**PROJECT DESIGN DOCUMENT FORM
FOR SMALL-SCALE CDM PROJECT ACTIVITIES (F-CDM-SSC-PDD)
Version 04.1**

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Demand side energy efficiency programmes for specific technologies at ITC Bhadrachalam pulp and paper making facility in India
Version number of the PDD	04
Completion date of the PDD	14th February 2014
Project participant(s)	ITC Paperboards and Speciality Papers Division (PSPD) ABN AMRO Bank N.V., London
Host Party(ies)	Government. of India
Sectoral scope(s) and selected methodology(ies)	Scope: 4 AMS-II.D.: Energy efficiency and fuel switching measures for industrial facilities --- Version 07, 28th November AMS I, D, version 09, 19th May, for grid emission calculation
Estimated amount of annual average GHG emission reductions	20967

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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ITC Paperboards and Speciality Papers Division (PSPD) Bhadrachalam Unit, a part of ITC Limited, took voluntary initiatives to reduce their electrical energy consumption with an objective to contribute towards the reduction of greenhouse gases (GhG) in line with their corporate sustainable business approach. ITC PSPD Bhadrachalam is one of the largest pulp and paper mills in India and produces about 2,61,641 tonnes of paper and paper board per annum. These initiatives were taken at a time (in the year 2001) when Clean Development Mechanism (CDM) and related activities in India were at a nascent stage.

The management of ITC PSPD appointed energy and industry experts to identify opportunities to save electricity by reducing energy demands through specific technology implementation. TERI, a premier Engineering and Research Institute in India, conducted energy audit across the pulp and paper mills along with PSPD Bhadrachalam energy engineers. The audit identified areas of possible energy savings that required additional investment and adoption of technologies not prevalent in the industry sector at that time.

The measures adopted under the energy efficiency programme can broadly be classified into:

a) *Replacement of low efficient equipment (such as pumps, compressors, lamps) with energy efficient alternatives;*

b) *Application of retrofit measures for various types of equipment through measures such as power factor improvement, and installation of energy saving devices, etc.;*

The programme has resulted in actual savings of 13.049GWh of electricity in a year. The energy savings has been calculated based on difference in energy consumption before and after the project implementation. Since the PSPD Bhadrachalam Unit consumes both in-house generation (from coal, black liquor and diesel) and grid import, the weighted average emissions from all sources has been calculated to obtain the weighted average CO_2 emission factor resulting from the combustion of fuels in the unit and at the grid. Since, black liquor is a climate neutral fuel (as per IPCC) emissions from black liquor combustion have been considered 'zero'. The project estimates an annual reduction of 20967 tCO2 for coming 10years of crediting period and thereafter.

The project also contributes to sustainable development in the following manner for the well-being of the country in terms of environment, socio-economic, technology, and economy:

Socio-economic well being: The CDM project activity leads to avoidance of coal which is an important source of energy for the utility sector in India. Often due to shortage of coal supply the thermal power plants undergo forced outages in power generation leading to crisis in electricity supply to the common people in India. Thus avoidance of coal will enable coal supply of India to divert to more important uses such as electricity generation.

Environmental well being: The energy efficiency measures reduce electrical energy consumption of the PSPD unit. Thus it directly reduces the fossil fuel consumption by the facility for power generation and indirectly at the thermal power plants connected to the local grid from which the facility imports electricity. The reduction in fossil fuel consumption in power generation corresponds to the reduced equivalent generation of carbon dioxide from fuel combustion and a proportionate GhG emission in transportation, mining and extraction of fossil fuel.

Technological well being: The project initiation encouraged the in-house engineers to participate and identify small but effective opportunities for energy efficiency measures. Since all the measures are

spread over the PSPD unit, it was a team effort among the in-house engineers, management and third party energy consultant that contributed to the success of the project. Few measures such as installation of rotary compressors, capacitor bank, harmonic filters and variable frequency drives required on-job training of the employees involved in operation and maintenance of the drives. This has lead to improved technical skill and knowledge level of the employees in the facility.

ITC PSPD will be the sole owner of the CERs generated from the project. The ITC PSPD shall be the principal contact for the CDM project activity. The contact information of all project participants has been provided in Annex 1.

A.2. Location of project activity

A.2.1. Host Party(ies)

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India

A.2.2. Region/State/Province etc.

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Southern Region, Andhra Pradesh, Khammam district

A.2.3. City/Town/Community etc.

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Sarapaka Village

A.2.4. Physical/ Geographical location

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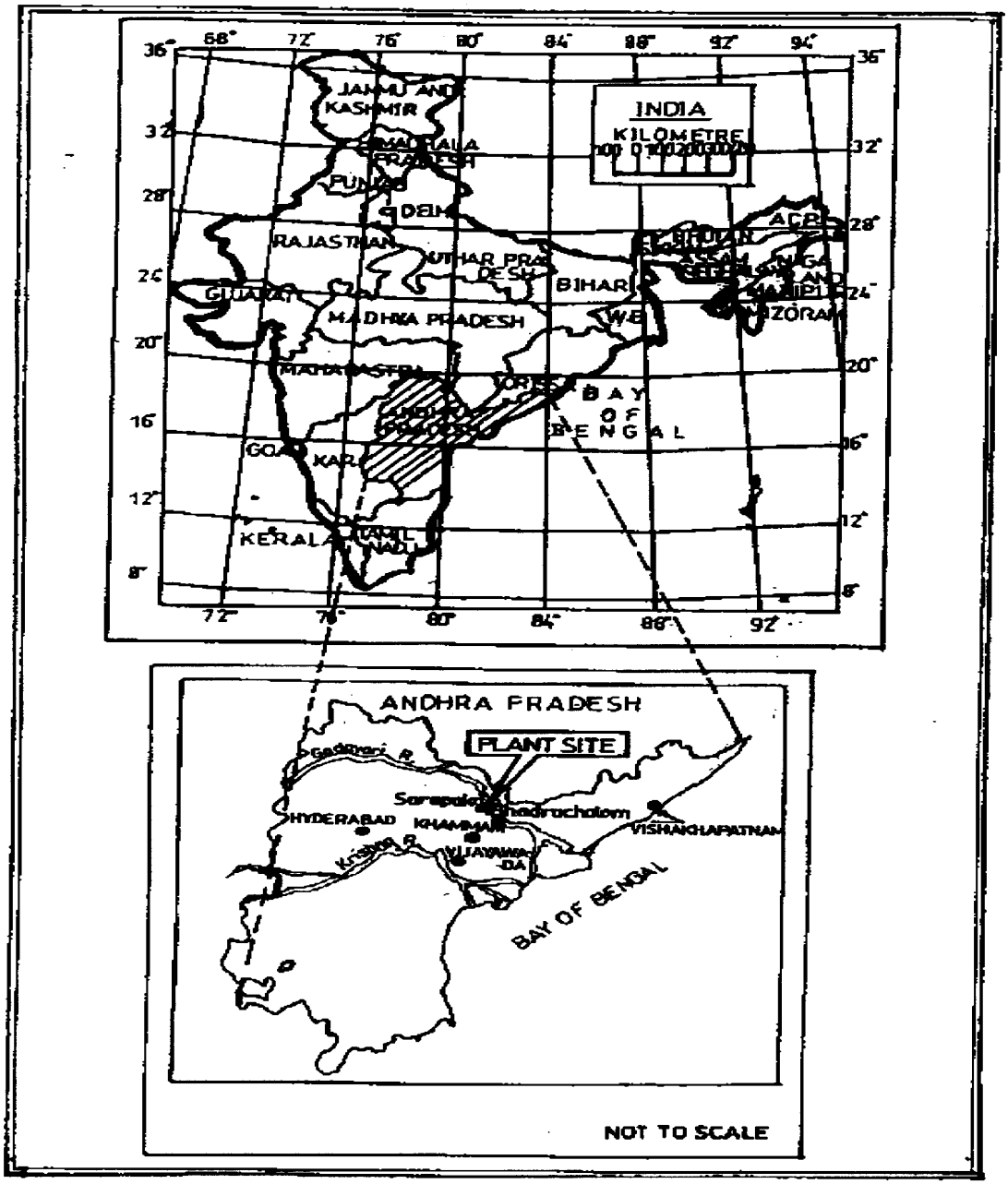
Location:

All measures under the energy conservation programme have been implemented within the manufacturing complex of Paperboards & Speciality Papers (PSPD) Division of ITC at Bhadrachalam. The PSPD unit is located at Sarapaka near Bhadrachalam town (around 17°41'19"N latitude and 80°52'05"E longitude) in Andhra Pradesh State. The site is at a distance of 300 km from Hyderabad. The nearest railway station is Bhadrachalam Road at a distanced of 45 km. Figure: Showing project location in Andhra Pradesh state, India.


