UNFCCC CDM Project Monitoring Report

Demand side energy efficiency programmes for specific technologies at ITC Bhadrachalam pulp and paper making facility in India.

(Project 0806)

CDM registration number - 0806

Monitoring period - 01/01/2006 up to 31/12/2006

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I T C Limited

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Project background

The CDM project with Title – "***Demand side energy efficiency programmes for specific technologies at ITC Bhadrachalam pulp and paper making facility in India"*** has been registered as CDM project by the UNFCCC on 19th February 2007 under reference number (***Project 0806***). 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-CUK1166082720.69/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 - All measures under the energy conservation programme have been implemented within the manufacturing complex of Paperboards & Specialty Papers (PSPD) Division of ITC at Bhadrachalam located at Sarapaka Village, near Bhadrachalam town, at Khamamm 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.

Project Description - The project involves implementing and maintaining energy conservative measures identified under a mill-wide power conservation programme leading to emission reduction due reduction in fossil fuel combusted to generate electricity. It's a uphill responsibility on ITC Bhadrachalam unit maintain the performances of the energy conservation measures throughout the 10years crediting period under the CDM protocol with known and unknown variability within the manufacturing process paperboards and specialty paper.

Current Status of the Project

Project Description			Project Start Date
Description	**Earlier Specification**	**Project specification**	
Paper Machine: 1			
Replacement of 12 nos. of vacuum fans connected to 4 nos. of formers (3 fans at each) by 4 nos. of energy efficient fans (1 fan at each former).	HBBB-10-3-H2 14 m3/min, 1100 mmwc	CEMTEK SINGLE FAN 42m3/min, 700 mmwc	26-09-2003
Replacement of low efficient Vacuum Pump - No. 3 at by energy efficient alternative Vacuum Pump	12E, 105m3/h, 500 mmhg	K202M, 105m3/h, 500 mmhg	16-02-2005
Replacement of double disc refiner by tri-disc refiner to reduce energy consumption in stock preparation by increasing the consecutive refining stage and improving the quality of the stock.	1 SDM,4.5T/h, 150m3/h	21TDR,4.5T/h 150m3/h	04-12-2003
Paper Machine:2			
Replacement of Unrefined chest pump with reduction in pump head of optimum requirement and reduce pumping energy	133m3/h @ 33m head	133m3/h @ 29m head	23-11-2004
Replacement of Refined chest pump with reduction in pump head of optimum requirement and reduce pumping energy	183m3/h @ 17.5m head	183m3/h @ 15m head	14-12-2004
Replacement of Mixing chest pump with reduction in pump head of optimum requirement and reduce pumping energy	181m3/h @ 14m head	181m3/h @ 10m head	14-12-2004
Replacement of Intermediate chest pump with reduction in pump head of optimum requirement and reduce pumping energy	181m3/h @ 14m head	181m3/h @ 10m head	23-11-2004
Replacement of Machine chest pump with reduction in pump head of optimum requirement and reduce pumping energy	200m3/h @ 24m head	200m3/h @ 20m head	14-02-2005
Paper Machine:3			

Project Description			Project Start Date
Description	**Earlier Specification**	**Project specification**	
Replacement of Mixing chest pump with reduction in pump head and flow of optimum requirement and reduce pumping energy	56m3/h @ 29m head	200m3/h @ 21.5m head	14-12-2004
Replacement of Intermediate chest pump with reduction in pump head of optimum requirement and reduce pumping energy	50m3/h @ 12m head	50m3/h @ 10m head	25-04-2005
Replacement of Machine chest pump with reduction in pump head and flow of optimum requirement and reduce pumping energy	79m3/h @ 21.5m head	72m3/h @ 20m head	14-12-2004
Replacement of PCC pump with reduction in pump head and flow of optimum requirement and reduce pumping energy	480m3/h @ 40m head.	260m3/h @ 30m head	14-12-2004
Replacement of SCC pump with reduction in pump head and flow of optimum requirement and reduce pumping energy	168m3/h @ 32.5m head.	140m3/h @ 25m head	14-12-2004
Replacement of TCC pump with reduction in pump head and flow of optimum requirement and reduce pumping energy	90m3/h @ 27.5m head	47m3/h @ 25m head	10-09-2004
Paper Machine: 4			
Replacement of Vacuum sealing water pump with reduction in pump head and flow of optimum requirement and reduce pumping energy	144m3/h @ 31m head	125 m3/h @ 17m head	14-12-2004
Replacement of Sand filter transfer pump with reduction in pump head of optimum requirement and reduce pumping energy	175m3/h @ 40m head	175 m3/h @ 15m head	14-12-2004
Replacement of Cooling Tower pump with reduction in pump head and flow of optimum requirement and reduce pumping energy	353m3/h @ 31m head	260 m3/h @ 25m head	23-03-2005
Others			
Replacement of one high flow capacity TG3 cooling water pump (CWP 1) by optimum flow capacity pump.	2500m3/h at 27.5m head	1250m3/h at 27.5m head	05-01-2001

