Revised Monitoring Plan

(UNFCCC Reference Number 0677)

Project Title

Optimization of steam consumption by applying retrofit measures in blow heat recovery system

Version 1
07-07-2008

SECTION D. Application of a monitoring methodology and plan

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

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Title: Steam Optimization System, AM0018: version 1, Sectoral Scope: 3, 6 December 2004;
Reference: website of CDM UNFCCC - Approved baselines and monitoring methodologies for CDM project

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

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As discussed earlier in the Section B.2, the applicability conditions of the methodology are applicable to the proposed CDM project. Thus, in conjunction with the baseline methodology, the monitoring methodology has also been applied to the project.

The monitoring methodology is applicable to the project activity as the parameters to be monitored is relevant to the project activity and project activity proposes to follow the monitoring methodology as provided in the tables below.

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	**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**
$E_{quip\ P}$	Rated Power of the spray condenser pump	Supplier document having Name plate details	kW	E	Once during installation	100%	Electronic/ paper	The unit has recorded the rated power of the spray condenser pump (supplier document) which has been additionally installed due to project activity.
$BHRS_{hrs}$	Running hours of the BHRS	Constant	hrs	C	Calculated for the given period	100%	Electronic	As the hours of operation of the BHRS is required to calculate the operating hours of the additional condenser pump additionally installed due to project activity leading to project emissions, it is conservatively assumed that the pump would have run for 24X7 for the given period. This would lead to higher consideration of project emission and thus conservative calculation of net emission reduction from the project activity.
E_{add}	Additional electricity consumed by the project activity	Monitoring report	GWh	C	For the monitoring period	100%	Electronic/Paper	The additional electricity consumed by the project activity would be calculated in million units (GWh) as rated power of the additional condenser pump (30kW) multiplied with number of days of operation for the given monitoring period into 24 hours in a day divided by 10^6.
EF_{elec}	Emission factor of the electricity used in the project activity	Using in plant records	tCO2/ GWh	C	Once during PDD completion	100%	Electronic/Paper	The grid emission factor is calculated based on methodology ACM0002 version 06. For in-house electricity emission factor calculation, proposed equation has been applied (given below). It is proposed that the emission factor of the electricity used by the project activity would be estimated only once during PDD completion. This is considered to be conservative because: - 1. Grid contribution to the total electricity consumed by

								the unit is only 5% and most likely to reduce further as the unit strives to be self sufficient. 2. The in-house generation is based on coal and biomass and the unit plans to increase the biomass contribution to the total capacity. Thus the emission factor of the in-house electricity is likely to drop. Therefore, it is conservative to keep the emission factor constant this is used for calculation of project emissions.

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

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$$\mathbf{Cer_p = E_{add} \times EF_{elec}} \quad \textbf{(1)}$$

Where

Cer_p = CO_2 emissions due to project activity (tCO_2)

E_{add} = Additional electricity consumed by the project (GWh) and calculated as: -

$$\mathbf{E_{add} = E_{quipP} * BHRS_{hrs} \ / 10\text{^}6} \quad \textbf{(2)}$$

Where:

E_{quipP} = Rated power of the spray pump (30 kW)

$BHRS_{hrs}$ = Operating hours of the blow heat recovery system (hrs) calculated as number of days of operation for the given monitoring period into 24 hours in a day

$$\mathbf{EF_{elec} = (EF_{in\text{-}house} * EG_{in\text{-}house}) + (EF_{grid} * EG_{grid}) / (EG_{grid} + EG_{in\text{-}house})} \quad \textbf{(3)}$$

Where

EF_{elec} = Emission factor for the electricity used by the project activity (tCO_2/GWh) (constant – 1275tCO2/GWh)

$EF_{in\text{-}house}$ = Emission factor of the electricity generated in-house (tCO_2/GWh)

EF_{grid} = Emission factor of the gird electricity imported by the unit (tCO_2/GWh)

EG_{grid} = Total grid electricity used by the unit (GWh)

$EG_{in\text{-}house}$ = Total in-house electricity generated by the unit (GWh)

$$\mathbf{EF_{grid} = \sum FF_{i,y} * COEF_i / \sum Gen_{f,i,y}} \quad \textbf{(4)}$$

Where:

$FF_{i,y}$ = Last 3 years average of fuel energy consumed by plant 'P' of type 'i'(TJ)

$COEF_i$ = Carbon-dioxide emission factor of fuel type 'i'(tCO_2/TJ)

$\sum Gen_{P,i,y}$ = Total generation by plant 'P' using fuel 'i' in the last 3 years (average) (GWh)

$$\mathbf{EF_{in\text{-}house} = ((S_{tot} * E_s)/ \eta_b) * COEF_{coal} * O_{CFB} / E_{in\text{-}house}} \quad \textbf{(5)}$$

Where:

S_{tot} = Total steam consumed for in-house electricity generation

E_s = Net enthalpy of the steam (kcal/kg) used for generation of electricity and calculated as per equation 15