INDIA
KILOMETRE
JAMMU AND KASHMIR
PUNJAB
DELHI
RAJASTHAN
UTTAR PRADESH
BIHAR
GUJARAT
MADHYA PRADESH
WB
MAHARASHTRA
BAY OF BENGAL
GOA
KARNATAKA
KERALA
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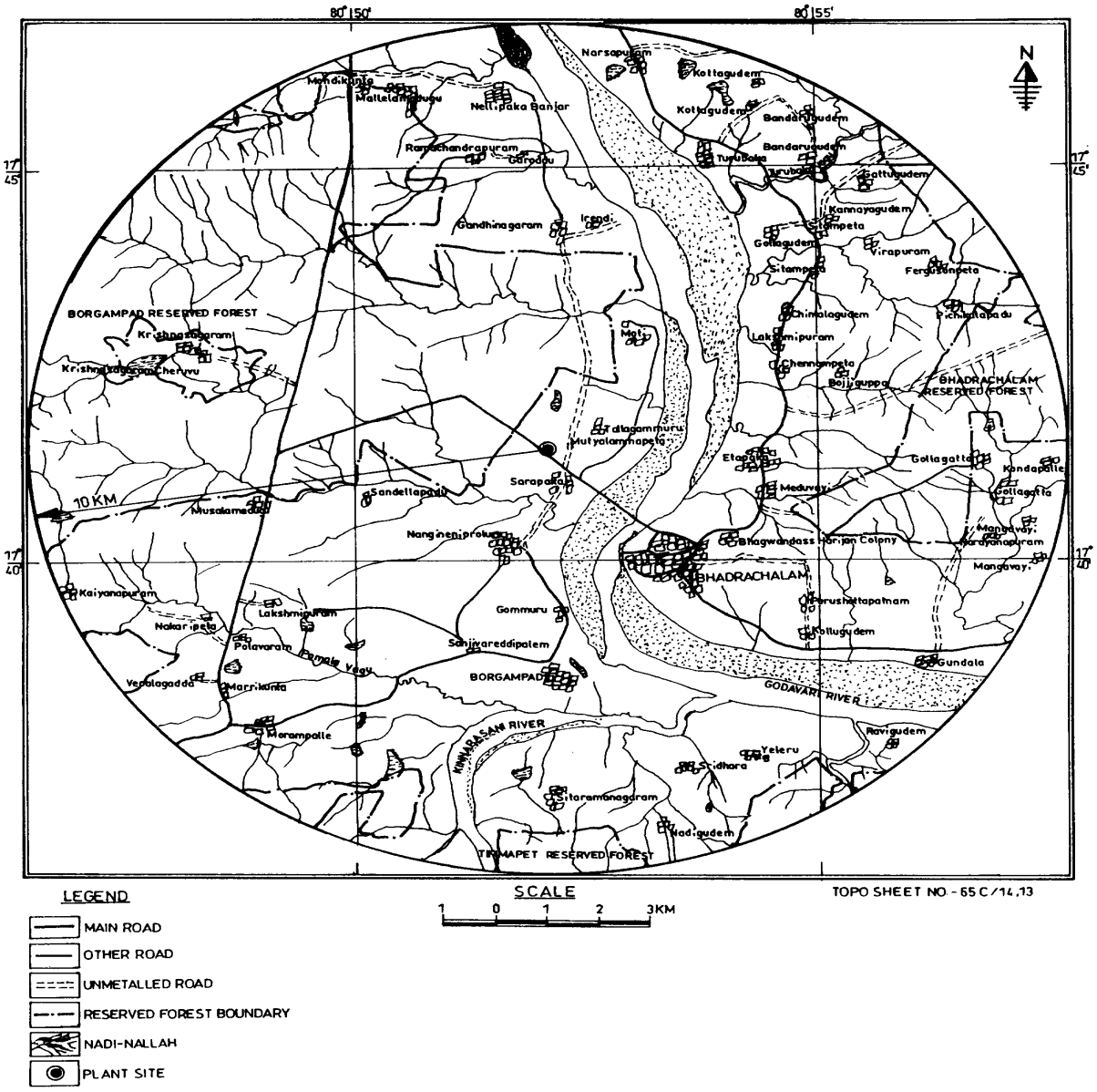

Location Map showing the PSPD plant site and its surroundings

A.3. Technologies and/or measures

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Description of each measure:

a) Replacement of inefficient low efficient equipment (such as pumps, compressors, lamps) with energy efficient alternatives;

Under the energy conservation programme, a detailed study was conducted to calculate the actual head required at the installed pumps when operated at maximum load and their efficiencies. It was then observed that around twenty pumps located at various sites within the unit required replacement with efficient and correctly rated pumps. PSPD Bhadrachalam has spent INR 9.4 million to replace pumps and save about 4.513 GWh of electricity per annum.

Similarly, the Unit has changed 3025 fluorescent tube lights (FTL) of 2x44W by 2x22W FTL fittings with electronic ballast and 100 HPMV lamps with metal halide lamps to augment energy efficiency of all light fittings. While providing desired illumination this initiative led to reduction in electricity

consumption. The investment in these measures was INR 2.01 million leading to electricity savings of 0.814 GWh of electricity per annum.

Further, under the replacement category, PSPD Bhadrachalam has replaced 9 reciprocating compressor (with heat of compression (HOC) air dryer) by one centrifugal compressor (with refrigerant dryer). The Unit bought the new compressor at a cost of INR 18.5 million and saved about 1.105 GWh of electricity.

The total aggregate saving of electricity achieved from the above-mentioned measures is about 6.432 GWh/annum.

b) Application of retrofit measures for various type of equipments and through measures such as power factor improvement, and installation of energy saving devices, etcimprove the power factor;

To improve the power factor at various electricity consumption points, PSPD Bhadrachalam has installed -

- two Two capacitor banks one each at secondary fibre treatment plant (SFT) A, B and new fibre line (NFL);
- two Two harmonic filters one each at Paper Machine #1 and #2 (PM1 & PM2);
- two Two variable frequency drives (VFDs) one each at coal fired boiler number 4 (CFB4) and chest pump of Paper Machine #1 (PM1);
- one One AC drive replacing a DC drive for Paper Machine #1 (PM1); and,
- one One electronic governor for 7.5 MW turbine (under implementation and would be concluded by August, 2005).

The total aggregate saving of electricity achieved from the above-mentioned measures is about 6.617 GWh/annum

Therefore the total savings from the project is 13.049 GWh/annum

The average life of all equipment had been estimated to be 15 years at the time of programme initiation (2001-2002).

Please refer to '*Enclosure# 1*' of this Project Design Document for details on all technology measures adopted under the energy conservation programme.

A.4. Parties and project participants

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Government. of India	ITC Paperboards and Speciality Papers Division (PSPD)	No
United Kingdom	ABN AMRO Bank N.V., London	No
Switzerland	STX Services B.V.	No

A.5. Public funding of project activity

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No public funding has been sought for the project activity. The project proponent will identify potential participants if additional funds are required in the future.

A.6. Debundling for project activity

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As mentioned under *Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project Activities*, the following results into debundling of large CDM project:

"A proposed small-scale project activity shall be deemed to be a debundled component of a large project activity if there is a registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point."

The identified CDM project is being promoted by ITC PSPD Bhadrachalam Unit. The project proponent further confirms that it has not registered any small scale CDM activity or applied for registration another small scale CDM project activity within 1km of the respective project boundaries of these proposed projects, in the same project category and technology/measure. Hence the above criteria of debundling cases are not applicable for these CDM projects.

SECTION B. Application of selected approved baseline and monitoring methodology

B.1. Reference of methodology

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Title: Type II, D – Energy efficiency and fuel switching measures for industrial facilities, Version 07, 28th November, Scope 4.

