UNFCCC CDM Project Monitoring Report – Version 03

Optimization of steam consumption at the evaporator (Project 0679)

CDM registration number - 0679
Monitoring period - 01/04/2002 up to 31/12/2006
Document ID - Monitoring Report/CDM/0679/01
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ITC Limited

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Project background

The CDM project with Title – "***Optimization of steam consumption at the evaporator.***" has been registered as CDM project by the UNFCCC on 12th January 2007 under reference number (***Project 0679***). Further background on this project can be found in the PDD and associated documents, which are available on the UNFCCC website: http://cdm.unfccc.int/Projects/DB/DNV-CUK1159891716.85/view.html

Parties involved are India (Host Country) and the United Kingdom of Great Britain and Northern Ireland [other Parties]. Private entities involved are ITC Limited – Paperboards & Specialty Paper Division Unit Bhadrachalam, India and ABN AMRO BANK N.V., UK. Contact details of the entities have been provided in pervious page.

Project Location - The aforesaid project is an integral part of the existing pulp mill process of Paperboards & Specialty Papers Division of ITC located at Sarapaka Village, near Bhadrachalam town, at Khamam District of state of Andhra Pradesh in India. The site is at a distance of 300 km from Hyderabad, the nearest metropolitan city with well connected roadways, rail route and national and international airport facility.

Current Status of the Project

The project has completed installation of new single unit seven effect free flow falling film evaporator (FFFE) of installed capacity to process (evaporation) black liquor of 125.5 tons per hour designed to produce 70% black liquor solids. The new unit operates at a steam economy of 6.03 (ton of water evaporated/ tone of steam used).

Operational Phase

The project has been fully operational since 01/04/2002.

There were planned major outages for a period of 64 days approx during the monitoring period of 01/09/2003 to 31/12/2006 for periodic maintenance of the Evaporator Unit.

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

Monitoring Period

Monitoring Period Covered

This is the first monitoring report of the project. It provides details on the performance of the CDM project towards greenhouse gases emission reduction for the period of 01/04/2002 to 31/12/2006.

However, the project claims for emission reduction from 01/09/2003 to 31/12/2006.

As mentioned above the new free falling film evaporator is operational since April 2002. However, it was under trial run for a period of year when other two evaporators (baseline evaporators) were also in operation. Since there was no dedicated steam meter during the period April 2002 – August 2003, it is difficult to assess the actual steam consumed by individual evaporators as required by the registered PDD. The baseline evaporators were closed for operation from August 2003 and later on dismantled from the site. Thus, monitoring performance from September 2003 to December 2006 has been reported in the monitoring report.

Monitoring Protocol Followed

Parameters Monitored for Calculating Project Emission

<table>
<tr><th>Parameter Id. No.</th><td>Eine</td></tr>
<tr><td>Description</td><td>Daily input energy into electrical energy source (% of in-house electricity mix), i.e. Additional electricity consumed due to the project activity</td></tr>
<tr><td>As applied to the project</td><td>As the methodology does not provide any guidance or formula on how to calculate additional quantity of electricity over and above the baseline consumption. Thus, in the registered PDD, it has been mentioned under section B.2 (Description how the project has been applied in context to the project activity) that the incremental quantity of the electricity will be calculated based on difference between actual electricity consumed in the baseline and the project.

Similarly, following method has been applied to calculate the additional amount of electricity during the mentioned monitoring period.

Eine = (Specific auxiliary consumption at the project - Specific auxiliary consumption at baseline) X Total BLS produced by the FFFE.