Project Description			Project Start Date
Description	**Earlier Specification**	**Project specification**	
Replacement of higher capacity evaporator cooling water pump by lower capacity pump	1500m3/h at 65m head	1800m3/h at 35m head	24-05-2005
Compressors			
Replacement of 9 nos. reciprocating compressors with HOC dryers by single centrifugal compressor with refrigerant dryer.	Compressor No:1,5,7,8,9,10 CFB4:1 CFB5:1	1 x 95Nm3/m	14-03-2003
Fluorescent Lamps (FL)			
Replacement 3025nos of 2x40W FL tubes with copper choke by 2x22W FL tubes with electronic ballast	2 x 40 W with Copper Choke	2 x 22 W with Electronic ballast	23-11-2004
High Pressure Mercury Vapour Lamps (HPMV)			
Replacement of 100nos of HPMV lamps by metal halide lamps.	1 x 400W HPMV	1 x 250W Metal Halide	05-06-2004
Distribution			
Installation of capacitor banks at SFT A&B to improve power factor and reduce distribution losses	500 Kvar	(7 x 50)Kvar 850 Kvar	04-06-2003
Installation of capacitor banks at NFL to improve power factor and reduce distribution losses	600 Kvar	(7 x 50)Kvar 950 Kvar	28-12-2004
Harmonic Filters			
Installation of harmonic filters at PM2 to reduce	Not available	450Kvar, Siemens make	20-03-2004
Variable Frequency Drives			
Installation 2 nos. of 200kw VFD for CFB4 FD fans	Not available	2 x 250Kva, ABB make	23-12-2004
Installation of 22kw VFD for PM1 horizontal chest pump.	NA	22 kw Eurotherm	30-11-2003
Drives			
Change of drives from DC to AC during machine rebuilt & Installation of Harmonic filter	Siemens make DC drives	ABB make AC drives	January,2001
Controls			

Project Description			Project Start Date
Description	**Earlier Specification**	**Project specification**	
Installation of electronic governor for 7.5MW unit to reduce bandwidth of frequency variation.	Model SR4 ,BHEL make Hydraulic governor	TS320 Trison make electronic governor	23-08-2005

Reporting 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 01/01/2006 to 31/12/2006 (both days including).

Monitoring and Verification Protocol

Monitoring Plan as per PDD and Monitoring Procedure Followed

Parameters to be monitored	Protocol on Monitoring	Procedure followed
$\mathbf{P_{base}}$ = Baseline kW rating of the equipment (kW)	Measured once before project implementation	Baseline measurement of all measures included in the project has been measured once before implementation of the project for a period of one month as a general protocol. *Reference:* • Capital Scheme Approved for the project measures • Third party audit reports
Pprj = Energy consumed by the equipment during the monitoring period as 'y' (kWh)	Continuous measurement through meter	Energy meters have been installed for all the measures wherever applicable to measure the energy of the equipment directly. Monthly, consumptions are also recorded in the log-sheets. Few of the equipments which are directly monitored through DCS system, monthly records on energy consumptions of those equipments are archived as paper back-up. All energy meters are been tagged with co-relation with the identified equipment and history cards are maintained at the site. Calibration schedule of the energy meter as preventive maintenance is also being followed under the unit's environment management system certified under ISO 9001.
$\mathbf{EF_{mix,y}}$ = Emission Factor of the electricity mixed used by the unit in the year 'y' (tCO2/GWh)	To be calculated annually	The emission factor of the electricity mix used by the unit has been calculated based in the annual performance data on self generation, fuel used and grid consumption.
$\mathbf{E_{gird,y}}$ = Total grid electricity used by the	Measured	Dedicated meter records the total grid electricity consumed by the unit on continuous basis. Monthly reports on month's consumption