This methodology also refers to AMS I, D, version 09, 19th May, for grid emission calculation.

Reference: http://cdm.unfccc.int/methodologies/SSCmethodologies

B.2. Project activity eligibility

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ITC PSPD Bhadrachalam Unit had launched an energy conservation programme in the year 2001, which led to savings in electricity consumption. There is no statutory policy or programme that sets regulatory benchmark for pulp and paper units in India on consumption of energy. Thus the project initiatives, that are voluntary efforts of Bhadrachalam Unit, would not have been possible in the absence of management decision of ITC PSPD to save electricity and thus GhG emissions associated with the generation of power by combustion of fossil fuel. In 2001 and even till date, such programme of mill-wide coverage for energy savings is not a common practice in the Indian pulp and paper making sector as it leads to significant investment yet resulting only in marginal savings. The sector business psyche typically diverts capital investments to mill expansions that lead to larger business gains rather than allow it to be siphoned to small replacement and retrofit measures with marginal profitability. Similarly, ITC PSPD had to spend INR 61 million under the programme that achieved only 13.049GWh per annum of electricity savings. The actual electricity saved by various measures has resulted in displacement of electricity both at the in-house generation level and grid imports in the proportion of actual usage of power. Thus, the CDM project is over and above the business-as-usual (BAU) practice and reduces

anthropogenic emissions of GhG (primarily CO_2) by the fossil fuel based power generating sources catering to the electricity demand of PSPD Bhadrachalam Unit. Hence, the weighted average emissions from all sources supplying electricity to Bhadrachalam, has been computed to obtain the aggregate CO_2 emissions occurring from the combustion of fuels to generate electricity. Since, PSPD Bhadrachalam uses coal, diesel (fossil fuels), biomass and black liquor solids (biomass from pulp digestion) to generate electricity, emissions from biomass and black liquor combustion has been considered "zero" (climate neutral fuel). The total GhG emission reduction achieved by the project is about 20,967 tonnes of CO_2equivalent in a year.

B.3. Project boundary

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Boundary – According to the selected approved project category II D, the project boundary has been described as the physical, geographical location of the industrial facility, processes or equipment that are affected by the project activity.. As recommended by the approved methodology, the physical location of each piece of equipment replaced/ retrofitted/ newly installed has been considered as the project boundary. No two measures under the CDM project are inter-related and hence all equipment have been considered as isolated systems having their own independent boundaries

B.4. Establishment and description of baseline scenario

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Justification on baseline scenario and baseline emission calculation

The most appropriate baseline scenario for the project activities is continuation with less efficient equipment run by electricity and thereby prone to consuming additional amount of electricity equivalent to the amount saved by the energy conservation drive. Thus, the emissions that would have occurred for the consumption of additional amount of electricity would be the emissions at the baseline occurring in the absence of the project activities.

There is no other possible baseline alternative to the project activity as it is not mandatory under Indian law or regulation for the industrial facilities to conduct regular energy audit and apply stringent energy efficiency measures and reduce electricity consumption. Thus, only the above mentioned option would have been the most appropriate baseline option. Further, it's not a BAU scenario to conduct mill-wide energy audit and invest significant amounts to reduce electricity demand by the industrial consumers. This is a voluntary initiative of ITC PSPD to encourage reduction in consumption of energy and attain sustainable development in their business operations.

Methodology applied in context to the selected project category

According to the selected project category (*Type II, D – Energy efficiency and fuel switching measures for industrial facilities*) the energy baseline consist of: -

1. The energy use of the existing equipment that is replaced in the case of retrofit measures and of the facility that would otherwise be built in the case of a new facility.
2. In both cases, the electricity component of the energy baseline is adjusted for technical transmission and distribution losses for the electrical grid serving the industrial facility.
3. Each energy form in the emission baseline is multiplied by an emission coefficient (in kg CO_2equ/kWh). For the electricity displaced, the emission coefficient is calculated in accordance with provisions or paragraphs 28 and 29 for category I.D projects. For fossil fuels, the IPCC default values for emission coefficients may be used.

- As mentioned, the energy baseline for the project is the actual energy consumed by the individual equipment before it was replaced/ retrofitted under the project activity. Thus while determining

individual energy baseline of the equipment included in the project, one month metered data based on actual load before implementation of the project measure was collected and recorded.

- PSPD unit consumes electricity both from in-house generation and grid imports. The unit is physically connected to electricity grid of Andhra Pradesh state electricity board called as APTRANSCO (Andhra Pradesh Transmission Company) which is a part of Southern Regional Grid; hence Southern Regional gird has been selected as project baseline grid to calculate emissions from grid electricity. For calculation of the emission factor of the selected grid, the approach that of combine margin has been adopted. Further, the project selects and apply simple operating margin as the contribution from low cost must run resources to the southern regional grid has been evident to be less than 50% of the total generation in last 5 years. The project would use one time estimated emission factor of the grid (at time of PDD finalization) because in future the unit is more likely to meet its total demand of electricity from in-house generation and remain connected to the grid for standby.
- Thus, the emission coefficient of the electricity displaced by the project has been calculated based on the weighted average emission of the generation mix (in-house and grid).
- Further, as mentioned earlier, the unit utilizes coal, diesel, biomass and black liquor solids (concentrated processed lignin obtained from wood based pulp digestion) for in-house electricity generation. Back liquor solids and Biomass are considered as carbon neutral fuel (IPCC 1997a, c). Hence, emissions from the above two sources to produce captive electricity have not been considered in the calculation of emission coefficient of the electricity mix used by the unit.

From the discussion it can be concluded that the energy baseline selected from the given option under the applicable project category can be applied to this particular project case.

Key variables/ data used for determination of baseline scenario

Key variables	Data Needed
Numbers of equipment/ devices either retrofitted or replaced in the CDM project and their unique location	N_i - the number of devices of the group of "i" such as lamps and pumps replaced and other equipments like compressors, VFDs, capacitor banks and harmonic filters installed been recorded with their unique location identified.
For the equipment/ devices with constant load – Rated power of the equipment/ devices replaced Operating/ running hours of the equipment/ devices	 P_i = the power of the devices of the group of "i" such as lamps replaced. O*i* = operating/ running hours of (average 10hours/day)
For the equipment/ devices fluctuating load but same technology applied at many places within the unit - "Metering the "energy use" of an appropriate sample of the devices installed."	 P_p = the actual energy consumed by the pumps Sampling procedure – the pumps connected to the same load type have been clubbed together.
For all other single initiatives, such as VFDs, compressors, capacitor banks, harmonic filters with variable loads	

"Metering the energy use of the equipment installed"	P_o = the actual energy consumed by the connected load.
Emission co-efficient of the electricity used by the project	Electricity mix of PSPD unit ▪ In-house generation – with ▪ Coal ▪ Black Liquor ▪ Diesel ▪ Biomass ▪ Grid Electricity Imports ▪ Transmission and distribution losses of the grid

B.5. Demonstration of additionality

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As has been already explained above, the project initiatives qualifies under *Type II, C – Demand-side energy efficiency programmes for specific technologies* of small scale CDM simplified modalities and procedure. The following paragraphs has been detailed on project additionality.

In accordance with paragraph 28 of the simplified modalities and procedures for small-scale CDM project activities, a simplified baseline and monitoring methodology listed in Appendix B may be used if project participants can demonstrate that the project activity would otherwise not be implemented due to the existence of one or more barrier(s) listed in attachment A of Appendix B. Similarly, for the identified CDM project, "*mill-wide energy conservation programme – primarily electricity consumption*", following barriers have been overcome during project planning and execution:

Barrier Analysis

Projects at the time of validation will provide qualitative documentary evidence to a designated operational entity on the following barriers as discussed:

Investment additionality:

To execute all the measures identified under electricity conservation programme, ITC PSPD has invested about INR 60.2million not including expenses borne for hiring energy and industrial consultants, conduct energy audits and monitoring. Such amount of significant investment, spent only to save marginal amounts of power with a concern for global warming and GhG emissions reduction is not commonly seen in any process industry sector in India. Further, from the business perspective for any industry, it is more viable and convenient to invest on modern technology either during designing phase or during total revamping of any unit rather than make piecemeal investment in retrofit and replace options. Investment returns on large capacity addition or technology adoption shows up prominently in terms of savings and helps in benchmarking operations. On the contrary, mill-wide energy conservation-initiatives of replacement and retrofit nature are not a common practice as it involves large capital investment against low returns. The programme was launched in the year 2001, and series of investments have been made either to purchase new equipment and/or to implement retrofit measures. All records on investment and equipment purchase are available with PSPD Bhadrachalam Unit's account management division.

