	1355.20	
RAPS-B	Nuclear	Nuclear	440	2954.43	
NAPS	Nuclear	Nuclear	440	2760.01	
Bhakra Complex	Hydro	Hydel	1479.5	4546.01	
Dehar	Hydro	Hydel	990	3150.52	
Pong	Hydro	Hydel	396	882.57	
SJVNL HEP	Hydro	Hydel	1500	5203.80	
Delhi	Thermal	Coal	382.5	1617.45	1330
Delhi	Thermal	Gas	612.4	4091.37	-
Haryana	Thermal	Coal	1540	7192.41	5269
Haryana	Hydro	Hydel	48	251.73	-
H.P.	Hydro	Hydel	709	3666.39	-
J&K	Hydro	Hydel	309.15	851.03	-
J&K	Thermal	Gas	175	23.51	-
Punjab	Thermal	Coal	2130	14390.42	9520
Punjab	Hydro	Hydel	1148.3	4420.43	-
Rajasthan	Thermal	Coal	2295	17330.79	11133
Rajasthan	Thermal	Gas	113.8	360.70	-
Rajasthan	Hydro	Hydel	432	494.07	-
U.P.	Thermal	Coal	4102	19788.21	15559
U.P.	Hydro	Hydel	518.6	2063.04	-
Uttaranchal	Hydro	Hydel	986.85	3452.96	-
TOTAL				**172681.58**	**73279.00**

-	**2002-03**		**2003-04**		**2004-05**	
	Million kWh		**Million kWh**		**Million kWh**	
Generation by Coal out of Total Generation	98724.42		102704.29		106451.00	
Generation by Gas out of Total Generation	17261.41		20251.12		19890.00	
Estimation of Baseline Emission Factor (tCO_2/M kWH)	-	-	-	-	-	-
Simple Operating Margin	-	-	-	-	-	-
Fuel 1 : Coal						

Avg. Calorific Value of Coal used (kcal/kg)		4593		4593		4593
Coal consumption (tons/yr)		70,923,000		70,397,000		73,279,000
Emission Factor for Coal-IPCC standard value (tonne CO_2/TJ)		94.6		94.6		94.6
Oxidation Factor of Coal-IPCC standard value		0.98		0.98		0.98
COEF of Coal (tonneCO_2/ton of coal)		1.783		1.783		1.783
Fuel 2 : Gas						
Avg. Efficiency of power generation with gas as a fuel, %		45		45		45
Avg. Calorific Value of Gas used (kcal/kg)		10317		10317		10349
Estimated Gas consumption (tons/yr)		2,877,831		3,376,277		3,305,807
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(tonneCO_2/ton of gas)		2.411		2.411		2.419
EF (OM Simple), tCO_2/MU		**1156.60**		**1094.28**		**1104.34**
Average EF (OM Simple), tCO_2/MU						**1118.41**

<u>Step 2. Calculate the Build Margin emission factor ($EF_{BM,y}$)</u>

As per Step 2 the Build margin emission factor ($EF_{BM, y}$) is calculated as the generation weighted average emission factor (tCO_2/MU) of a sample of power plants.

The methodology suggests the project proponent to choose one of the two options available to calculate the Build Margin emission factor $EF_{BM, y}$

<u>Option 1:</u>

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

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

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

Option 2:

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

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

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

TEIL has adopted Option 1, which requires the project proponent to calculate the Built Margin emission factor $EF_{BM,y}$ ex ante based on the most recent information available on plants already built for sample group at the time of PDD submission. For the project activity under discussion the sample group 'm' consists of - the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently because it comprises the larger annual generation. None of the power plant capacity additions in the sample group have been registered as CDM project activities.

The following Table B-3 presents the key information and data used to determine the simple BM emission factor.