unit in the year 'y' (GWh)	annually	are maintained under report reference # UTR019 and can be verified in cross reference with bills paid for the year.
EF_{grid} = Emission Factor of the grid (tCO2/GWh)	Determined ex-ante based on latest version of AMS I D during PDD finalization	The emission factor of 941.07tco2/GWh for the southern regional grid has been applied in the project.
$E_{in-house,y}$ = Total electricity generated in-house by the unit in the year 'y' (GWh)	Measured annually	Dedicated meter records the total electricity generated by the unit on continuous basis. Monthly reports on month's generation are maintained under report reference # UTR019 and can be verified in cross reference with Integrated Management Information System on daily and monthly mill performance.
$EF_{in-house,y}$ = Emission Factor of the in-house electricity for the year 'y' (tCO2/GWh)	To be calculated annually	The emission factor of the electricity mix generated using coal and black liquor (climate neutral fuel) by the unit has been calculated based total emission due to fossil fuel consumption divided by total in-house generation by all types of fuel.
$FF_{i,y}$ = Fossil fuel of type 'i' used for in-house generation of electricity for the year 'y' (MT)	Measured annually	Daily, cumulative monthly and annual measurement of fuel consumed by type is maintained under report reference UTR004.
NCV_i = Average net calorific value of the fossil fuel used by type 'i' in the year 'y' (kcal/kg converted to TJ/MT)	Measured daily	Daily, cumulative monthly and annual measurement of gross calorific value and moisture contained of the fuels consumed by type is maintained under report reference CLR012.

Operational Control Procedure Followed for Data Assurance

ITC Bhadrachalam unit has a specific operational control procedure for proper management and review of the CDM project (***Ref - Doc. No. EPM 4.4.6.29 CLEAN DEVELOPMENT MECHANISM, ENVIRONMENTAL OPERATION CONTROL PROCEDURE***).

The primary object of the procedure is to "establish system for monitoring, measuring, recording, reporting, reviewing and communicating on the performance of the Clean Development Project registered at UNFCCC under Reference No. #0806". The OCP is the integral part of the Environment Management System certified under ISO 14001:2004. The operational control procedure takes care of all quality control and quality assurance on the monitoring system and uncertainty analysis on the monitored data.

The procedure clearly delineates roles and responsibility for all activities that are required to be performed for reporting on the performance of the CDM project on the periodic basis to the management of the ITC PSPD (Project Participant). The instruments and tools identified for measurement of parameters have been listed in the critical category of instruments and are periodically calibrated as per set calibration schedule. In the event of malfunctioning of any instruments, tools, equipments, emission reduction is accounted for as per the registered Monitoring Plan.

Emission Reductions

Formulas Applied

$$EB_{i,y} = P_{base} - P_{prj} * EF_{mix,y} \quad (1)$$

Where

$EB_{i,y}$ = Emission Reduction achieved by the measures of type 'i' in the year 'y' (tCO2)

P_{base} = Baseline kW rating of the equipment measured once before project implementation and multiplied with operating hours at the project scenario (**Ohrs**) (calculated to GWh)

P_{prj} = Energy consumed by the equipment during the monitoring period as 'y' (measured in kWh, calculated to GWh)

$EF_{mix,y}$ = Emission Factor of the electricity mixed used by the unit in the year 'y' (tCO2/GWh) determined as,

$$EF_{mix,y} = [(E_{gird,y} * EF_{grid}) + (E_{in\text{-}house,y} * EF_{in\text{-}house,y})] / (E_{gird,y} + E_{in\text{-}house,y}) \quad (2)$$

Where

$E_{gird,y}$ = Total grid electricity used by the unit in the year 'y' (GWh)

EF_{grid} = Emission Factor of the grid determined ex-ante based on latest version of AMS I D during PDD finalization (tCO2/GWh)

$E_{in\text{-}house,y}$ = Total electricity generated in-house by the unit in the year 'y' (GWh)

$EF_{in\text{-}house,y}$ = Emission Factor of the in-house electricity for the year 'y' (tCO2/GWh) determined as follows:

$$EF_{in\text{-}house,y} = FF_{i,y} * COEF_i / E_{in\text{-}house,y} \quad (3)$$

Where

$FF_{i,y}$ = Fossil fuel of type 'i' used for in-house generation of electricity for the year 'y' (MT)

$COEF_i$ = Carbon-dioxide emission factor for fossil fuel of type 'i' (tCO2/MT) determined as

$$COEF_i = NCV_i * EF_i * OXID_i \quad (4)$$

Where

NCV_i = Average net calorific value of the fossil fuel used by type 'i' in the year 'y' (kcal/kg converted to TJ/MT)