Technology Barrier:

The energy efficiency initiatives carried out in various parts of the pulp and paper manufacturing facility can have a cascading or domino effect of failure in critical production areas directly or indirectly connected if the intended performance of the replaced / retrofitted equipment falls below design values. Hence, it was a challenge to take the risk of such business interruption against the drive to save energy and contribute to mitigation of climate change. In certain applications of energy savings such as in change of drives for machines, compressors, the redundancy of the system has been reduced by replacing

a series of equipment with equipment whose failure mode could lead to larger risks and consequences. Special expertise on maintenance service provider has to be sourced from the equipment supplier in case of a sudden breakdown. This would necessarily require larger lead times as compared to operating the existing equipment whose maintenance was well understood by the plant maintenance and operational personnel. The paper machine #1 retrofit, centrifugal compressor and TG2 electronic governor would certainly require specialized external support in case of equipment failure on account of their technological complexities

Barrier due to prevailing practices:
Indian government enacted the Energy Conservation Act in the year 2001, with the main objective of institutionalizing and strengthening delivery mechanism for energy efficiency services in the country and foster the much-needed coordination between the various energy providers and distributors. Therefore, the act is more to encourage rather than regulate the adoption of energy efficiency programmes. There is no mandatory law in the country which ensures compulsory adoption of energy efficiency measures. Therefore, all conservation measures adopted by ITC PSPD Bhadrachalam Unit is over an above any requirement under national law or regulation. Further, a survey conducted by a national industrial federation shows that a modern pulp and paper making unit installed to produce writing and printing paper based on 100% wood pulp with kraft process would ideally consume 1300 kWh[1] of electricity per tone of finished paper. However, PSPD Bhdrachalam being one the more energy efficient pulp and paper facilities has brought down their specific electricity consumption to 1016.12 kWh per tonne of paper (*figure of 2002-2003*).

Other Barriers:
Organisation Capacity: The core business of ITC PSPD Bhardachalam Unit is to manufacture high quality paper and paperboards. To execute implementation of the proposed energy efficiency drive, the management of ITC PSPD had to overcome obstacles in streamlining various aspects of project planning and execution. The Unit had to hire consultant to conduct feasibility study emphasising upon technological options and equipment selection, equipment procurement and test runs, operation and maintenance and training.

Insufficient technical know-how on CDM: At a time when the energy conservation programme was launched by ITC PSPD, knowledge of CDM in the process industry was rather poor. Further, till date there has been no project proposed such as the present project on energy efficiency measures across a single industrial facility. Hence, uncertainty of project success as a CDM project was an area of concern for the ITC PSPD management as it involved a large capital investment of INR 61million. Till date (at the time of PDD formulation, July 2005) no small scale CDM project on demand side energy efficiency has been proposed.

Effect of changes in the Project Design:
Two of the proposals planned during the first PDD preparation were not implemented namely:

1. Replacement of fan pumps at PM1 by energy efficient pumps which had expected savings of 0.48 GWh of energy
2. Replacement of machine chest pump of PM3 which had expected savings of 0.02 GWh of energy

Even though the above two proposals were not implemented, the project still abides by all the conditions mentioned in Section A.4.2 of this PDD and thus, the applicability of the applied methodology still stands. The non-implementation of the above two proposals will result in reduced emission reductions but will not affect the either compliance of the monitoring plan as mandated by the applied methodology

[1] http://www.greenbusinesscentre.com/papereng.asp

or the additionality of the project activity. The estimated power savings from the project will drop by 0.50 GWh. However, the project will still classify as a small scale project.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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As earlier proved in Section B, that the project category *Title: Type II, D – Energy efficiency and fuel switching measures for industrial facilities* is applicable to the project, as project also demonstrates demand-side energy efficiency programme implemented across PSPD Bhadrachalam pulp and paper facility. Further, the project has achieved electricity savings of 12.852 GWh in a year after completion of programme spread over a period of time. Therefore, it is justified to apply the small scale selected project category to determine the actual GhG saved.

B.6.2. Data and parameters fixed ex ante

(Copy this table for each piece of data and parameter.)

Data / Parameter	$\sum$**Equ$_i$**
Unit	Numerical
Description	Numbers of devices replaced/ retrofitted of group "i" where "i" refers to pumps, lamps, compressors., etc
Source of data	Plant records
Value(s) applied	-
Purpose of data	Baseline and Project
Additional comment	-

For measure involve replacement of lamps across the mill

Data / Parameter	$\sum$**P$_{ibase,}$**
Unit	kW
Description	Rated Power of the device replaced/ retrofitted at the baseline
Source of data	Plant Records- Third party report by MKRC
Value(s) applied	-
Purpose of data	Baseline
Additional comment	Only for lamps

Data / Parameter	$\sum$**P$_{j,Prj}$**
Unit	kW
Description	Rated Power of the device installed as the project measures
Source of data	Plant Records- Third party report by MKRC
Value(s) applied	-
Purpose of data	Project
Additional comment	Only for lamps

For measures involve replacement of equipments that are operated without significant change of connected load

Data / Parameter	$\sum P_{p,base}$
Unit	kW
Description	Actual energy consumed by the equipments at the baseline
Source of data	Plant Records- Daily for a period of one month prior to the implementation of the project measure
Value(s) applied	-
Purpose of data	Baseline
Additional comment	Equipments – Pumps, VFDs, Drives, Compressors

For the measures that involves installation of power correction equipments operated at variable connected load

Data / Parameter	F_{base}
Unit	Hz
Description	Frequency at which the TG2 was being operated in absence of the electronic governor
Source of data	Plant Records- Daily for a period of one month prior to the implementation of the project measure
Value(s) applied	-
Purpose of data	Baseline
Additional comment	-

Others

Data / Parameter	***COEFi***
Unit	tCO_2/TJ
Description	CO_2 emission co-efficient of each fuel (i) type
Source of data	IPCC default
Value(s) applied	Coal- 89.5 Diesel-72.6
Purpose of data	Baseline, Project and leakage– Used for calculation of grid EF
Additional comment	-

Data / Parameter	***EFy***
Unit	tCO_2/TJ
Description	CO_2 emission factor of current generation mix of the grid
Source of data	Calculated based on data on $\sum kGEN_{k,y}$, FFi, COEFi available from regional load despatch centre for the year 2004-2005 : $EFgrid = [FF_i*COEF_i*44/12] / [\sum k\ GEN_{k,y}]$.
Value(s) applied	941
Purpose of data	Baseline, Project and leakage
Additional comment	-

B.6.3. Ex-ante calculation of emission reductions

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Formula for leakage calculation

According to the selected small scale CDM project category II D, leakage for the project activity should be calculated when - the energy efficiency technology is equipment is transferred from another activity or if the existing equipment is transferred to another activity. The project has mostly invested in new equipment. In a two instances such as:

- two numbers of variable frequency drive of 200 kw for FD fans of coal fired boiler #4 (CFB4); and
- One number of capacitor bank at secondary fibre treatment #A&B;

The project has utilised energy efficient equipment transferred from applications that have now been abandoned/ decommissioned. However in two cases -
1. Double disc refiner (which has been replaced by Tri disc refiner in project scenario)
2. Ten reciprocating compressors (which has been replaced by one centrifugal compressor)

The Unit proposes to keep them on site for standby purpose. Thus its usage as and when in the future, is likely to cause leakage. To calculate leakage, the following formula should be applied: -

The leakage is calculated as the sum of devices of group "i" replaced or retrofitted of power "p_i" multiplied by average annual operation hours "o_i" of the devices.

$$\mathbf{E_{L,\,y} = \Sigma_i\ (Equi_{\,i,p} * O_{hrs})} \qquad \mathbf{(1)}$$

Where,
$E_{L,y}$ = Annual leakage (kWh/yr)
Σ_i = the sum over the group of "i" devices retained and used, for which the replacement is not operating during the period, implemented as part of the project.
$\mathbf{Equ_i}$ = the rated power of devices of the group of "i" devices replaced or retrofitted for which the replacement is not operating during the period (kW).
$\mathbf{O_{hrs}}$ = the average annual operating hours of the devices of the group of "i" devices replaced or retrofitted. (Hours)

The energy baseline is multiplied by an emission coefficient (measured in kg CO_2equ/GWh) for the electricity displaced (electricity mix in the unit- both in-house and grid, as derived below- equation 3 - 6).