Data used once during PDD finalization to determine Baseline Specific Consumption of Electricity is as follows
<table>
<tr><th>Parameter</th><th>Baseline Consumption of Electricity for Auxiliary</th><th>Baseline Production of BLS for respective period</th><th>Specific Consumption of electricity in baseline</th></tr>
<tr><td>Values which are constant through out the project crediting period</td><td>226310</td><td>10337</td><td>21.89</td></tr>
</table>
</td></tr>
<tr><td>Measured - M/ Calculated - C/ Estimated - E</td><td>Calculated - Monthly (the additional energy consumed as auxiliary consumption in comparison to baseline in GWh).</td></tr>
<tr><td>Units</td><td>GWh</td></tr>
</table>

Values applied	Sep 03 – Dec 03: 0.02831GWh Jan 04 – Dec 04: 0.9156 GWh Jan 05 – Dec 05: 0.8759 GWh Jan 06 – Dec 06: 0.8402 GWh

Parameter Id. No.	**F_C**
Description	The carbon emission factor of the fuels
As applied to the project	Since information on fuel type of fuel used by grid connected power plant is not available at the public domain, hence IPCC default values for coal has been used to calculate grid emission factor
Units	tC/TJ
Values applied	Sep 03 – Dec 03: 22.6 tC/TJ Jan 04 – Dec 04: 22.6 tC/TJ Jan 05 – Dec 05: 22.6 tC/TJ Jan 06 – Dec 06: 22.6 tC/TJ

Parameter Id. No.	**ŋG**
Description	Efficiency of the electricity generation system used in-house
As applied to the project	Determined by Direct Method – Output/ Input; Wherein the Output is the equivalent electrical energy (in Mkcal) and Input is the equivalent steam energy (in Mkcal)
Measured - M/ Calculated - C/ Estimated - E	Calculated annual based on monthly measured data on steam utilized for generation for power, total power produced and steam enthalpy at the boiler end.

Units	%
Values applied	Sep 03 – Dec 03: 16% Jan 04 – Dec 04: 16% Jan 05 – Dec 05: 18% Jan 06 – Dec 06: 18%

Monitoring Protocol Followed

Parameters Monitored for Calculating Baseline Emission

Parameter Id. No.	**P_{rep}**
Description	Total amount of black liquor solids (BLS) produced by the evaporator at the baseline
As applied to the project	Since there is no variance in BLS production from shift to shift basis, actual (total) production of BLS (shift wise) has been considered as representative sample of production. Standard Deviation with 95% confidence interval has been demonstrated during validation.
Measured - M/ Calculated - C/ Estimated – E	Measured - Once for a period of one month before the project was implemented
Units	MT
Values applied	10337 MT
Parameter Id. No.	**S_{rep}**
Description	Total amount of steam consumed at the baseline for the representative amount of BLS produced as reported under P_{rep}
As applied to the project	Since there is no variance in BLS production from shift to shift basis, actual (total) steam consumption for the total BLS (shift wise) produced, has been considered as representative sample of steam consumption at the baseline. Standard Deviation with 95% confidence interval has been demonstrated during validation.
Measured - M/ Calculated - C/ Estimated – E	Measured - Once for a period of one month before the project was implemented
Units	MT
Values applied	15064 MT

Monitoring Protocol Followed

Parameters Monitored for Calculating Project Emission

Parameter Id. No.	$P_{rep\,1}$
Description	Representative daily average BLS production values
As applied to the project	As per the methodology AM0018, average representative daily BLS production values should be within the normal range of output for the year 'y'. The normal range for the project has been defined as the range of +/-5% of the plant output that takes place most of the time in the year. For the days when the actual output is beyond the +/-5% of the defined normal production range, it has been excluded from the data list for the calculation of specific steam consumption ratio for the project. Since, the BLS the product line (BLS production) in the project has installed meter which is connected to the DCS system continuous measurement of BLS production is done. The daily production data is archived (daily basis) in Integrated Management Information System. The data on BLS production that is recorded in shift will also add to the same figure. The installed meter reads the flow of black liquor in mass. Mass flow is converted into volumetric flow using constant density factor (1.35). To ascertain percentage solids in the biomass fuel, samples are tested in the in-house laboratory on daily basis and accurate amount of biomass flow is determined. Volumetric flow is multiplied by the % solids determined by the lab results and density factor 1.35 to arrive at BLS production.
Measured - M/ Calculated - C/ Estimated – E	Measured – shift wise. Shift wise data is summed for a day, and daily for a month, and monthly for the year 'y'
Units	MT
Reference/ Records	Flow Meter - Tag - FIQ5787 - Is monitored for recording the total BLS generated (in volume – m3) for year 'y' through the connected DCS control system and archived as cumulative monthly generation.