EF_i = IPCC default carbon di-oxide emission factor fossil fuel of type 'i' per unit of energy used (tCO2/TJ) (default - 89.5 as per 2006 IPCC Guidelines for National Greenhouse Gas Inventories"

$OXID_i$ - IPCC default oxidation factor of the fossil fuel by type 'i' (%) 1% as per 2006 IPCC Guidelines for National Greenhouse Gas Inventories"

Months	**$FF_{i,y}$**	**NCV_i**		**EF_i**	**$COEF_i$**	**$E_{in-house}$**	**E_{grid}**	**$EF_{in-house,y}$**
Units	**MT**	**kcal/kg**	**converted to TJ/MT**	**tCO2/TJ**	**tCO2/MT**	**GWh**		**tCO2/GWh**
Jan-06	22866	5264.93	0.02	89.5	1.97	24.91	0.57	1810
Feb-06	19212	5297.43	0.02	89.5	1.98	21.50	0.39	1774
Mar-06	23139	5220.68	0.02	89.5	1.96	25.91	0.22	1747
Apr-06	22707	5214.21	0.02	89.5	1.95	24.68	0.34	1797
May-06	23383	5199.65	0.02	89.5	1.95	26.26	0.26	1735
Jun-06	21863	5190.90	0.02	89.5	1.94	25.30	0.47	1681
Jul-06	23878	5198.58	0.02	89.5	1.95	26.23	0.62	1773
Aug-06	23947	4994.23	0.02	89.5	1.87	24.70	0.32	1814
Sep-06	24265	5026.88	0.02	89.5	1.88	25.38	0.44	1800
Oct-06	24421	5028.34	0.02	89.5	1.88	25.87	0.87	1778
Nov-06	23949	5107.56	0.02	89.5	1.91	24.56	1.26	1866
Dec-06	25079	4852.65	0.02	89.5	1.82	26.79	0.16	1702
Emission Factor of the in-house electricity used for the year (tCO2/GWh)								1773
Emission Factor of the grid electricity (ex-ante once during PDD finalization) (tCO2/GWh)								941
Total Emission due to in-house generation of electricity (tCO2)								535634
Total Emission due to use of grid electricity (tCO2)								5572
Emission Factor of in-house electricity mix for the year 'y' - $E_{mix,y}$ (tCO2/GWh)								**1757**

Summary Energy Savings and Emission Reduction Achieved

Project Measures	**P_{base}**	**O_{hrs}**	**P_{prj}**	**EB_y**	**EF_y**	**ER**
Unit	**kW**	**hrs**	**kWh**	**GWh**	**tCO2/GWh**	**TCO2**
Paper Machine: 1						
Replacement of 12 nos of vacuum fans connected to 4 nos. of formers (3 fans at each) by 4 nos of energy efficient fans (1 fan at each former).	35.68	7651.81	85607.00	0.19	1757.15	329.31
Replacement of low efficient Vacuum Pump -No. 3 at by energy efficient alternative Vacuum Pump	150.50	7651.81	921226.00	0.23	1757.15	404.80
Replacement of double disk refiner by tri-disc refiner to reduce energy consumption in stock preparation by increasing the consecutive refining stage and improving the quality of the stock.	380.00	7651.81	1561069.00	1.35	1757.15	2366.21
Paper Machine:2						
Replacement of Unrefined chest pump with reduction in pump head of optimum requirement and reduce pumping energy	17.30	7610.25	96341.00	0.04	1757.15	62.06
Replacement of Refined chest pump with reduction in pump head of optimum requirement and reduce pumping energy	13.80	7610.25	97635.00	0.01	1757.15	12.98
Replacement of Mixing chest pump with reduction in pump head of optimum requirement and reduce pumping energy	12.70	7610.25	63071.00	0.03	1757.15	59.00