Formula for anthropogenic emission estimation

The energy baseline is calculated as difference in metered energy consumption of the sum of devices of group "i" replaced or retrofitted. Following formula expresses in details:

For measure involve replacement of lamps across the mill

$$\mathbf{EB,y = \Sigma i\ (\ (P_{base,i} - P_{project,i}) * O_{hrs,\ actual}\ )} \qquad \mathbf{(2)}$$

Where,
EB,y = Annual energy saved by the project (GWh/yr)
Σi = the sum over the group of "i" devices replaced (lamps), for which the replacement is operating during the year, implemented as part of the project.
$\mathbf{P_{base,i}}$ = power used by the devices/ equipment of the group of "i" devices replaced (lamps) **(at the baseline)** (kW).
$\mathbf{P_{project,i}}$ = power used by the devices/ equipment of the group of "i" devices (lamps)newly installed **(at the project scenario)** (kW).

$O_{hrs, actual}$ = the actual annual burning hours of the devices of the group of "i" devices (lamps) replaced or retrofitted. (Hours)

For measures involve replacement of equipments that are operated without significant change of connected load

$EB,y = \Sigma i ((P_{base,i} - P_{project,i}) * O\text{-}_{hrs, actual})$ **(3)**
$P_{project,i} = Energy_{project}/O\text{-}hrs_{, actual}$ **(3a)**
Where,
EB,y = Annual energy saved by the project (GWh/yr)
Σi = the sum over the group of "i" devices retrofited (pumps, fans, etc), for which the replacement is operating during the year, implemented as part of the project.
$P_{base,i}$ = power used by the devices/ equipment of the group of "i" devices retrofitted (pumps, fans, etc) **(at the baseline)** (kW), recorded based on a period of one month monitoring prior to the implementation of the project. .
$P_{project,i}$ = power used by the devices/ equipment of the group of "i" devices newly installed **(at the project scenario)** (kW).
$Energy_{project}$ = electricity consumed by the devices/ equipment of the group of "i" for the project monitoring period (kWh)
$O_{hrs, actual}$ = the actual annual operating hours of the devices of the group of "i" devices replaced or retrofitted. (Hours)

For the measures that involves installation of power correction equipments operated at variable connected load
$EB,y = \Sigma i (P_{base,i} - P_{project,i}) * O\text{-}hrs_{actual}$ **(4)**

Where:
$P_{base,I}$ = power used by the devices, equipment of the group of "i" devices retrofitted (pumps, fans, etc) **(at the baseline**) (kW) and calculated as **$P_{base} = (Energy_{base}/ O\text{-}hrs_{corresponding,3})$** **(4,a)**

Where: -
$P_{base,i}$ = power used by the devices/ equipment of the group of "i" devices retrofitted (pumps, fans, etc) **(at the baseline)** (kW),
$Energy_{base}$ - Total electricity consumed during the three consecutive days of continuous operation in a month without the harmonic filter/ capacitor bank (in switched off mode) (kWh).
$O\text{-}hrs_{corresponding,3}$ - Corresponding operating hours for the 3 consecutive days of continuous operation for baseline establishment
$O\text{-}hrs_{actual}$ – Actual operating hours in the given month.

$P_{project} = (Energy_{project} /O\text{-}hrs_{corresponding})$
(4,b)
Where:
$P_{project}$ = Energy consumed at project ($Energy_{project}$, kWh) and is the monthly recording of the metered energy consumed by the equipment with harmonic filter/ capacitor bank (less 3 days of the month for baseline energy measurement) and recording the corresponding operating hours of the equipment during the month (kW).
$O\text{-}hrs_{corresponding}$ - Corresponding operating hours for the month less 3 consecutive days of baseline monitoring

Please note that the savings due to installation of harmonic filter in PM1 (proposal 2.1 in Retrofit proposals list given in Enclosure 1) is included along with savings due to conversion of DC drives to AC drives (proposal 4.1 in Retrofit proposals list given in Enclosure 1)

Only for Electronic Governor

$$P_{base} = P_{project} * (F_{base} / F_{project})^3 \quad (4,c)$$

Where

P_{base} = Power generated at baseline (kWh)

$P_{project}$, = (kWh) is the recorded monthly generation by the TG with electronic governor at a frequency of $F_{project}$ (Hz) (recorded monthly average).

F_{base} = (Hz) is recorded before installation of electronic governor based on monitoring for a period of month (49.89). Note - Power is proportional to cube of frequency.

Project Category	Initiative	Total GWh saved/ year	Monitoring Plan
Replacement			Rated Capacity Equp'i' * Running Hours Direct - Cross verifiable with Sample Meter Reading
	Pumps	4.513	
	Lights	0.814	
	Compressor	1.105	
Sub Total		**6.432**	
Retrofit			
	Capacitor Banks	0.696	Rated Capacity Equp'i' * Running Hours Direct - Cross verifiable with Sample Meter Reading
	Harmonic Filters	0.966	
	Variable Frequency Drive	0.496	
	Other drives	2.083	
	Power Governor	2.376	
Sub Total		**6.617**	
Total GWh saved/ year		**13.049**	

The energy baseline is multiplied by an emission coefficient (measured in kg CO_2equ/kWh) for the electricity displaced (electricity mix in the unit- both in-house and grid).

$$EF_y = (EF_{grid} * E_{grid} + EF_{in\text{-}house} * E_{in\text{-}house}) / (E_{grid} + E_{in\text{-}house}) \quad (3)$$

Where:

EF_y = Emission Factor of the electricity mix of the unit (tCO_2/GWh)

EF_{grid} = Emission Factor for the grid electricity used (tCO_2/GWh)(determined using formula (3))

E_{grid} = Total grid electricity imported in the year 'y' (GWh)

$EF_{in\text{-}house}$ = Emission Factor for the grid electricity used (tCO_2/GWh) (determined using formula (4 & 5))

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

Electricity mix in the Unit		Emission Factor	Gross Emission
In-house generation	**GWh**	**tCO_2/GWh**	**tCO_2/GWh**
Fossil Fuel (coal)	202.96	1929.12	391527.82
BLS	33.41	0.00	0.00
Electricity purchased (grid)	17.615	941.07	16576.47

Total GWh (04-05)	**253.98**		**408104.28**
Total Net Emission at Baseline (tCO_2/GWh)			**1606.85**

The biomass fired boiler was commissioned in 2010 and since the baseline estimation has been carried out in 2004-05, the contribution of this boiler is not being taken in the baseline ER calculation

For grid electricity emission factor calculation:

The emission factor *EFy* of the grid is represented as weighted average emission of the operating and build margin of the electricity mix in Southern Regional grid. If we set the emission factor of associated method, the *EFy* is given by

$$\mathbf{EF_{grid} = [FFi*COEFi*44/12] / [\sum_k GENk,y]} \quad \mathbf{(4)}$$

Where, the summation over *i* and *k* is for the fuels and electricity generation of the set of plants contributing to the Southern regional grid. FF stands for fossil fuel consumed by the respective plant connected to the grid and 44/12 is conversion factor for tC/TJ to tCO_2TJ.

For detail calculation of the grid please refer to the attached excel workbook to this PDD.

For fossil fuel based in-house electricity emission factor calculation

$$\mathbf{EF_{in\text{-}house} = FF_{,i,,y} * COEF_{FF,i} / E_{in\text{-}house}} \quad \mathbf{(5)}$$

Where:

EB_y = Annual Baseline emission due fossil fuel usage (tCO_2 eqv.)