Responsibility	Shift data - Operator (to record), Shift in-charge (to archive)
Values applied	Sep 03 – Dec 03: 24783 MT Jan 04 – Dec 04: 116789 MT Jan 05 – Dec 05: 81671 MT Jan 06 – Dec 06: 67055 MT

Parameter Id. No.	**$S_{rep\ 1}$**
Description	Steam consumption values corresponding to daily BLS production values as reported under $P_{rep\ 1}$ in the year 'y'
Measured - M/ Calculated - C/ Estimated - E	Measured – shift wise. Shift wise data is summed for a day, and daily for a month, and monthly for the year 'y'
Units	MT
Reference/ Records	Steam Flow Meter - Tag - FIQ5828 – Is monitored to record the total amount of steam consumed for the given quantity of BLS produced and monitored through the connected DCS control system..
Responsibility	Shift data - Operator (to record), Shift in-charge (to archive)
Values applied	Sep 03 – Dec 03: 18017 MT Jan 04 – Dec 04: 88282 MT Jan 05 – Dec 05: 62562 MT Jan 06 – Dec 06: 49437 MT

Parameter Id. No.	Pact
Description	Total amount of BLS generated at the project during the year 'y'
As applied to the project	This value is equivalent to the value represented under parameter P_{rep1}
Measured - M/ Calculated - C/ Estimated - E	Measured – shift wise. Shift wise data is summed for a day, and daily for a month, and monthly for the year 'y'
Units	MT
Reference/ Records	Flow Meter - Tag – FIQ5787 - Is monitored for recording total generation of BLS produced during the given period through the connected DCS control system.
Responsibility	Shift data - Operator (to record), Shift in-charge (to archive)
Values applied	Sep 03 – Dec 03: 73182 MT Jan 04 – Dec 04: 224664 MT Jan 05 – Dec 05: 228060 MT Jan 06 – Dec 06: 235134 MT

Parameter Id. No.	Etot
Description	Net Enthalpy of the steam generated by the service boilers
As applied to the project	The 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 pressure and temperature configuration of the steam at the boiler end. Thus based on the average monthly value of pressure and temperature configuration of the steam at the service boilers outlet is applied to derive the enthalpy of the steam from

<table>
<tr><td></td><td>the steam tables published by IS.</td></tr>
<tr><td>Measured - M/ Calculated - C/ Estimated - E</td><td>Enthalpy of the steam at the boiler end - Calculated on monthly basis

Stot - Measured on continuous basis through meters and monitored at the connected DCS control system. Daily cumulative values are archived. Daily values are summed to derive monthly values and monthly for yearly generation of steam.

Steam Pressure and Temperature - Similarly, pressure and temperature configuration of the steam produced by the service boilers are measured through DCS control system on per boiler basis as reported below.</td></tr>
<tr><td>Units</td><td>Enthalpy of the steam at the boiler end - kcal/ kg