Table B-3 Data used for Simple BM emission factor

Plant	Date of commissioning	MW	Generation of the unit in 2004-2005 (Million kWh)	Fuel Type	Coal Consumption (000' tonnes)
Chamera HEP-II (Unit 1)	2003-2004	100	448.02	Hydro	-
Chamera HEP-II (Unit 2)	2003-2004	100	448.02	Hydro	-
Chamera HEP-II (Unit 3)	2002-2003	100	448.02	Hydro	-
SJVPNL	2003-2004	1500	5108.77	Hydro	-
Baspa-II (Unit 3)	2003-2004	100	398.94	Hydro	-
Suratgarh-III (Unit-5)	2003-2004	250	1698.37	Coal	1184
Kota TPS-IV (Unit-6)	2003-2004	195	1302.49	Coal	972.7607656

Baspa-II (Unit 1 & 2)	2002-2003	200	797.88	Hydro	-
Pragati CCGT (Unit II)	2002-2003	104.6	790.21	Gas	-
Pragati CCGT (Unit III)	2002-2003	121.2	915.61	Gas	-
Ramgarh CCGT Stage -II (GT-2)	2002-2003	37.5	114.19	Gas	-
Ramgarh CCGT Stage -II (GT-2)	2002-2003	37.8	115.11	Gas	-
Upper Sindh Extn (HPS)(1)	2001-2002	35	32.12	Hydro	-
Suratgarh stage-II (3 & 4)	2001-2002	500	3396.74	Coal	2368
Upper Sindh Stage II (2)	2001-2002	35	32.12	Hydro	-
Malana-1 & 2	2001-2002	86	266.08	Hydro	-
Panipat TPS Stage 4 (Unit-6)	2000-2001	210	1269.31	Coal	1085.895349
Chenani Stage III (1,2,3)	2000-2001	7.5	19.10	Hydro	-
Ghanvi HPS (2)	2000-2001	22.5	74.06	Hydro	-
RAPP (Unit-4)	2000-2001	220	1309.70	Nuclear	-
Ranjit Sagar (Unit-1,2,3,4)	2000-2001	600	1131.37	Hydro	-
Gumma HPS	2000-2001	3	4.35	Hydro	-
Faridabad CCGT (Unit 1) (NTPC)	2000-2001	144	1030.59	Gas	-
Suratgarh TPS 2	1999-2000	250	1698.37	Coal	1184
RAPS-B (2)	1999-2000	220	1309.70	Nuclear	-
Uppersindh-2 HPS #1	1999-2000	35	32.12	Hydro	-
Faridabad GPS 1 & 2 (NTPC)	1999-2000	286	2046.86	Gas	-
Unchahar-II TPS #2	1999-2000	210	1559.75	Coal	1151
Unchahar-II TPS #1	1998-1999	210	1559.75	Coal	1151
Suratgarh TPS #1	1998-1999	250	1698.37	Coal	1184
GHGTPLM (Unit 1)	1998-1999	210	1453.23	Coal	997.5
GHGTPLM (Unit 2)	1997-1998	210	1453.23	Coal	997.5
Tanda TPS (Unit-4)	1997-1998	110	731.54	Coal	649
Total			**34694.10**		**12925**
20% of Generation			**34536.32**		

Sector	**2004-05**	
Thermal Coal Based	17821.15	
Thermal Gas Based	5012.58	
Hydro	9240.97	
Nuclear	2619.40	
Total	34694.10	
<u>Built Margin</u>	-	-
Fuel 1 : Coal		

Avg. calorific value of coal used in Northern Grid, kcal/kg		4593
Estimated coal consumption, tons/yr		12924656
Emission factor for Coal (IPCC),tonne CO_2/TJ		94.6
Oxidation factor of coal (IPCC standard value)		0.98
COEF of coal (tonneCO_2/ton of coal)		1.783
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		833113
Emission factor for Gas (as per standard IPCC value)		56.1
Oxidation factor of gas (IPCC standard value)		0.995
COEF of gas(tonneCO_2/ton of gas)		2.419
EF (BM), tCO_2/MU		**728.67**

STEP 3. Calculate the Electricity Baseline Emission Factor ($EF_{electricity, y}$)

As per Step 3 the baseline emission factor $EF_{electricity,\ y}$ is calculated as the weighted average of the Operating Margin emission factor ($EF_{OM,\ y}$) and the Build Margin emission factor ($EF_{BM,\ y}$), where the weights w_{OM} and w_{BM} by default are 50% and $EF_{OM,\ y}$ and $EF_{BM,\ y}$ are calculated as described in Steps 1 and 2 above and are expressed in ton of CO_2/MU.