$FF_{i,y}$ = Amount of additional fossil fuel (including coal and diesel) by type 'i' required at baseline to generate electricity (MT)

$COEF_{FF,i}$ = default IPCC carbon-dioxide emission factor for fossil fuel of type "i", (tC/TJ)

The CO_2 emission coefficient COEFi is obtained as

$$\mathbf{COEF_{FF,i} = NCV_{FF,i} * EFCO_{2,FF,i} * OXID_{FF,i}} \quad \mathbf{(6)}$$

Where:

$NCV_{FF,i}$ = Net calorific value (kcal per mass or volume unit) of the fossil fuel

$OXID_{FF,i}$ = Oxidation factor of the fossil fuel

$EFCO_{2,FF,i}$ = CO_2 emission factor per unit of energy of the fossil fuel (IPCC default)

Thus

$$\mathbf{ER_y = (E_{B,y} – E_{L,y}) * EF_y} \quad \mathbf{(7)}$$

Where:

ER_y = Emission Reduction from the project (tCO2 equ)

$E_{B,y}$ = Annual energy saved by the project in kWh per year

***$E_{L,y}$* =** Annual leakage from the project in kWh per year

EF_y= Emission Factor of the electricity mix of the unit (tCO_2/GWh)

B.6.4. Summary of ex-ante estimates of emission reductions

Year	Baseline emissions (tCO_2 e)	Project emissions (tCO_2 e)	Leakage (tCO_2 e)	Emission reductions (tCO_2 e)
2006	20967	0	0	20967
2007	20967	0	0	20967
2008	20967	0	0	20967
2009	20967	0	0	20967
2010	20967	0	0	20967
2011	20967	0	0	20967
2012	20967	0	0	20967
2013	20967	0	0	20967
2014	20967	0	0	20967
2015	20967	0	0	20967
Total	209672	0	0	209672
Total number of crediting years	10 years			
Annual average over the crediting period	20967			20967

B.7. Monitoring plan

Monitoring methodology as suggested by selected project category is as follows:
Monitoring shall consist of:
1. In the case of retrofit measures, monitoring shall consist of:
(a) Documenting the specifications of the equipment replaced;
(b) Metering the energy use of the industrial facility, processes or the equipment affected by the project activity;
(c) Calculating the energy savings using the metered energy obtained from subparagraph (b).
2. In the case of a new facility, monitoring shall consist of:
(a) Metering the energy use of the equipment installed;
(b) Calculating the energy savings due to the equipment installed.
3. Published values for technical transmission and distribution losses may be used. Alternatively, technical transmission and distribution losses for the grid that supplies the industrial facility may be monitored.

As described earlier, the project involves a number of equipment replacement and/or implementation of retrofit measures to reduce power consumption which in turn directly or indirectly reduce GhG emissions at fossil fuel fired power plant, either captive or grid. Therefore, the main parameters that are required to be monitored and archived for calculation of actual emissions saved by the project are as follows:

- Electricity consumption by the equipment that has been either replaced or retrofitted
- Electricity consumption by the new installed equipment (in case of replacement) or existing equipment undergone retrofit.
- Emission factor for the electricity used by PSPD Bhadrachalam Unit.
- Specification of the equipment replaced/ retrofitted and the new equipment.

Project proposes to apply the monitoring methodology in following way:

Project Measures	Monitoring Plan
Numbers of equipments/ devices either retrofitted or replaced in the CDM project and their unique location	N_i - the number of devices of the group of "i" such as lamps and pumps replaced and other equipments like compressors, VFDs, capacitor banks and harmonic filters installed been recorded with their unique location identified.
For the equipments/ devices with constant load – Rated power of the equipments/ devices replaced Operating/ running hours of the equipments/ devices	 P_i = the power of the devices of the group of "i" such as lamps replaced. O*i* = operating/ running hours of (average 10hours/day)
For the equipments/ devices fluctuating load but same technology applied at many places within the unit - "Metering the "energy use" of an appropriate sample of the devices installed."	P_p = the actual energy consumed by the pumps Sampling procedure – the pumps connected to the same load type has been clubbed together.
For all other single initiatives, such as VFDs, compressors, capacitor banks, harmonic filters with variable loads "Metering the energy use of the equipment installed"	P_o = the actual energy consumed by the connected load.
Emission co-efficient of the electricity used by the project	Electricity mix of PSPD unit ▪ In-house generation – with ▪ Coal ▪ Black Liquor Solids ▪ Biomass ▪ Diesel ▪ Grid Electricity Imports ▪ Transmission and distribution losses of the grid ▪ Archive the electricity mix of the unit during the year 2004-2005; ▪ Archive the fuel used at in-house to generate electricity; ▪ For electricity mix at the grid refer to public domain data available from any central or local electricity despatch centre, 2004-2005; ▪ Calculate emissions from electricity generation using formula described under Section B.6 of this PDD.

B.7.1. Data and parameters to be monitored

For measure involve replacement of lamps across the mill

Data / Parameter	O_{hrs}
Unit	Hrs
Description	Operating/ running hours of the replaced device (only for lamps)
Source of data	Plant records
Value(s) applied	1385
Measurement methods and procedures	Measured
Monitoring frequency	Daily
QA/QC procedures	Hour meters are installed in every plant area to monitor the running hours of the lamps replaced in that particular plant area. Hour meters are calibrated at regular intervals as per the ISO system in place at the plant
Purpose of data	Project
Additional comment	-

Data / Parameter	$\sum Energy_{project}$
Unit	kWh
Description	Actual energy consumed by the equipments after the implementation of the project measure
Source of data	IMIS Report
Value(s) applied	-
Measurement methods and procedures	Measured
Monitoring frequency	Continuously with energy meter installed and monthly recording
QA/QC procedures	Monitoring equipment are calibrated at regular intervals as per the ISO system in place at the plant
Purpose of data	Project
Additional comment	-

Data / Parameter	**O-hrs**$_{\text{, actual}}$
Unit	Hrs
Description	Operating/ running hours of the equipments based on operating hours of the parent machine or equipment (such as pumps connected to paper machine, VFDs connected to fans, and the Compressors that are included in the project boundary)
Source of data	IMIS Report
Value(s) applied	2332
Measurement methods and procedures	Measured
Monitoring frequency	Measured – shift wise start and stop times are recorded in the SAP system from which actual hours of operation is determined. The summation of total operating hours from all shifts is compiled as monthly figure.
QA/QC procedures	Monitoring equipment are calibrated at regular intervals as per the ISO system in place at the plant
Purpose of data	Project
Additional comment	-

Data / Parameter	**Energy** $_{\text{base}}$
Unit	kWh
Description	Actual energy consumed by the load connected to the common line without equipment 'i' (in switched off mode) for any 3 consecutive days of continuous operation in a month Equipment 'i' – Capacitor bank, harmonic filter (For the measures that involves installation of power correction equipments operated at variable connected load)
Source of data	Down loaded Data from Load Manager
Value(s) applied	639873
Measurement methods and procedures	Measured
Monitoring frequency	Monthly reporting-Measured for any 3 consecutive days in a month
QA/QC procedures	Monitoring equipment are calibrated at regular intervals as per the ISO system in place at the plant
Purpose of data	Project
Additional comment	-

Data / Parameter	**O-hrs** $_{corresponding,3}$
Unit	Hrs
Description	Corresponding operating hours for the 3 consecutive days for baseline monitoring when the equipment 'i' is not connected to the load
Source of data	Down loaded Data from Load Manager
Value(s) applied	288
Measurement methods and procedures	Measured
Monitoring frequency	Monthly reporting-Measured for any 3 consecutive days in a month
QA/QC procedures	Monitoring equipment are calibrated at regular intervals as per the ISO system in place at the plant
Purpose of data	Project
Additional comment	-

Data / Parameter	**Energy**$_{project}$
Unit	kWh
Description	Actual energy consumed by the load connected to the common line with equipment 'i'Equipment 'i' – Capacitor bank, harmonic filter (For the measures that involves installation of power correction equipments operated at variable connected load)
Source of data	Down loaded Data from Load Manager
Value(s) applied	5329163
Measurement methods and procedures	Measured
Monitoring frequency	Monthly reporting-Measured for any 3 consecutive days in a month
QA/QC procedures	Monitoring equipment are calibrated at regular intervals as per the ISO system in place at the plant
Purpose of data	Project
Additional comment	-

