Monitoring Report

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

(Project 0677)

For the period - 01/01/2007- 30/11/2007

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I T C Limited

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Project background

The aforesaid CDM project is an integral part of the existing pulp mill process of Paperboards & Specialty Papers Division (PSPD) of ITC located at Sarapaka Village, near Bhadrachalam town, at Khamam District of state of Andhra Pradesh in India.

The CDM project was implemented to attain the following objectives.

1. To re-design the existing blow heat recovery system such that it recovers 100% flash steam that was otherwise being vented and
2. To enhance the capacity and improve the efficiency of the existing heat exchanger so that it generates hot water at 75^{o}C with the recovered flash steam,

And the overall impact will reduce the consumption of fresh steam for generation of hot water.

The following design features as a retrofit activity has been successfully implemented to achieve the objectives of the project

1. Increased size of the flash steam collection pipe to 300NB to recover 100%flash steam;
2. Increased capacity of heat exchanger plates from 45m2 to 83m2 for additional heat exchange;
3. Additional wide gap plate heat exchanger of surface area 153 m2, imported from M/s Sondex UK;
4. New spray condenser with spray water pump after secondary condenser to handle 25% of the flash vapours;
5. Installation of custom designed cyclone separator in the flash vapour line to remove residual black liquor and waste pulp fibre, thereby reducing surface clogging of heat exchanger;
6. Connecting the heat recovery system with distribution control system (DCS) for automated operation and performance monitoring and recording.

The project has been fully operational since 01/09/2003 and there has been an average reduction of consumption of fresh steam by 70% in last three years of performance.

Further details on this project can be found in the registered PDD and associated documents (validation report and first monitoring and verification reports), which are available on the UNFCCC website: http://cdm.unfccc.int/Projects/DB/DNV-CUK1160722166.0/view.html

There has been no change in the project boundary after successful implementation of the project.

Monitoring Protocol

Parameters Monitored for Calculating Project Emission

Parameter Id. No.	Equip P
Description	Rated Power of the spray condenser pump (kW)
Source of data	Evidence of supplier document have nameplate details
Monitoring details	Estimated – Details as per the supplier's of the pump Recorded once during the project implementation
Reference/ Records	Name Plate Details - Tag – 213-P-023
Values applied	30KW

Parameter Id. No.	$BHRS_{hrs}$
Description	Running hours of BHRS (hrs)
Source of data	Constant
Monitoring details	Calculated annually by applying the formula - 24hr/day*365day/year = 8760 hours per year.
Reference document	Refer to Annexure to this document – Emission Reduction calculation excel sheet
Values applied	8016

Parameter Id. No.	E_{add}
Description	Additional electricity consumed by the project activity (GWh)

Source of data	Refer to Annexure to this document – Emission Reduction calculation excel sheet
Monitoring details	Calculated 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.
Reference document	Refer to Annexure to this document – Emission Reduction calculation excel sheet
Values applied	0.~~246~~240

Parameter Id. No.	**EF_{elec}**
Description	Emission factor of the electricity used in the project activity (tCO2/GWh)
Source of data	From the registered PDD

Electricity mix in the unit	**Unit**	**Emission Factor**	**Gross Emission**
In-house generation	**GWh**	**tCO_2/GWh**	**tCO_2**
Coal	187.24	1885.69	353080.49
Black Liquor	85.22	0.00	0
Electricity purchased	17.310	941.07	16289.91
Total GWh	**289.77**		**369370.40**
Total Net Emission at baseline (tCO_2/GWh)			**1274.68**

Monitoring details	Calculated ex-ante (once during PDD finalization)
Values applied	1274.68 tCO2/GWh

Monitoring Protocol

Parameters Monitored for Calculating Baseline

Parameter Id. No.	**P_{rep}**
Description	Hot water generated at baseline (MT)
Source of data	Recorded once prior to implementation of project activity and archived for 10+2 years
Monitoring details	Measured per shift for a month prior to the implementation of the project
Values applied	210000 MT

Parameter Id. No.	**S_{rep}**
Description	Corresponding steam consumption in relation to P_{rep} (MT)
Source of data	Recorded once prior to implementation of project activity and archived for 10+2 years
Monitoring details	Measured - Once for a period of one month before the project was implemented
Values applied	10102 MT

Parameter Id. No.	**SSCR**
Description	Specific steam consumption at the baseline (MT/MT)
Source of data	Refer to Annexure to this document – Emission Reduction calculation excel sheet
Monitoring details	Calculated once during PDD finalization by applying the formula - S_{rep}/ P_{rep}
Units	MT/MT
Values applied	0.0481 MT/MT

Monitoring Protocol

Parameters Monitored for at Project Scenario

Parameter Id. No.	$P_{rep\ 1}$
Description	Total amount of hot water generated at the project scenario in the year 'y' (MT)
Source of data	IMIS Report PRRPL03
Monitoring details	Hot water generated at the project activity is measured using online flow meters (Tag - FIQ5787) connected DCS control system and the total meter reading is recorded in every shift. The shift reading is summed for a day, and daily for a month, and monthly for the year 'y'. The flow meter is calibrated against the master equipment once in every year. And the master equipment is calibrated by third party once in every year.
Values applied	**590345**~~1686220~~