The most recent 3-years average of the simple OM and the BM of the base year i.e., 2004-2005 are considered. Table B-4 presents these values.

Table B-4: Data used for Baseline Emission Factor

Parameters	Values (ton of CO_2/MU)	Remarks
Simple OM, $EF_{OM, simple}$	**1118.41**	Average of the most recent 3-years values
BM, $EF_{BM, y}$	**728.67**	Value of the base year 2004-2005
Baseline Emission Factor, EF_y (Average of OM and BM)	**923.54**	Calculated

Annex 4

MONITORING PLAN

In order to calculate the mitigation of GHG due to the project activity, parameters mentioned in table D.2.1.1 and table D.2.1.3 shall be monitored at the project plant location. Instruments used for monitoring shall be in conformance with national/international standards for measuring parameters. All instruments shall be calibrated at regular frequency

GHG SOURCES

Direct On-Site Emissions

Direct on-site emissions after implementation of the project arise from the combustion of biomass in the boiler. These emissions mainly include CO_2. However, CO_2 released is taken up by the biomass when it grows, therefore no net emissions occur.

Direct Off-Site Emissions

Direct off-site emissions in the project activity arise from the biomass transport. The same type of CO_2 emission occurs during transportation of coal from coal mines to thermal power plants (supplying power to state grid). However on conservative basis these emissions have been deducted from baseline emissions.

Indirect On-Site Emissions

The indirect on site GHG source is the consumption of energy and the emission of GHGs involved in the construction of project activity.

Considering the life of the cogeneration plant and the emissions to be avoided in the life span, emissions from the above-mentioned source is too small and hence neglected.

No other indirect on-site emissions are anticipated from the project activity.

Key Project Parameters affecting Emission Reductions

The project revenue is based on the net units exported by TEIL. The power exported by TEIL would be monitored to the best accuracy and as per the table given in section D.2.

The general principles for monitoring above parameters are based on:

- Frequency
- Data recording
- Reliability
- Experience and training

Frequency

Monthly joint meter reading of main meters installed at interconnection point shall be taken and signed by authorised officials of TEIL and UPPCL on the first day of every month.

Data recording

Records of this joint meter reading would be maintained by TEIL and UPPCL. Daily and monthly reports stating the net power export would be prepared by the shift in-charge and verified by the plant manager.

Reliability

Reliability of energy data would be maintained as per PPA.

TEIL shall archive and preserve all the monthly invoices raised against net saleable energy, for at least two years after end of the crediting period. TEIL shall also archive the complete metering data at generation electronically and all the data would be preserved for at least two years after end of the crediting period.

All the records shall be maintained at site.

ENCLOSURE – I: EIA SUMMARY REPORT

ENVIRONMENTAL IMPACT ASSESSMENT

The environmental impacts can be categorized as either primary or secondary. Primary impacts are those that are attributed directly by the project, secondary impacts are those which are indirectly induced and typically include the associated investment and changed patterns of social and economic activities by the proposed action.

The proposed project would create an impact on the environment in two distinct phases:

- During the construction phase and
- During the operation phase which would have long term effects.

The proposed cogeneration plant is being set up adjacent to the proposed sugar-manufacturing unit at Deoband . The land is presently barren with not much vegetation. No cutting of trees is involved and there is no deforestation required. During the study of environmental impact assessment, a few additional mitigating measures have been identified to further minimize the net impact. These issues have been covered with each of the impacts below.