Data / Parameter	$O_{-hrs,actual}$
Unit	Hrs
Description	Operating/ running hours of the equipments based on operating hours of the parent machine or equipment (For the measures that involves installation of power correction equipments operated at variable connected load such as Capacitor banks connected to NFL, harmonic filters connected to paper machine, and electronic governor connected to the generator)
Source of data	IMIS Report
Value(s) applied	2684
Measurement methods and procedures	Measured
Monitoring frequency	Measured - shift wise downtimes are monitored and recorded and then subtracted from 24 hours to get the actual hours of operation. The summation of daily operating hours is compiled as monthly figure
QA/QC procedures	Monitoring equipment are calibrated at regular intervals as per the ISO system in place at the plant
Purpose of data	Project
Additional comment	-

Data / Parameter	$O_{-hrs,corresponding}$
Unit	Hrs
Description	Corresponding operating hours for the month when the equipment 'i' is switched on
Source of data	IMIS Report
Value(s) applied	2396
Measurement methods and procedures	Measured
Monitoring frequency	Monthly-Measured for days in a month corresponding to measurement Of $Energy_{project}$: shift wise downtimes are monitored and recorded and then subtracted from 24 hours to get the actual hours of operation. The summation of daily operating hours is compiled as monthly figure
QA/QC procedures	Monitoring equipment are calibrated at regular intervals as per the ISO system in place at the plant
Purpose of data	Project
Additional comment	-

Data / Parameter	$F_{project}$
Unit	Hz
Description	Frequency at which the TG2 is operated in line with the electronic governor (Only for electronic governor)
Source of data	Log Books
Value(s) applied	49.81
Measurement methods and procedures	Measured
Monitoring frequency	Monthly
QA/QC procedures	Monitoring equipment are calibrated at regular intervals as per the ISO system in place at the plant
Purpose of data	Project
Additional comment	-

Data / Parameter	E_{grid}
Unit	GWh
Description	Electricity imported from the grid
Source of data	IMIS Report
Value(s) applied	0.41
Measurement methods and procedures	Measured
Monitoring frequency	Annual
QA/QC procedures	Monitoring equipment are calibrated at regular intervals as per the ISO system in place at the plant
Purpose of data	Project
Additional comment	-

Data / Parameter	$E_{inhouse}$
Unit	GWh
Description	Electricity generated in-house
Source of data	IMIS Report
Value(s) applied	43.75
Measurement methods and procedures	Measured
Monitoring frequency	Annual
QA/QC procedures	Monitoring equipment are calibrated at regular intervals as per the ISO system in place at the plant
Purpose of data	Project
Additional comment	-

Data / Parameter	$FF_{i,}$
Unit	MT, kL (for diesel)
Description	Annual quantity of fossil fuel of type 'i' (coal and diesel) utilized by the project
Source of data	IMIS Report
Value(s) applied	40836
Measurement methods and procedures	Measured
Monitoring frequency	Monthly
QA/QC procedures	Monitoring equipment are calibrated at regular intervals as per the ISO system in place at the plant
Purpose of data	Project
Additional comment	-

Data / Parameter	NCV_{FFi}
Unit	kCal/kg
Description	Average gross calorific value of fossil fuel of type 'i' (coal and diesel)
Source of data	IMIS Report
Value(s) applied	3774
Measurement methods and procedures	Calculated The NCV will be determined based the following formula – NCV = GCV – 10.2*Moisture %
Monitoring frequency	Monthly
QA/QC procedures	Monitoring equipment are calibrated at regular intervals as per the ISO system in place at the plant
Purpose of data	Project
Additional comment	-

Data / Parameter	$EF_{inhouse}$
Unit	tCO_2/GWh
Description	Emission Factor for the in-house electricity generation
Source of data	IMIS Report
Value(s) applied	1317
Measurement methods and procedures	Calculated $EF_{in\text{-}house} = FF_{i,y} * COEF_{FF,i} / E_{in\text{-}house}$
Monitoring frequency	Monthly
QA/QC procedures	Monitoring equipment are calibrated at regular intervals as per the ISO system in place at the plant
Purpose of data	Project
Additional comment	-

Data / Parameter	EF_y
Unit	tCO_2/GWh
Description	CO_2 emission factor of current mix of the electricity (in house and grid) being used by the measures included in the project activity
Source of data	IMIS Report
Value(s) applied	1346
Measurement methods and procedures	Calculated $EFy = (EF_{grid} * E_{grid} + EF_{in\text{-}house} * E_{in\text{-}house}) / (E_{grid} + E_{in\text{-}house})$
Monitoring frequency	Annually
QA/QC procedures	Monitoring equipment are calibrated at regular intervals as per the ISO system in place at the plant
Purpose of data	Project
Additional comment	-

B.7.2. Sampling plan

>>

For measuring the running hours of replaced CFL lamps, hour meters are installed in each area of the plant. 100% of the data is monitored for the installed hour meters. Each hour meter is used to monitor the running hours of a group of replaced lamps (ranging from 12 to 22 lamps). Out of a total of 3125 replaced lamps, 242 are connected to the hour meters.As per the EB guidelines, the sampling size should be 132.

For all other parameters 100% of the data is monitored and recorded.

B.7.3. Other elements of monitoring plan

>>

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>

The real action on the project was initiated during August 2000.

C.1.2. Expected operational lifetime of project activity

>>

In an average all equipment either replaced or retrofitted has lifetime of 15years.

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>

Fixed

C.2.2. Start date of crediting period

>>

01/1/2006

C.2.3. Length of crediting period

>>

10 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>

The host Party, i.e. Ministry of Environment and Forest, Government of India, does not require Environmental Impact Assessment of small developmental projects within an industrial facility.

However, ITC PSPD as a responsible corporate could visualize the adverse impacts of inefficient energy use in their facility. The Energy Audits were conducted across Bhadrachalam Unit with the twin objectives of becoming energy efficient and reducing the ill effects of global warming. The resultant energy conservation programme thus led to the reduction of GhG emissions from the fossil fuel energy generation directly or indirectly attributable to the operations. Following are the environmental benefits derived from the project's energy efficiency measures:

- Reduction in GhG emission from combustion of fossil fuel;
- Conservation of fossil fuel (natural resource of commercial energy); Sustainable Development;
- Reduction of environmental deterioration due to extraction (dust and acid mine drainage), processing (dust and wastewater) and procurement of fossil fuel (poor ambient air quality);
- Reduction of thermal power emissions

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

PSPD Bhadrachalam conducted stakeholder meeting on 13th July 2005. The Unit published a notice 15 days prior to the meeting with detailed description on the project initiatives and all associated benefits. All comments of the stakeholder were recorded during the meeting. Summary of the meeting has been enclosed as *Enclosure #2* to this project design document.

E.2. Summary of comments received

>>

Refer to *Enclosure #2*

E.3. Report on consideration of comments received

>>

Refer to *Enclosure #2*

SECTION F. Approval and authorization

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- - - - -

Appendix 1: Contact information of project participants

Organization	ITC Limited – Paperboards & Speciality Papers Division, Unit: Bhadrachalam
Street/P.O. Box	106 Sardar Patel Road
Building	
City	Sarapaka near Bhadrachalam town
State/Region	Andhra Pradesh
Postcode	Secunderabad- 500003
Country	India
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Fax	91-40-27842997
E-mail	
Website	
Contact person	
Title	Mr.
Salutation	MD, CEO
Last name	Singh
Middle name	
First name	Sanjay
Department	Paperboards & Speciality Papers Division, Unit: Bhadrachalam
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Direct tel.	
Personal e-mail	sanjay.singh@itc.co.in

Organization	ABN AMRO BANK N.V.
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State/Region	
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Country	United Kingdom
Telephone	+44 20 7678 0905
Fax	+44 20 7857 9658
E-mail	gavin.i.tait@uk.abnamro.com
Website	www.abnamro.com
Contact person	
Title	Commodity Derivatives Trader
Salutation	Mr
Last name	Tait
Middle name	
First name	Gavin
Department	Commodity Derivatives
Mobile	
Direct fax	+44 20 7857 9658
Direct tel.	+44 20 7678 0905
Personal e-mail	gavin.i.tait@uk.abnamro.com

Appendix 2: Affirmation regarding public funding

No public funding has been sought for the project activity. The project proponent will identify potential participants if additional funds are required in the future.