Stot - MT

Steam Pressure and Temperature - Steam Pressure - kg/cm^2; Steam Temperature - ^oC</td></tr>
<tr><td>Values applied</td><td>
<table>
<tr><th colspan="4">Sep - 03 - Dec 03</th></tr>
<tr><th>Boilers</th><th>Steam Pressure at boiler outlet</th><th>Steam Temperature at boiler outlet</th><th>Enthalpy of the steam at the boiler outlet</th></tr>
<tr><td>CFB1</td><td>42</td><td>405</td><td>767</td></tr>
<tr><td>CFB2</td><td>42</td><td>405</td><td>767</td></tr>
<tr><td>CFB3</td><td>11</td><td>300</td><td>727</td></tr>
<tr><td>CFB4</td><td>63</td><td>480</td><td>805</td></tr>
<tr><td>CFB5</td><td>63</td><td>480</td><td>805</td></tr>
<tr><td>SRB3</td><td>64</td><td>460</td><td>793</td></tr>
<tr><td>Average</td><td></td><td></td><td>777</td></tr>
<tr><th colspan="4">Jan-04 - Dec-04; Jan-05 - Dec-05; Jan-06 - Dec-06;</th></tr>
<tr><th>Boilers</th><th>Steam Pressure at boiler outlet</th><th>Steam Temperature at boiler outlet</th><th>Enthalpy of the steam at the boiler outlet</th></tr>
<tr><td>CFB1</td><td>42</td><td>405</td><td>767</td></tr>
<tr><td>CFB2</td><td>42</td><td>405</td><td>767</td></tr>
<tr><td>CFB3</td><td>11</td><td>300</td><td>727</td></tr>
<tr><td>CFB4</td><td>63</td><td>480</td><td>805</td></tr>
<tr><td>CFB5</td><td>63</td><td>480</td><td>805</td></tr>
<tr><td>CFB6</td><td>63</td><td>480</td><td>805</td></tr>
</table>
</td></tr>
</table>

	SRB3	64	460	793	
	Average			**781**	

Parameter Id. No.	**Efw**
Description	**Enthalpy of the feed water maintained at the inlet of the service boilers**
As applied to the project	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. Thus based on the average monthly value of pressure and temperature configuration of the feed water fed into the service boilers, the enthalpy of the feed water is derived from the steam tables published by IS.
Measured - M/ Calculated - C/ Estimated - E	Calculated on monthly basis and reported as annual average
Units	kcal/ kg
Values applied	Sep 03 – Dec 03: 121.7 kcal/ kg Jan 04 – Dec 04: 123.3 kcal/ kg Jan 05 – Dec 05: 123.3 kcal/ kg Jan 06 – Dec 06: 123.3 kcal/ kg

Parameter Id. No.	**η_{boiler}**
Description	Average efficiency of the service boilers
Assumptions if any	Average efficiency of the service boilers is calculated using formula from register PDD as below 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 recorded monthly $E_i = NCV_{fuel} \times F$ where NCV_{fuel} = Net Calorific Value of Fuel 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. The Net Calorific Value (NCV) of the fuel is calculated based on Ultimate Analysis (method of measuring carbon, hydrogen, nitrogen, ash and moisture content) of the fuels. Where – NCV = Gross Calorific Value (GCV) – 10.02*Moisture percentage. (as per IS standard)
Measured - M/ Calculated - C/ Estimated - E	Calculated monthly on actual measurements. Based on which annual average is calculated.
Units	%
Values applied	Sep 03 – Dec 03: 62.3 Jan 04 – Dec 04: 70.9 Jan 05 – Dec 05: 71.2 Jan 06 – Dec 06: 70.3

<table>
<tr><td>Parameter Id. No.</td><td>% H_{fuel}</td></tr>
<tr><td>Description</td><td>Hours of operation of the service boilers in percentage on per type of fuel fed
• % Operating hours of the boilers feed with coal
• % Operating hours of the boiler feed with BLS</td></tr>
<tr><td>Measured - M/ Calculated - C/ Estimated - E</td><td>Measured on daily basis and reported as in % based on cumulative monthly, and monthly cumulative figures as annual %</td></tr>
<tr><td>Units</td><td>% Hours</td></tr>
<tr><td>Values applied</td><td>
<table>
<tr><td>Year</td><td>% Annual Hours of operation of the boilers by Coal</td><td>% Annual Hours of operation of the boiler by Black Liquor Solids</td></tr>
<tr><td>Sep 03 – Dec 03</td><td>81%</td><td>19%</td></tr>
<tr><td>Jan 04 – Dec 04</td><td>79%</td><td>21%</td></tr>
<tr><td>Jan 05 – Dec 05</td><td>77%</td><td>23%</td></tr>
<tr><td>Jan 06 – Dec 06</td><td>77%</td><td>23%</td></tr>
</table>
</td></tr>
</table>