η_b = Average efficiency (%) of the steam producing boilers calculated as per approved methodology using direct method
$\%H_{CFB}$ = Operating hours of the coal fired boiler (%)
$COEF_{coal}$ = Carbon-dioxide emission factor of coal (tCO_2/TJ)
$E_{in\text{-}house}$= Total electricity generated in-house

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	**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**
At Baseline Scenario								
P_{rep}	Hot water generation at the baseline	In-plant	MT	M	Measured per shift for a month prior to the implementation of the project	100%	Electronic/paper	The generation of hot-water is monitored through the connected distribution control system (DCS) and recorded per shift basis in the in-plant shift log book by the operator / shift in-charge. Daily aggregates are then logged into online Integrated Management Information System (IMIS). Archived – For crediting period plus 2 years
S_{rep}	Corresponding steam consumption	In-plant	MT	M	Measured per shift for a month prior to the implementation of the project	100%	Electronic/paper	-do as above -
SSCR	Specific steam consumption	Project Excel-sheet	MT/ MT	C	Once during PDD completion	100%	Electronic/Paper	Archived – For crediting period plus 2 years
At the project scenario								
P_{rep1}	Hot water generation at the project scenario	In-plant	MT	M	Per shift	100%	Electronic/ paper	The generation of hot-water is monitored through the connected distribution control system (DCS) and recorded per shift basis in the in-plant -shift log book by the operator / shift in-charge. Daily aggregates are then logged into online Integrated Management Information System (IMIS). Archived – For crediting period plus 2 years

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	**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**
S_{rep1}	Corresponding steam consumption	In-plant	MT	M	Per shift	100%	Electronic/ paper	-do as above-
$SSCR_1$	Corresponding specific steam consumption	Emission calculation sheet	MT/ MT	C	As and when emission is calculated	100%	Electronic / paper	Archived – For crediting period plus 2 years
E_s	Net enthalpy of the steam	Emission calculation sheet	kcal/kg	C	As and when emission is calculated	100%	Electronic/paper	Enthalpy of the steam at the boiler outlets is determined based on steam table which is a matrix of steam properties with corresponding values of steam pressure and temperature. The net enthalpy of the steam is determined by subtracting feed water enthalpy from the gross steam enthalpy. This parameter is calculated based on daily data of steam pressure and temperature, and feed water flow and temperature
Steam pressure	Steam pressure at the boiler end	In-plant records	kg/cm^2 (gauge)	M	Per-shift	100%	Electronic/ paper	The steam pressure at the boiler end is measured with dedicated pressure gauges. The pressure gauges are monitored through dedicated DCS and values are recorded on per shift basis and archived in IMIS on daily basis.
Steam temperature	Steam temperature at the boiler end	In-plant records	^0C	M	Per-shift	100%	Electronic/ paper	The steam temperature at the boiler end is measured with dedicated thermocouple. The thermocouples are monitored through dedicated DCS and values are recorded on per shift basis and archived in IMIS on daily basis.

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	**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**
Feed water flow	Feed water flow to the steam boilers	In plant records	MT	M	Monthly	100%	Electronic/ paper	The feed water inlet to the boiler is measured with dedicated flow meter. The meters are monitored through dedicated DCS and archived in IMIS on daily basis.
Feed water temperature	Feed water temperature	Emission calculation sheet	^{0}C	M	Monthly	100%	Electronic/ paper	The feed water temperature at the boiler end is measured with dedicated thermocouple. The thermocouples are monitored through dedicated DCS
$H_{boiler,i}$	Operating hours of the boiler by fuel type 'i'	Mill performance report	Hours	C	Monthly	100%	Electronic/ paper	The actual operating hours of the boilers are calculated on daily basis by subtracting the recorded downtime (in log-sheets/ IMIS report) from the total operating hours possible in a given month considering 24hours of operation per day.
S_{tot}	Total steam produced by the boilers	Mill performance report	MT	M	Monthly	100%	Electronic/ paper	The steam generated by the boilers is measured with dedicated steam flow meters. The meters are monitored through dedicated DCS and archived in IMIS.

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	**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**
$F_{tot,i}$	Total amount of fuel used for steam generation by type 'i'	Mill performance report	MT	M	Monthly	100%	Electronic/ paper	Two types of fuel are used, namely, coal and black liquor solids. Coal – measured using weigh bridge and stock method BLS - Measured on daily basis and computed on monthly basis in IMIS. The installed meter reads the flow of black liquor in mass. To ascertain the % of solids in the biomass fuel, samples are tested in the in-house laboratory and accurate amount of biomass flow is determined based on volumetric flow multiplied by the % solids determined by the lab results. The density factor used to convert to mass is 1.35.
NCV_i	Net calorific value of the fuel by type 'i'	Emission calculation sheet	Kcal/ kg	m	Monthly	100%	Electronic/ paper	Internal fuel test Procedure: Ash and moisture content in the coal sample is tested as per procedure and values are substituted in the formula to arrive at GCV. The net calorific value of the coal used will be calculated based on GCV and moisture percentage (NCV = GCV – 10.02*M). Ultimate analysis for coal is also done with third party on monthly basis. . NCV for BLS will be determined by third party on dry basis.
$\eta boiler$	Average efficiency of the steam generating boilers	Emission calculation sheet	%	e	Monthly	100%	Electronic/ paper	Average efficiency of the steam generating boilers is calculated using formula inline with the approved methodology by applying Direct Boiler Efficiency Method (Input-Output Method)