IMPACTS DURING CONSTRUCTION The impacts envisaged during the construction of the proposed plant are:
Impact on Land use The land use pattern is not expected to show any noticeable change. No additional land is required for the proposed plant. The land is presently barren with no much vegetation. The establishment of plant will be within the existing premises of sugar unit.
Impact on Terrestrial Ecology The proposed land is barren and there is no requirement to clear the land. There is no negative effect of the proposed project on the terrestrial ecology of the area. The project site will also be extensively landscaped with the development of green belt consisting of variety species which would enrich the ecology of the area.
Impact on Soil The impact of proposed expansion and power plant project on soil is negligible. Land development activities have already been completed in the area, which will reduce the soil erosion in the adjacent land.

Demography and Socio-Economics
During operation stage about 200 additional staffs and workmen personnel will be required. After the completion of the project, about 60 additional individuals will reside in the colony. Most of these people are expected to be educated and will maintain a higher standard of living. A number of villagers will improve their living by supplying essential commodities to the colony. Higher money input in the nearby villages may lead to higher agricultural product in the area. This will increase the per capita income of the population. Dissemination of education amongst the population, higher living standard and economic upliftment are some of the beneficial impacts of the industrial development. More employment opportunities for educated persons will further stipulate individuals to undertake education seriously. This will also help the population to utilise their earnings in proper way. The infra structural facilities such as, transport, medical, education and communication are also likely to improve further due to construction and operation of the project.
Traffic and Traffic Hazards for Access Roads
During construction phase, the building material, equipment and machinery and labour will be transported to the site and this will increase the volume of traffic on access roads. However this effect will not be very significant in view of the fact that the construction activities will be spread over a period of 10 months.

The impacts during the construction phase are regarded as temporary or short term and hence do not have an everlasting affect on the soil, air, noise or water quality of the area.

During Construction Phase

The impact from the construction phase is not envisaged to be serious. However the following factors are considered to make certain that the impacts are minimal.

Site Preparation

No major leveling operations are required. However during dry weather conditions, it is necessary to control the dust generated by excavation and transportation activities. To achieve this at site, such activity will be carried out after water sprinkling.

Sanitation

The construction site shall be provided with sufficient and suitable toilet facilities for workers meeting the proper standards of hygiene. These facilities shall be connected to septic tank and maintained to ensure minimum environmental impact.

Noise

The impact of noise on the nearest inhabitants during the construction activity will be negligible. Site workers using high noise equipment will use noise protection devices like ear muffs. Noise prone activities will be restricted to the extent possible during night, particularly during the period 10 p.m. to 6 a.m. in order to have minimum environmental impact.

Construction Equipment and Waste

It will be ensured that both gasoline and diesel powered vehicles are properly maintained to minimize smoke in the exhaust emissions. The vehicle maintenance area will be located in such a manner to prevent contamination of surface and ground water sources by accidental spillage of oil. Unauthorized dumping of waste oil will be prohibited.

Deforestation

Although the site is not endowed with trees and vegetation, in order to avoid felling of trees in the vicinity, the construction site workers will be assisted in procuring fuel for cooking purposes in order to avoid felling of any trees in the neighborhood.

Storage of Hazardous Materials

The following hazardous materials are anticipated to be stored at site during construction:

- Petrol and Diesel
- Gas for welding purpose
- Painting materials

These materials will be stored in drums as per international safety norms.

Land Environment

As soon as construction is over the surplus earth will be utilized to fill up low lying areas, the rubbish will be cleared and all unbuilt surfaces reinstated. There are no trees at the present site hence no felling of trees is involved. Appropriate vegetation will be planned after construction activity.

During construction the impacts are generally manifested by loss of minor vegetative cover, migration of minor avian population restricted to site. After green belt development these will be mitigated and the avian population will increase after green belt development since there are no tress presently.

Development of green belt is to be taken up along with civil works.