Parameter Id. No.	**NCV**
Description	Average Net Calorific Values of the fuels fed into the service boilers
Assumptions if any	The Net Calorific Value (NCV) of the fuel is calculated based on Ultimate Analysis (method of measuring carbon, hydrogen, nitrogen, ash and moisture content) of the fuels conducted by the in-house laboratory on monthly basis for composite sample (for coal only) and third party (for black liquor solids) on biannual basis. Where – NCV = Gross Calorific Value (GCV) – 10*Moisture percentage.

<table>
<tr><td>Measured - M/ Calculated - C/ Estimated - E</td><td>Calculated monthly actual. Based on which annual average is calculated.</td></tr>
<tr><td>Units</td><td>kcal/kg</td></tr>
<tr><td>Values applied</td><td>
<table>
<tr><td>Year</td><td>Average Net Calorific Value of Coal (kcal/kg)</td><td>Average Net Calorific Value of BLS (kcal/kg)</td></tr>
<tr><td>Sep 03 – Dec 03</td><td>5389.8</td><td>3550</td></tr>
<tr><td>Jan 04 – Dec 04</td><td>5126.00</td><td>3030</td></tr>
<tr><td>Jan 05 – Dec 05</td><td>4996.56</td><td>2919</td></tr>
<tr><td>Jan 06 – Dec 06</td><td>5141.82</td><td>2985</td></tr>
</table>
</td></tr>
</table>

Monitoring Protocol Followed

Parameters Monitored for Calculating Leakage Emission

Parameter Id. No.	Eavg
Description	Daily electricity consumed by the auxiliaries of the new FFFE system (mix of in-house generation and grid power)
As applied to the project	As per the methodology it should be measured either directly through metering system or by nameplate capacity. The project selected to monitor and measure the auxiliary consumption through dedicated meters.
Measured - M/ Calculated - C/ Estimated - E	Measured – Daily (the auxiliary consumption of new FFFE unit in kWh)
Units	kWh
Reference/ Records	Meter Tag nos - MCC1 (71X4.3X1/2), MCC2 (71X40.3X3/4), MCC3 (71X40.3X5/6), MCC4 (71X40.3X7/8)
Values applied	Sep 03 – Dec 03: 1885324kWh Jan 04 – Dec 04: 5834165kWh Jan 05 – Dec 05: 5868890kWh Jan 06 – Dec 06: 5988026kWh

Parameter Id. No.	F_{grid}
Description	Emission Factor of the electricity imported from grid (Southern Regional Grid)
As applied to the	As mentioned in the registered PDD and validation report this was calculated on ex-ante

<table>
<tr><td>project</td><td>basis given below

<table>
<tr><th colspan="2">Average OM</th><th>tCO2/GWh</th></tr>
<tr><td>2002-2003</td><td></td><td>1357.80</td></tr>
<tr><td>2003-2004</td><td></td><td>1041.71</td></tr>
<tr><td>2004-2005</td><td></td><td>1051.06</td></tr>
<tr><td>Total</td><td></td><td>3450.57</td></tr>
<tr><td>Simple OM</td><td>EFOM,y</td><td>1150.19</td></tr>
<tr><td>BM</td><td>EFBM,y</td><td>731.95</td></tr>
<tr><td>CM</td><td>EFy</td><td>941.07</td></tr>
</table></td></tr>
<tr><td>Measured - M/ Calculated - C/ Estimated - E</td><td>Calculated ex-ante (once during PDD finalization)</td></tr>
<tr><td>Units</td><td>tCO2/GWh</td></tr>
<tr><td>Values applied</td><td>941.07 tCO2/GWh</td></tr>
</table>