Parameter Id. No.	$S_{rep\ 1}$
Description	Total amount of steam consumed corresponding to P_{rep1} in the year 'y' (MT)
Source of data	IMIS Report PRRPL03
Monitoring details	The steam to the project activity is measured using online steam flow meters (Tag - FIQ5282) connected DCS control system and the total meter reading is recorded in every shift. The shift reading is summed for a day, and daily for a month, and monthly for the year 'y' The flow meter is calibrated against the master equipment once in every year. And the master equipment is calibrated by third party once in every year.

Values applied	10242~~29475~~

Parameter Id. No.	**$SSCR_1$**
Description	Specific steam consumption in the project for the year 'y' (MT/MT)
Source of data	Refer to Annexure to this document – Emission Reduction calculation excel sheet
Monitoring details	Calculated using formula - $SSCR_1 = S_{rep\ 1} / P_{rep\ 1}$
Values applied	0.017

Parameter Id. No.	**Es**
Description	Net enthalpy of the steam used in the project to generated hot water (kcal/ kg converted to TJ/MT)
Source of data	Refer to Annexure to this document – Emission Reduction calculation excel sheet
Monitoring details	Net enthalpy of the steam produced is calculated using the following formula: - $E_s = E_{tot} – E_{fw}$ E_s = Net enthalpy of steam being supplied in boiler (kCal/kg) converted to TJ/MT. E_{tot} = Total enthalpy of steam at the boiler outlet (kCal/kg) converted to TJ/MT E_{fw} = Heat content of feed water (kCal/kg) converted to TJ/MT The total enthalpy of the steam produced by the six numbers (6) of service boilers is calculated based on continuous measurement of the total steam produced at the boiler end (Stot) and steam pressure and stem temperature configuration at the boiler end. Similarly, the total heat content of the feed water, i.e. the temperature at which it is feed into the service boilers and total quantity of feed water fed into the boilers is measured on monthly basis.

Values applied	0.0028

Parameter Id. No.	**Steam pressure**
Description	Steam pressure at the boiler end (kg/cm^2 (gauge))
Source of the data	IMIS Report Utr004
Monitoring details	Steam pressure (kg/cm^2) is measured using dedicated pressure gauges installed at the steam distribution line connected to the DCS control system for monitoring. The digital data reading from the DCS are recorded in the plant log-sheets once in every shift and archived in IMIS system. The pressure gauges are calibrated against the master equipment once in every year. And the master equipment is calibrated by third party once in every year.
Values applied	**Steam Pressure** **Boilers** / **Average** (kg/cm^2 (gauge)) **CFB1**: 39.83 **CFB2**: 40.06 **CFB3**: 11.17 **CFB4**: 62.12 **CFB5**: 62.04 **CFB 6**: 62.06 **SRB (3)**: 63.38 **SRB (4)**: 63.05

Parameter Id. No.	**Steam temperature**
Description	Steam temperature at the boiler end (^{0}C)
Source of the data	IMIS Report Utr004
Monitoring details	Steam temperature (^{o}C) is measured using dedicated thermocouple installed at the steam distribution line connected to the DCS control system for monitoring. The digital data reading from the DCS are recorded in the plant log-sheets once in every shift and archived in IMIS system.

	The thermocouples are calibrated against the master equipment once in every year. And the master equipment is calibrated by third party once in every year.
Values applied	**Steam temperature** **Boilers** / **Average (^{0}C)** **CFB1** 397.17 **CFB2** 393.93 **CFB3** 327.80 **CFB4** 480.11 **CFB5** 477.58 **CFB 6** 478.17 **SRB (3)** 460.49 **SRB (4)** 459.50

Parameter Id. No.	**Feed water flow**
Description	Feed water flow to the steam boilers (MT)
Source of the data	IMIS Report Utr004
Monitoring details	Feed water fed into the boilers is measured using online flow meters connected DCS control system and the total integrated meter reading is recorded in every month. The flow meter is calibrated against the master equipment once in every year. And the master equipment is calibrated by third party once in every year.
Values applied	1989305.00

Parameter Id. No.	**$H_{boiler,i}$**
Description	**Hours of operation of the steam generating boilers in percentage by type of fuel used** • **% Operating hours of the boilers feed with coal** • **% Operating hours of the boiler feed with BLS**

Source of data	Mill Performance Report
Monitoring details	Measured on daily basis and reported as in % based on cumulative monthly, and monthly cumulative figures as annual
Values applied	Annual hours of operation % Hours by the coal fired boilers - 77% % Hours by the BLS fired boilers – 23%

