Revised Monitoring Plan

Dated 21/01/2009

For

Deoband Bagasse Based Co-generation Power Project

Project Participant

Triveni Engineering and Industries Ltd.

UNFCCC Ref No. 0578

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 table D.3)	Data Type	Data variable	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	How will the data be archived? (electronic/ paper)	Comment
1. BFi,,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 for biomass transportation	-	M	continuous	electronic	Number of truck trips are measured and recorded in log books for measurement.

4. EFkm, CO2	Emission factor	Average CO2 emission factor for transportation of biomass with trucks	tCO2/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 CO2 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):

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

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 CO_2 emission factor for the trucks measured in t CO_2/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	c	Continuous	100%	Electronic	Net quantity of electricity generated will be calculated by subtracting auxiliary consumption of the project plant from gross generation of the project plant. Separate energy meters are used for measurement of gross electricity generation and auxiliary consumption of the project plant. Energy meters will be 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. $EG_{Gross,project\ plant,\ y}$	Electricity Quantity	Gross quantity of electricity generated in the project plant during the year y	Metering records	MWh	M	Continuous	100%	Electronic	Gross quantity of electricity generated in the project plant will be monitored by energy meters Energy meters will be calibrated periodically as per standard procedures by accredited third party agencies.
3. $EG_{Aux,project\ plant,\ y}$	Electricity Quantity	Auxiliary electricity consumption in the project plant during the year y	Metering records	MWh	M	Continuous	100%	Electronic	Auxiliary electricity consumption in the project plant will be monitored by energy meters. Energy meters will be calibrated periodically 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
4. $EG_{total, y}$	Electricity Quantity	Total net 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	c	Continuous	100%	Electronic	Total net quantity of electricity generated will be calculated by subtracting aggregated auxiliary consumption from the aggregated gross generation of all the power units at the plant site. Separate energy meters are used for measurement of gross generations and auxiliary consumptions of all units at the project site and thus subsequently aggregated respectively. Energy meters will be calibrated periodically as per standard procedures internally.

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
5. $EG_{Gross,total,y}$	Electricity Quantity	Gross quantity of electricity generated 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	For gross quantity of electricity generated at the project site the total shall be calculated by adding the gross generation of all power generating units. For each individual power generating unit gross quantity has been monitored by energy meters. Energy meters will be calibrated periodically as per standard procedures internally.

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
6. $EG_{Aux,total, y}$	Electricity Quantity	Total auxiliary consumption 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	For auxiliary consumption at the project site the total shall be calculated by adding the auxiliary consumption of all power generating units. For each individual power generating unit auxiliary consumption will be monitored by energy meters. Energy meters will be calibrated periodically as per standard procedures internally.

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
7. $Q_{project\ plant}$,	Heat quantity	Net quantity of heat generated from firing biomass in the project plant	Meters	MWh	C	Continuous	100%	Electronic	Steam Quantity, its pressure and temperature will be monitored on continuous basis. Net quantity of heat can be calculated from monitored parameters. Accuracy of boiler outlet steam flow meter and turbine inlet steam flow meter (a) Nozzle 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
8.$BF_{i,y}$	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
9. 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.

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
10. ε_{boiler}	Thermal energy efficiency	Average net Energy efficiency of heat generation in the project plant boiler			C	Quarterly	100%	Electronic	Boiler efficiency will be calculated by dividing energy output of steam from project plant boilers by total energy of biomass input in boilers. Where energy input will be the product of biomass consumed and the calorific value and energy output will the product of steam enthalpy and steam generated
11. $S_{project\ plant}$	Total Steam generated	Quantity of steam generated by the project plant boiler	Log Books	MT	M	Continuous	100%	Paper	Total steam generated will be logged using steam flow meters which will be calibrated periodically
12. $T_{Project\ Plant}$	Temperature of Steam	Temperature of Steam generated in the project	Log Book	^{o}C	M	Continuous	100%	Paper	Steam Temperature will be logged using temperature gauges which will be calibrated

		plant boiler							periodically
13. $P_{Project\ Pl}$	Pressure of Steam	Pressure of steam generated in the project plant boiler	Log Book	Kg/cm^2	M	Continuous	100%	Paper	Steam Pressure will be logged using pressure gauges which will be calibrated periodically
14. E_{steam}	Enthalpy of Steam	Enthalpy of steam generated in the project plant boiler	Steam Tables	MJ/Tonne	C	Daily	100%	Paper	Monthly averages of steam temperature and pressure are used to determine enthalpy using steam tables

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 (*EFelectricity,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 lowcost/must run resources constitutes less than 50% of total grid generation. Simple OM factor is calculated as under.

EFOM,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

COEFi,j y- Is the CO2 emission coefficient of fuel i (t CO2 / mass or volume unit of the fuel), calculated as given below and

GENj,y - Is the electricity (MWh) delivered to the grid by source j

Fi ,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 *Fi ,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 CO2 emission coefficient $COEF_i$ is obtained as

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

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 ($EF_{BM,y}$) 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 $_{wBM,}$ 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 CO2/MWh.
The emission reductions due to the displacement of electricity are given as:

$ER_{electricity,y} = EG_y$ x $EF_{electricity,y}$

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	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), 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.

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

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

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.
		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	Gross Electricity generated in the project plant is monitored using digital energy meters. 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. (3)	Low	Auxiliary Electricity consumed in the project plant is monitored using digital energy meters. Digital meters calibration procedures are planned. Daily consumption details are kept in log books and electronic data base. Energy meters are of class 0.5 with tolerance of 0.5%. All Meters are calibrated by accredited external third party, as per standard procedures, periodically.
D.2.1.3. (4)	Low	Total net quantity of electricity generated will be calculated by subtracting aggregated auxiliary consumption from the aggregated gross generation of all the power units at the plant site. Separate energy meters are used for measurement of gross generations and auxiliary consumptions of all units at the project site and thus subsequently aggregated respectively. Energy meters will be calibrated periodically as per standard procedures internally.
D.2.1.3. (5)	Low	For gross quantity of electricity generated at the project site the total shall be calculated by adding the gross generation of all power generating units. For each individual power generating unit gross quantity will be monitored by energy meters. Energy meters will be calibrated periodically as per standard procedures internally.
D.2.1.3. (6)	Low	For Auxiliary consumption of electricity at the project site the total shall be calculated by adding the Auxiliary generation of all power generating units. For each individual power generating unit auxiliary consumption will be monitored by energy meters. Energy meters will be calibrated periodically as per standard procedures internally.
D.2.1.3. (7)	Low	Heat generated will be calculated by measuring quantity of steam produced and

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.
		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. (8)	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. (9)	Low	NCV value of bagasse has been measured by bomb calorimeter in a national accredited lab.
D.2.1.3. (10)	Low	Boiler efficiency has been calculated by dividing energy output of steam from boilers by total energy of biomass input in boilers.
D.2.1.3. (11)	Low	Total steam generated will be logged using steam flow meters which will be calibrated periodically
D.2.1.3. (12)	Low	Steam Temperature will be logged using temperature gauges which will be calibrated periodically
D.2.1.3. (13)	Low	Steam Pressure will be logged using pressure gauges which will be calibrated periodically
D.2.1.3. (14)	Low	Monthly average of steam temperature and pressure are used to determine enthalpy using steam tables

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.