Emission Reductions

Project data compilation sheet

Parameter	Eavg	Eine	P_{rep1}	S_{rep1}	SSC_P	SSC_{diff}	P_{act}	E_s	E_{net}	$\eta boiler$	E_{in}	EF_{fuels}	$CER_1 + CER_2$	CER	CER net
Months															
Sep-03	439050.00	0.09	5445	4028.00			15821	2.82		0.632		74.755			
Oct-03	498380.00	0.08	7845	5619.00			19060	2.82		0.619		72.498			
Nov-03	465256.00	0.06	5458	3880.00			18459	2.80		0.617		75.181			
Dec-03	482638.00	0.05	6035	4490.00			19843	2.82		0.626		77.575			
Total Sep 03-Dec03	**1885324.00**	**0.28**	**24783**	**18017**	**0.727**	0.730	**73182**	**2.81**	**150.42**	**0.623**	**241.34**	**75.002**	**26**	**18101**	**18075**
Jan-04	509407.00	0.07	8711	6449.00			19923	2.85		0.628		73.270			
Feb-04	455302.00	0.07	8751	6541.00			17793	2.81		0.638		75.025			
Mar-04	505469.00	0.09	9350	6923.00			19172	2.80		0.631		79.000			
Apr-04	466678.00	0.06	14129	10929.00			18677	2.78		0.660		72.911			
May-04	499559.00	0.06	3721	2788.00			20023	2.78		0.738		72.798			
Jun-04	488303.00	0.08	8214	6308.00			18713	2.78		0.731		72.801			
Jul-04	500076.00	0.07	11236	9005.00			19838	2.78		0.746		78.338			
Aug-04	481620.00	0.08	15933	11588.00			18349	2.78		0.781		82.669			
Sep-04	440636.00	0.09	8124	6292.00			16111	2.78		0.757		67.862			
Oct-04	505030.00	0.09	7355	5606.00			18834	2.78		0.735		63.249			
Nov-04	477670.00	0.09	9379	6905.00			17918	2.78		0.719		72.675			
Dec-04	504415.00	0.08	11887	8948.00			19313	2.78		0.750		67.350			
Total Jan 04-Dec04	**5834165.00**	**0.92**	**116789**	**88282**	**0.756**	0.701	**224664**	**2.79**	**439.32**	**0.709**	**619.27**	**73.162**	**55**	**45307**	**45252**
Jan-05	523920.00	0.12	13682	10106.00			18534	2.78		0.743		70.538			
Feb-05	437475.00	0.10	7508	5638.00			15234	2.78		0.767		80.179			
Mar-05	483813.00	0.05	10772	7918.00			19858	2.78		0.732		64.862			
Apr-05	489870.00	0.04	3224	2389.00			20471	2.78		0.704		66.997			
May-05	502563.00	0.06	4962	3857.00			20413	2.78		0.695		64.958			
Jun-05	458060.00	0.02	3813	3101.00			20014	2.78		0.692		64.775			
Jul-05	474659.00	0.06	10665	8259.00			18872	2.78		0.699		65.675			
Aug-05	478058.00	0.07	5011	3931.00			18858	2.78		0.712		62.218			
Sep-05	511671.00	0.08	5709	4446.00			19766	2.78		0.688		69.213			
Oct-05	463991.00	0.08	6294	5286.00			17627	2.78		0.706		74.028			
Nov-05	516455.00	0.13	6283	4958.00			17681	2.78		0.719		68.076			