History of the document

Version	Date	Nature of revision
04.1	11 April 2012	Editorial revision to change history box by adding EB meeting and annex numbers in the Date column.
04.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for small-scale CDM project activities" (EB 66, Annex 9).
03	EB 28, Annex 34 15 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.
02	EB 20, Annex 14 08 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
01	EB 07, Annex 05 21 January 2003	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		

Enclosure # 1

Detail list of energy efficiency measures of the energy conservation/ improvement programme in ITC PSPD Bhadrachalam Unit

ENERGY CONSERVATION PROGRAMME – REPLACEMENT

S.No	Job Description	Specification of old pump	Specification of new Pump	Rated Power kw	Hours of Operation	Yearly savings GWh	Start Date	Completion Date	Method of monitoring
	Paper Machine: 1								
1	Replacement of 12 nos of vacuum fans of PM1 formers by energy efficient 4 nos of fans.	HBBB-10-3-H2 14 m3/min , 1100 mmwc	CEMTEK SINGLE FAN 42m3/min, 700 mmwc	24	8000	0.192	20/08/2003	26/09/2003	metered
2	Replacement of vacuum pump-3 at PM1 by energy efficient vacuum pump	12E, 105m3/h, 500 mmhg	K202M, 105m3/h, 500 mmhg	32.8	8000	0.2624	20/01/2005	16/02/2005	metered
3	Installation of tridisc refiner at PM1 stock preparation.	1 SDM,4.5T/h, 150m3/h	21TDR,4.5T/h 150m3/h	130	8000	1.04	10/11/2003	14/12/2003	metered
	Sub Total of PM #1					**1.494**			
	Paper Machine:2								
1	Unrefined chest pump	133m3/h @ 33m head	133m3/h @ 29m head	1.40	8000	0.0112	11/11/2004	23/11/2004	Metered
2	Refined chest pump	183m3/h @ 17.5m head	183m3/h @ 15m head	7.96	8000	0.06368	23/11/2004	14/12/2004	Metered
3	Mixing chest pump	181m3/h @ 14m head	181m3/h @ 10m head	6.80	8000	0.0544	11/11/2004	04/12/2004	Metered
4	Intermediate chest pump	181m3/h @ 14m head	181m3/h @ 10m head	9.90	8000	0.0792	11/11/2004	23/11/2004	Metered
5	Machine chest pump	200m3/h @ 24m head	200m3/h @ 20m head	6.30	8000	0.0504	18/11/2004	14/02/200	Metered
	Sub Total of PM #2					**0.25888**			

ENERGY CONSERVATION PROGRAMME – REPLACEMENT

S.No	Job Description	Specification of old pump	Specification of new Pump	Rated Power kw	Hours of Operation	Yearly savings GWh	Start Date	Completion Date	Method of monitoring
	Paper Machine:3								
1	Mixing chest pump	56m3/h @ 29m head	200m3/h @ 21.5m head	9.00	8000	0.072	11/11/2004	14/12/2004	Metered
2	Intermediate chest pump	50m3/h @ 12m head	50m3/h @ 10m head	4.20	8000	0.0336	23/02/2005	25/04/2005	Metered
3	PCC pump	480m3/h @ 40m head.	260m3/h @ 30m head	44.2	8000	0.3536	11/11/2004	14/12/2004	Metered
4	SCC pump	168m3/h @ 32.5m head.	140m3/h @ 25m head	9.10	8000	0.0728	11/11/2004	14/12/2004	Metered
5	TCC pump	90m3/h @ 27.5m head	47m3/h @ 25m head	10.88	8000	0.08704	11/11/2004	09/10/2004	Metered
	Sub Total of PM #3					**0.6190**			
	Paper Machine: 4								
1	Vacuum pump sealing water pump	144m3/h @ 31m head	125 m3/h @ 17m head	8.15	8000	0.0652	31/08/2004	14/12/2004	Metered
2	Sand filter water transfer pump	175m3/h @ 40m head	175 m3/h @ 15m head	15.95	8000	0.1276	31/08/2004	14/12/2004	Metered
3	Cooling tower pump	353m3/h @ 31m head	260 m3/h @ 25m head	23.00	8000	0.184	31/01/2005	23/03/2005	Metered
	Sub Total of PM #4					**0.3768**			
	Others								

ENERGY CONSERVATION PROGRAMME – REPLACEMENT

S.No	Job Description	Specification of old pump	Specification of new Pump	Rated Power kw	Hours of Operation	Yearly savings GWh	Start Date	Completion Date	Method of monitoring
1	Replacement of higher capacity TG3 cooling water pump by lower capacity pump.	2500m3/h at 27.5m head	1250m3/h at 27.5m head	120	8400	1.008	30/09/2000	01/05/2001	metered
2	Replacement of higher capacity evaporator cooling water pump by lower capacity pump	1500m3/h at 65m head	1800m3/h at 35m head	90	8400	0.756	01/03/2005	24/05/2005	metered
	Sub Total of Others					**1.764**			
	TOTAL ENERGY SAVED IN PUMPS REPLACEMENT					**4.513**			
1	**Compressors**								
1.1	Replacement of 9 nos. reciprocating compressors with HOC dryers by single centrifugal compressor with refrigerant dryer.		1 x 95Nm3/m	131.5	8400	1.104600	14/03/2002	14/03/2003	Metering
	Sub Total of Compressor					**1.105**			
	Lamps								
1	**Flouresent Lamps (FL)**								
1.1	Replacement 3025nos of 2x40W FL tubes with copper choke by 2x22W FL tubes with electronic ballast		2 x 22 W & 1 x 1W Electronic ballast	53	3650	0.193	05/04/2004	23/12/2004	metered
2	**High Pressure Mercury Vapour Lamps (HPMV)**								

ENERGY CONSERVATION PROGRAMME – REPLACEMENT									
S.No	**Job Description**	**Specification of old pump**	**Specification of new Pump**	**Rated Power kw**	**Hours of Operation**	**Yearly savings GWh**	**Start Date**	**Completion Date**	**Method of monitoring**
2.1	Replacement of 100nos of HPMV lamps by metal halide lamps.		1 x 250W with 1 x 13W electronic choke & ignitor	170	3650	0.621	20/05/2004	06/05/2004	metered
	Sub Total of Lamps					**0.814**			
	TOTAL ELECTRICITY SAVED PER YEAR in GWh					**6.432**			

ENERGY CONSERVATION PROGRAMME – RETROFIT									
S.No	**Job Description**	**Specification of old equipment**	**Specification of new equipment**	**Actual power saved kw**	**Operation Hours/Yr**	**Yearly savings GWh**	**Start Date**	**Completion Date**	**Method o monitoring**
1	**Location Distribution**								
1.1	Installation of capacitor banks at SFT A&B to improve power factor from 0.92 to 0.96	500 kVAR	7x50Kvar	47	8000	0.376	04/06/2003	27/06/2003	metered
1.2	Installation of capacitor banks at NFL.	600 kVAR	7x50Kvar	40	8000	0.32	28/12/2004	30/12/2004	metered
						0.696			
2	**Harmonic Filters**								
2.1	Installation of harmonic filters at PM1	Not Available	900Kvar ABB make	75	7920	0.594	05/09/2003	29/09/2003	metered
2.2	Installation of harmonic filters at PM2	Not Available	450Kvar, Siemens make	47	7920	0.37224	05/02/2004	20/03/2004	metered
						0.966			

3	**Variable Frequency Drives**								
3.1	Installation 2 nos of 200kw VFD for CFB4 FD fans	Not Available	2x250Kva, ABB make	54	7920	0.42768	05/12/2003	23/12/2003	metered
3.2	Installation of 22kw VFD for PM1 horizontal chest pump.	not applicable	22 kw Eurotherm	8.6	7920	0.068112	05/10/2004	30/11/2004	metered
						0.496			
4	**Drives**								
4.1	Change of drives from DC to AC during machine rebuilt	Siemens make DC drives	ABB make AC drives	263	7920	2.08296	01/11/2001	05/02/2002	metered
						2.08296			
5	**Controls**								
5.1	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	300	7920	2.376	01/06/2005	31/07/2005	metered
						2.376			
	TOTAL ELECTRICITY SAVED PER YEAR in GWh					**6.617**			