IMPACTS DURING OPERATION
The operational phase will involve power production using bagasse. The following activities in relation to the operational phase will have varying impact on the environment and are considered for impact prediction.
Impact on Air Quality The EIA study establishes that the existing status of the ambient air quality of the area is well within the national ambient air quality standard. The pollutants envisaged from the proposed co-generation power plant are Suspended Particulate Matter (SPM), Oxides of Nitrogen (NO_x), Carbon mono-oxide (CO) and CO_2. As such the bagasse has very low ash content (1.5%). The SPM as ash is controlled by high efficiency Electro-Static Precipitator (ESP). High efficiency (> 99%) ESP will ensure SPM levels less than 150 mg/Nm^3 in the stack. There will not be any Sulpher di-oxide (SO_2) emission considering bagasse do not contain sulpher. Moisture content of 50% in bagasse will keep the burner temperatures low so that NO_X formation will not take place. Similarly the for high efficiency combustion is envisaged so that CO formation do not take place and the CO_2 gets absorbed by the sugar canes harvested each year. To reduce the ground level concentrations of the pollutants still further, 74 m high R.C.C. stack height is proposed. This will further help is fast dispersion of pollutants into the atmosphere, thus, reducing their impact in the vicinity of the project area. The predictions for air quality during operation phase were carried out for suspended particulate matter, concentrated for using Air Quality model “Industrial Source Complex Version 99155 (ISCST3)” developed by the US Environmental protection agency in 1995 for atmospheric dispersion of stack emissions from point source (Details provided in the EIA Report). The maximum predicted ground level concentrations for SPM were 238.2 ug/m^3 and these were observed in the North at Girls Inter college, Deoband at a distance of 1.9 km. This shows that TEIL will be taking adequate measures such that air quality impacts of running the power plant operation phase are reduced to a minimum. There may be some adverse impact on air quality from truck/tractor exhaust and dust due to transport of bagasse from Khatauli to the site considering per truck load 2 to 5 tones of loose bagasse or 8 tones of bale bagasse will be transported. That is additional trips per day based on the bale or loose type bagasse transport respectively. About 29,050 tones of bagasse will be transported to plant site from Khatauli per annum. TEIL proposes It is recommended that TEIL should transport of bagasse as compressed bales to reduce number of transport trips. For this TEIL has already installed ‘baling machine’ at Khataukli and ‘de-baling machine’ at their Deoband sugar unit. Considering the advantage of transporting 5 to 8 tones of bagasse as bales over 2 to 5 tones per truck without baling the system will have economic benefits along with environmental benefits. Also, it will be ensured that the bagasse transporting

trucks do not return empty.

The air pollution from the plant in the form of particulate matter emitted mainly from the boiler are found to be well within the prescribed norms and hence no mitigation measures are envisaged. In case of non-availability of bagasse, biomass is envisaged to be used as fuel. Considering bio-mass has more ash content (17%) against 1.5% of bagasse the ESP needs to be fine tuned so that stack emissions remains within limits. ESP is already included in equipment specifications of the boiler order.

Impact on Soil

Most of the impacts on soil due to the project are negligible and restricted to the construction phase and will get stabilized during the operational phase. Fly ash collected from the ESP hoppers and air heater hoppers and the ash collected from the furnace bottom hoppers can be used as landfills and also can used as fertilizers in the sugar cane fields. The ash content in the bagasse is less than 2%. The total fly ash collected may be mixed with press mud from the sugar plant and sold to farmers as manure because of its high nutrient value.

The boiler soot after cleaning will be stored in a closed drum and to be disposed properly. Similarly the oily waste, cloth *etc.* should be stored in a drum and disposed properly.

Impact On Water Resources

Only 0.25 million cubic meter annum will be required for the proposed project which will be drawn from the ground which will not affect the existing water level of the area.

Impact on Noise

For assessing the impact of noise during operation phase, considerations have been given to two aspects, those relating to the noise sources and the other relating to potential receivers.