ITC Limited

Project data compilation sheet

Parameter	Eavg	Eine	P_{rep1}	S_{rep1}	SSC_P	SSC_{diff}	P_{act}	E_s	E_{net}	$\eta boiler$	E_{in}	EF_{fuels}	$CER_1 + CER_2$	CER	CER net
Months															
Dec-05	528355.00	0.07	3748	2673.00			20734	2.78		0.684		65.503			
Total Jan 05-Dec05	**5868890.00**	**0.88**	**81671**	**62562**	**0.766**	0.691	**228060**	**2.78**	**437.59**	**0.712**	**614.67**	**68.085**	**21**	**41850**	**41829**
Jan-06	535338.00	0.10	7785	5594.00			19980	2.78		0.693		69.520			
Feb-06	475603.00	0.06	5289	4047.00			19012	2.78		0.698		67.171			
Mar-06	502083.00	0.10	3899	3280.00			18527	2.78		0.719		71.638			
Apr-06	409305.00	0.04	4524	3668.00			16656	2.78		0.716		73.182			
May-06	520651.00	0.07	9081	7075.00			20394	2.78		0.694		66.229			
Jun-06	514762.00	0.06	653	471.00			20816	2.78		0.706		64.738			
Jul-06	516865.00	0.07	6492	4966.00			20276	2.78		0.710		66.158			
Aug-06	501132.00	0.09	11051	7687.00			18925	2.78		0.679		65.767			
Sep-06	524693.00	0.08	5828	3781.00			20128	2.78		0.679		65.574			
Oct-06	519302.00	0.05	0	0.00			21586	2.78		0.702		69.381			
Nov-06	453653.00	0.06	2641	1923.00			17866	2.78		0.746		69.201			
Dec-06	514639.00	0.06	9811	6945.00			20966	2.78		0.690		67.881			
Total Jan 05-Dec05	**5988026.00**	**0.84**	**67055**	**49437**	**0.737**	0.720	**235134**	**2.78**	**469.94**	**0.703**	**668.75**	**68.037**	**22**	**45499**	**45477**
TOTAL															**150633**

Months	Project Emissions TCO2/month	Baseline Emissions TCO2/month	Emission Reductions TCO2/month
Sep-03 - Dec-03	26	18101	18075
Jan-04 - Dec-04	55	45307	45252
Jan-05 - Dec-05	21	41850	41829
Jan-06 - Dec-06	22	45499	45477
TOTAL			**150633**

I T C Limited

Appendix I

Monitoring Protocol Followed

Other Derived Parameters Applied for Calculation of Emission Reduction

Parameter Id. No.	**SSC_B**
Description	Specific consumption of steam at the baseline for the given amount of BLS generated at the baseline
Measured - M/ Calculated - C/ Estimated - E	Calculated once during PDD finalization
Formula Applied	S_{rep} / P_{rep}
Units	MT/MT
Values applied	1.4573 MT/MT

Parameter Id. No.	**SSC_P**
Description	Specific steam consumption in the project for the year 'y'
Measured - M/ Calculated - C/ Estimated - E	Calculated annually
Formula Applied	$SSC_P = S_{rep\,1} / P_{rep\,1}$

Units	MT/MT
Values applied	Sep 03 – Dec 03: 0.727 MT/MT Jan 04 – Dec 04: 0.756 MT/MT Jan 05 – Dec 05: 0.766 MT/MT Jan 06 – Dec 06: 0.737 MT/MT

Parameter Id. No.	**SSC_{diff}**
Description	Difference in specific steam consumption between the baseline and the project
Measured - M/ Calculated - C/ Estimated – E	Calculated annually
Formula Applied	$SSC_{diff} = SCC_B – SCC_P$
Units	MT/MT
Values applied	Sep 03 – Dec 03: 0.734 MT/MT Jan 04 – Dec 04: 0.715MT/MT Jan 05 – Dec 05: 0.698 MT/MT Jan 06 – Dec 06: 0.737 MT/MT

Parameter Id. No.	**Stot**
Description	Total steam generated by the service boilers for the given year 'y' of given Steam Pressure and Temperature characteristics