Project Measures	**P_{base}**	**O_{hrs}**	**P_{prj}**	**EB_y**	**EF_y**	**ER**
Unit	**kW**	**hrs**	**kWh**	**GWh**	**tCO2/GWh**	**TCO2**
Replacement of Intermediate chest pump with reduction in pump head of optimum requirement and reduce pumping energy	15.00	7610.25	55942.00	0.06	1757.15	102.29
Replacement of Machine chest pump with reduction in pump head of optimum requirement and reduce pumping energy	22.70	7610.25	79583.00	0.09	1757.15	163.71
Paper Machine:3						
Replacement of Mixing chest pump with reduction in pump head and flow of optimum requirement and reduce pumping energy	15.50	7671.28	99026.00	0.02	1757.15	34.93
Replacement of Intermediate chest pump with reduction in pump head of optimum requirement and reduce pumping energy	12.10	7671.28	19030.00	0.07	1757.15	129.66
Replacement of PCC pump with reduction in pump head and flow of optimum requirement and reduce pumping energy	78.00	7671.28	266707.00	0.33	1757.15	582.76
Replacement of SCC pump with reduction in pump head and flow of optimum requirement and reduce pumping energy	32.90	7671.28	93267.00	0.16	1757.15	279.59
Replacement of TCC pump with reduction in pump head and flow of optimum requirement and reduce pumping energy	15.00	7671.28	47447.00	0.07	1757.15	118.82
Paper Machine: 4						

Project Measures	**P_{base}**	**O_{hrs}**	**P_{prj}**	**EB_y**	**EF_y**	**ER**
Unit	**kW**	**hrs**	**kWh**	**GWh**	**tCO2/GWh**	**TCO2**
Replacement of Vacuum sealing water pump with reduction in pump head and flow of optimum requirement and reduce pumping energy	20.10	7675.53	65790.00	0.09	1757.15	155.49
Replacement of Sand filter transfer pump with reduction in pump head of optimum requirement and reduce pumping energy	21.60	7675.53	65514.00	0.10	1757.15	176.20
Replacement of Cooling Tower pump with reduction in pump head and flow of optimum requirement and reduce pumping energy	44.30	7675.53	171890.00	0.17	1757.15	295.44
Others						
Replacement of one high flow capacity TG3 cooling water pump (CWP 1) by optimum flow capacity pump.	230.00	5776.00	618820.00	0.71	1757.15	1246.98
Replacement of higher capacity evaporator cooling water pump by lower capacity pump	304.60	5335.80	1260633.00	0.36	1757.15	640.75
Compressors						
Replacement of 9 nos. reciprocating compressors with HOC dryers by single centrifugal compressor with refrigerant dryer.	721.00	8760.00	5740561.00	0.58	1757.15	1011.06
Fluorescent Lamps (FL)						
Replacement 3025nos of 2x40W FL tubes with copper choke by 2x22W FL tubes with electronic ballast	284.35	3996.88	483622.18	0.65	1757.15	1147.22
High Pressure Mercury Vapour Lamps (HPMV)						

Project Measures	**P_{base}**	**O_{hrs}**	**P_{prj}**	**EB_y**	**EF_y**	**ER**
Unit	**kW**	**hrs**	**kWh**	**GWh**	**tCO2/GWh**	**TCO2**
Replacement of 100nos of HPMV lamps by metal halide lamps.	19.20	5114	61368	0.04	1757.15	64.70
	20.80	4278	33368	0.03		58.63
Distribution						
Installation of capacitor banks at SFT A&B to improve power factor and reduce distribution losses	921.62	3862.50	3367443.38	0.19	1757.15	340.48
Installation of capacitor banks at NFL to improve power factor and reduce distribution losses	3774.17	8216.00	30381371.28	0.63	1757.15	1102.10
Harmonic Filters						
Installation of harmonic filters at PM2 to reduce	732.43	7609.00	5277348.77	0.29	1757.15	514.02
Variable Frequency Drives						
Installation 2 nos. of 200kw VFD for CFB4 FD fans	279.80	7682.00	1508391.37	0.64	1757.15	1126.39
Installation of 22kw VFD for PM1 horizontal chest pump.	13.60	7651.81	47919.00	0.06	1757.15	98.66
Drives						
Change of drives from DC to AC during machine rebuilt & Installation of Harmonic filter	901.29	7651.81	3389747.4	3.51	1757.15	6161.88
Controls						
Installation of electronic governor for 7.5MW unit to reduce bandwidth of frequency variation.	5239.42	8471.00	42106695	2.18	1757.15	3824.16
Total Energy Savings (GWh) and Emission Reduction (tCO2)				**11.70**		**20532**

Year	Baseline Emission (tCO_2e)	Project Emission (tCO2e)	Leakage (tCO2e)	Total Emission Reduction (tCO2e)
01/01/2006 - 31/01/2006	20532	0	0	20532