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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	**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**
Fc	Carbon content of the coal	Third party analysis report	% on weight basis	m	Monthly	100%	paper	Carbon percentage in the coal is analysed through third party report

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

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Prep = (P_1 +P_2 .....+P_m) x A / m **(6)**

Where

P_{rep} = Representative production for the day at the baseline for a period of a month prior to implementation of the project (MT)

P_1, P_2,….P_m = shift-wise hot water production (MT) for a period of a month prior to implementation of the project

A = number of shifts/day (constant 3)

m = number of shifts in that particular month

Srep =(S_1 +S_2 ..... +S_z) x A/z **(7)**

Where

S_{rep1} = Representative steam consumption for the day (corresponding to Prep) at baseline for a period of a month prior to implementation of the project (MT)

S_1, S_2,….S_m = shift-wise steam consumption values, corresponding to P1, ….Pm

A = number of shift/day (constant 3)

z = number of shifts in that particular month

SSCR = Srep/ Prep **(8)**

Where

SSCR = Specific Steam Consumption Ratio at baseline (MT/MT)

$Prep_1$ = (P_1 +P_2 .....+P_m) x A / m **(9)**

Where

P_{rep1} = Representative production for the day (MT) and then aggregated for a month

P_1, P_2,….P_m = shift-wise hot water production (MT)

A = number of shifts/day (constant 3)
m = number of shifts in the given period

$$\mathbf{Srep_1 = (S_1 + S_2 ..... + S_z) \times A/z} \quad \mathbf{(10)}$$

Where
S_{rep1} = Representative steam consumption for the day (corresponding to $Prep_1$) (MT)
$S_1, S_2, \ldots S_m$ = shift-wise steam consumption (MT) corresponding to P1, ….Pm
A = number of shift/day (constant 3)
z = number of shifts in the given period

$$\mathbf{SSCR_1 = Srep_1 / Prep_1} \quad \mathbf{(11)}$$

Where
$SSCR_1$ = Average specific steam consumption ratio for the given period (MT/MT)

$$\mathbf{SSCR_{diff} = SSCR - SSCR_1} \quad \mathbf{(12)}$$

Where
$SSCR_{diff}$ = difference in specific steam consumption ratio from baseline and project scenario (MT/MT)

$$\mathbf{S_{net} = SSCR_{diff} \times P_{act}} \quad \mathbf{(13)}$$

Where
S_{net} = Actual reduction in steam consumption for the given period (MT)
P_{act} = Actual hot water generation for the given period (MT)

$$\mathbf{E_{net} = S_{net} \times E_s} \quad \mathbf{(14)}$$

Where
E_{net} = Net reduction in steam energy consumption (kCal)
S_{net} = Net reduction in steam consumption (MT)
E_s = Net enthalpy of steam being supplied (kCal/kg).
and

$$\mathbf{E_s = E_{tot} - E_{fw}} \quad \mathbf{(15)}$$

where
E_{tot} = Gross enthalpy of steam at the boiler outlet (kCal/kg)
E_{fw} = Heat content of feed water (kCal/kg)

$$\mathbf{E_{in} = E_{net} / \eta b} \quad \mathbf{(16)}$$

Where
E_{in} = Total fuel energy saved by the project for the given period (TJ)
ηb = Efficiency of boiler, to be monitored periodically by direct method (%) as per methodology

$C_{er}=E_{in} \times \sum(EF_{fuel} \times \%H \text{ fuel})$ **(17)**

Where

C_{er} = CO_2 emission reductions for the given period (tCO_2e)

EF_{fuel} = Carbon emission factor for fuel by type 'i' (tCO_2/TJ)

$\%H_{fuel}$ = % of hours of operation of the boiler with fuel by type 'i'.

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

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	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

NOT APPLICABLE

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

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NOT APPLICABLE

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	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.)

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Not applicable project emission has already been accounted.

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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.)

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$$C_{ernet} = C_{er} - C_{er,p} \quad (18)$$

Where

C_{ernet} = Net CO_2 emission reductions due to the project (tCO_2e)
C_{er} = CO_2 emission reductions due to the project (tCO_2e)
C_{erP} = CO_2 emissions attributable to the project activity (tCO_2e)

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
All	*Medium to low*	*All data will be monitored under recorded under ISO system, which undergoes periodic review once in three month, internally, and bi-annually by third party. Where relevant the meters and equipments will be calibrated as per schedule (once in a year) internally. For those where internal facilities are not available such as calibration, fuel analysis will be done through external accredited agencies.*

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

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

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

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Date of completion of monitoring plan – 07-07-08
Entity determining monitoring methodology: CDM Project Developer – M/s PricewaterhouseCoopers Pvt. Ltd.
Not project participants.