Measured - M/ Calculated - C/ Estimated - E	Measured on continuous basis through meters and monitored at the connected DCS control system. Daily cumulative values are archived. Daily values are summed to derive monthly values and monthly for yearly generation of steam.
Units	MT
Values applied	

Year	Steam Generation (MT)
Sep 03 – Dec 03	638093
Jan 04 – Dec 04	1959635
Jan 05 – Dec 05	2099934
Jan 06 – Dec 06	2166931

Parameter Id. No.	**Es**
Description	Net enthalpy of steam being supplied in boiler
As applied to the project	Net enthalpy of the steam produced is calculated using the following formula from the PDD $E_s = E_{tot} – E_{fw}$ 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 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-power) and pressure and temperature configuration of the steam 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. Thus based on the average monthly value of pressure and temperature configuration of the steam at the service boilers end and the feed water fed into the service boilers, the enthalpy of the steam and the enthalpy of feed water are estimated from the steam tables published by IS.
Measured - M/ Calculated - C/ Estimated - E	Calculated on monthly basis
Units	kcal/ kg converted to TJ/MT
Values applied	Sep 03 – Dec 03: 2.83 TJ/MT Jan 04 – Dec 04: 2.79 TJ/MT Jan 05 – Dec 05: 2.78 TJ/MT Jan 06 – Dec 06: 2.78 TJ/MT

Parameter Id. No.	**E_{net}**
Description	Net reduction in steam energy consumption per day, i.e. the additional Steam that would have been consumed in absence of the Project
Measured - M/ Calculated - C/ Estimated - E	Calculated annually
Formula Applied	$E_{net} = E_s * S_{net}$ Where $S_{net} = SSC_{diff} * P_{act}$
Units	TJ
Values applied	Sep 03 – Dec 03: 151.82 TJ

	Jan 04 – Dec 04: 448.04 TJ Jan 05 – Dec 05: 441.79 TJ Jan 06 – Dec 06: 481.25 TJ

Parameter Id. No.	**Ein**
Description	Actual amount of input energy that would have been consumed as fuel energy to generate fresh steam in absence of the project
As applied to the project	It is calculated based on following formula as per registered PDD $E_{in} = E_{net} / \eta boiler$
Measured - M/ Calculated - C/ Estimated - E	Calculated annually
Units	TJ
Values applied	Sep 03 – Dec 03: 243.58 TJ Jan 04 – Dec 04: 631.57 TJ Jan 05 – Dec 05: 620.56 TJ Jan 06 – Dec 06: 684.84 TJ

Parameter Id. No.	**EF_{fuels}**
Description	Weighted average of emission factor of the fuel used to generate steam at the project
Assumptions if any	It is calculated applying following formula from the registered PDD

	Σ (Fc_{fuel} * % H_{fuel}) Fc_{fuel} = Carbon emission factor for fuel is calculated based on actual analysis tests reports on carbon content in the fossil fuel conducted by the in-house laboratory on monthly basis for composite sample and crossed checked from the third party on annual basis. %Hfuel = % of hours per day for each type of fuel. Measured based on total running hours of the boilers on monthly basis. The unit has six service boilers, all coal feed and one soda recovery boiler (process boiler to recover chemical) is feed with black liquor solids (waste from wood pulp processing – considered carbon neutral as it is from biogenic source). All boilers within project boundary are dedicated for firing particular type of fuel (i.e. coal / black liquor solids).
Measured - M/ Calculated - C/ Estimated - E	Calculated monthly. Value applied is annual average
Units	tCO2/TJ
Values applied	Sep 03 – Dec 03: 75.002 tCO2/TJ Jan 04 – Dec 04: 71.906 tCO2/TJ Jan 05 – Dec 05: 67.421 tCO2/TJ Jan 06 – Dec 06: 67.438 tCO2/TJ