The sound pressure level generated by noise sources decreases with increasing distance from the source due to wave divergence. An additional decrease in sound pressure level with distance from the source is expected due to atmospheric effect in its interaction with objects in the transmission path. Hence, the maximum exposure of noise is when a person is at line of sight from the noise generating source.

In the cogeneration unit continuous and very high noise levels are generated near primary air fans, forced drafted fans, boilers, generators, compressors and pumps.

Plant equipments are designed to keep noise levels less than 90 dB(A). This is considering damage risk criteria as enforced by OSHA (Occupational Safety and Health Administration) to reduce hearing loss, stipulates that noise level upto 90 dB(A) are acceptable for 8 hour working shift per day.

For computing the noise levels at various distances with respect to the plant site in general and the turbo-generator bay in particular, noise propagation analysis was undertaken. The noise computed at a far distance of about 750 m is of the order of 44 dB(A) during the operation of the plant. The ambient noise level recorded in the nearby villages ranges between 44-53 dB(A). (Details provided in the EIA Report) Due to masking effect, the ambient noise levels in the nearby villages will not increase during the operation phase.

The noise levels in the work areas like generator room and boiler room may be slightly on the higher side (>85dB(A) continuously) but at these places, continuous attendance of workers are not required and workers will be on duty only in shifts as required. Provision of protective personnel equipment in addition will reduce the impact of noise level. Hence these noise levels may not be of much concern from occupational health point of view. However under the general health check-up scheme as per factory act, a trained doctor will check up the workers for any Noise Induced Hearing Loss (NIHL).

The greenbelt, which is being provided by TEIL will act as noise attenuator.

Impact on Water Quality

The EIA study establishes that the existing status of the water quality of the area are well within the environmental norms. The effluent generated from the proposed project activity – the cogeneration power plant will be treated in the effluent treatment plant to ensure there is no environmental deterioration.

The liquid effluents from the power plant would include effluent generated from DM water treatment plant, boiler blow down, cooling tower blow-down, floor washings, sanitation etc.

- Effluent from DM Plant: Hydrochloric acid and sodium hydroxide will be used as regenerants in the DM water plant for boilers and effluent would be drained into epoxy lined underground neutralizing pits. Generally, these effluents are self neutralizing, however provisions will be made such that the effluents are completely neutralized by addition of acid/alkali. The effluent would then be pumped into the effluent treatment ponds, which are a part of the effluent disposal system.

- Effluent from Boiler:The salient characteristics of the blow down water from the point of view of pollution would mainly be the pH and temperature since the suspended solids are negligible. The pH would be in the range of 9.8 to 10.3 and the temperature would be around 100 ^{o}C. The quantity of the blow down water is as low as 1.2 tones/hr it is proposed to put the blow down into the trench and leave it into the sugar plant effluent ponds.

Therefore there are no major impacts envisaged due to effluent generation from the project activity.

Impact on Ecology

The inventory on terrestrial ecology has been compiled through data collection from marshes, irrigation canals, agricultural land and groves (Details provided in the EIA Report). Air emissions from the plant are very low as mentioned above. SPM will contain primarily ash with high nutrient value and will be beneficial to the plants. Other pollutants like NO_X and CO are not envisaged in much quantity to adversely affect the plants or animals.

There are no liquid discharges from the plant that will interfere with the local aquatic ecological system.

Ecology and Green belt Development

Implementation of afforestation program is of paramount importance for any industrial development. In addition to augmenting green cover, it also checks soil erosion, marks the climate more conductive, restores water balance and makes ecosystem more complex and functionally more stable. TEIL is proposing an extensive program for the development of green belt around the plant. The green belt is being proposed for the following objectives:

- Mitigation of fugitive dust emissions including any odor problems
- Noise pollution control
- Controlling soil erosion
- Balancing eco-environment
- Aesthetics

The tree species selected for green belt would include the native species like *Mohua, Dhak, Neem, Mango, Bargad, Sesham, Ashoka etc*. The treated sewage effluent from the plant would be used for watering the green belt.