Parameter Id. No.	**Stot**
Description	Total steam generated by the service boilers (i.e. six numbers of coal fired boilers (CFBs) and soda recovery boilers (i.e two numbers of SRBs) (MT)
Source of the data	IMIS Report Utr004
Monitoring details	Measured on continuous basis through steam flow meters and monitored at the connected DCS control system. Daily cumulative values are archived. Daily values are summed to derive monthly values and monthly values are integrated to get annual generation.
Values applied	2067970

Parameter Id. No.	**$F_{tot,i}$**
Description	Total fuel consumed to produce steam at the service boilers by type, i.e. coal and BLS (MT)
Source of the data	Mill Performance Report
Monitoring details	Measured on daily basis and reported as cumulative monthly, and monthly cumulative as total annual consumption

Values applied	Coal – 282774 MT BLS - 219954.81 MT

Parameter Id. No.	**$NCV_{,i}$**
Description	Net calorific value of the fuel by type 'i' (kcal/kg)
Source of the data	Refer to Annexure to this document – Emission Reduction calculation excel sheet
Monitoring details	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.
Values applied	**NCV** **Boilers** | **Average** (kcal/kg) **CFB1, 2, & 3** | 4374.77 **CFB4** | 4605.12 **CFB5** | 4686.94 **CFB6** | 5034.32 **SRB 3** | 3031.82 **SRB 4** | 3031.82

Parameter Id. No.	**$\eta boiler$ (%)**
Description	Average efficiency of the steam generating boilers (i.e CFBs and SRBs)
Source of the data	Refer to Annexure to this document – Emission Reduction calculation excel sheet
Monitoring details	Average efficiency of the steam generating boilers is calculated using formula from registered PDD in line with the approved methodology AM0018 ***Direct Boiler Efficiency Method (Input-Output Method):*** $\eta_{boiler} = E_s \div E_i$

	where η_{boiler} = Efficiency of the boiler E_s = Total energy output as steam (kCal) E_i = Total input energy as fuel (kCal) $E_s = E_{net} \times S$ where E_{net} = Net enthalpy of steam monitored as given before (E_{net} = Etot – Efw) (kCal/kg) S = Steam flow monitored by flow meter (kg) on continuous basis and integrated reading recorded on monthly basis $E_i = NCV_{fuel} \times F$ where NCV_{fuel} = Net Calorific Value of Fuel by type 'i' monitored as given below (kCal/kg) F = Fuel consumption monitored (MT) and recorded on monthly basis The total fuel by type (coal and black liquor solids) consumed by the boilers for production of steam is measured (M) on daily basis and compiled into monthly cumulative. This would not change due to project activity, hence same values has been reported under project scenario.
Values applied	69.32

Parameter Id. No.	**F_C**
Description	The carbon content of the coal (%)
Source of the data	Third party report
Monitoring details	Carbon percentage in the coal is analysed through third party report..
Values applied	26.2 tC/TJ

Emission Reductions

Project data compilation sheet													
Parameter	**$P_{rep\ 1}$**	**$S_{rep\ 1}$**	**$SSCR_{1}$**	**$SSCR_{diff}$**	**P_{act}**	**E_s**	**E_{net}**	**$\eta boiler$**	**E_{in}**	**EF_{fuels}**	**CER_{P}**	**CER**	**CER net**
Units	**MT**	**MT**	**MT/MT**	**MT/MT**	**MT**	**TJ/MT**	**TJ**	**%**	**TJ**	**tCO2/TJ**	**tCO2**	**tCO2**	**tCO2**
Jan-07	113600~~173065~~	23513~~3666~~			173065	0.0029		71.61		77.85			
Feb-07	118755~~158020~~	1760~~1760~~			158020	0.0029		72.91		70.37			
Mar-07	9251~~134248~~	101~~2095~~			134248	0.0028		68.90		75.26			
Apr-07	1320~~123397~~	18~~2245~~			123397	0.0029		73.48		70.29			
May-07	62897~~159149~~	11973~~3432~~			159149	0.0028		71.21		73.65			
Jun-07	14237~~141106~~	300~~3169~~			141106	0.0028		72.70		69.18			
Jul-07	99855~~173810~~	21093~~3835~~			173810	0.0028		71.29		70.15			
Aug-07	39886~~159793~~	635~~2383~~			159793	0.0028		67.55		74.79			
Sep-07	86672~~160526~~	987~~1890~~			160526	0.0028		63.63		74.93			
Oct-07	27101~~156897~~	302~~2009~~			156897	0.0028		58.99		75.90			
Nov-07	16771~~146209~~	482~~2991~~			146209	0.0029		70.94		65.57			
TOTAL	590345~~1686220~~	10242~~29475~~	**0.017**	**0.031**	**1686220**	**0.0028**	**146.~~02~~64**	**69.32**	**~~210~~211.~~6555~~**	**72.54**	**307**	**~~15280~~15346**	**~~14974~~15039**

Monitoring Period	Baseline Emissions tCO_2	Project Emissions tCO_2	Emission Reductions tCO_2
01/01/2007 – 30/11/2007	~~15280~~15346	307	~~14974~~15039
TOTAL			**~~14974~~15039**

ITC Limited