CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

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Improvement in recovery of black liquor solids through Oxygen-Delignification and Free Flow Falling Film Evaporator and its use for steam generation in Soda Recovery Boiler.

A.2. Description of the project activity:

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ITC Paperboards and Speciality Papers Division (PSPD) Bhadrachalam Unit, is one of the largest paper units of ITC group. As a responsible corporate citizen, ITC PSPD Bhadrachalam Unit (herein after referred as PSPD Unit) has made conscious efforts to contribute to preserving the environment and enhancing sustainable development at its existing paperboard and paper mill.

Pulp making process generates effluent with high organic load through a series of washing steps where part of the lignin in the pulp is removed from weak black liquor. The black liquor[1] generated from the pulping process is concentrated at the evaporator to a desired solids level for firing at a boiler, in the the parlance of the paper industry the soda recovery boiler (SRB). One of the methods for increasing recovery of additional waste biomass (black liquor solids) for steam generation is using oxygen delignification coupled with efficient evaporation and combustion of the additional black liquor solids. Black liquor solids, being a climate neutral fuel, helps in mitigating climate change impacts both by reducing direct emissions from fossil fired steam generation as well as through reduction of organic load at treatment plants. Additionally, oxygen delignification significantly reduces the chemical requirement in the bleaching process.

PSPD unit has installed a two-stage Oxygen Deligninfication (ODL) process, an efficient free flow falling film (FFFF) evaporator and an efficient soda recovery boiler (SRB) that has increased biomass based energy in the plant and parallely reduced organic load at the effluent treatment plant.
The FFFF evaporator has reduced the steam required for evaporating black liquor solids over the rising film evaporator while the new and efficient soda recovery boilers generate more steam for the same quantity of black liquor fired at the boiler. This CDM project initiative increases biomass generation as well as improves its processing and utilization through the ODL-FFFF-SRB route thus obviating the need for fossil fuel generated steam energy.

From the above, it can be seen that the objectives of the project are to :

- Increase black liquor generation and its availability for steam generation;
- Economize steam requirement for evaporating black liquor
- Improve steam generation from black liquor
- Reduce steam generation from coal combustion;
- Reduce organic loading to the waste treatment facility;
- Reduce bleaching chemical consumption;
- Increases paper brightness and improve yield selectivity;

[1] spent pulping liquor

Sustainable development attained by the project has been discussed in Annex 5.

A.3. Project participants:

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ITC Paperboards and Speciality Papers Division (PSPD) Bhadrachalam Unit, was promoted by ITC in 1975, as backward integration of ITC's requirement of paper and paperboards. It is today, the largest integrated paperboard manufacturer in India. In addition to manufacturing world class, online coated boards matching the converters upgraded technologies; the mill also produces quality grades of printing and writing papers.

To consolidate and further improve on the operation and financial performance, meet the emerging demands of paper and paperboards, and develop into a more environmentally friendly operation, the mill is presently investing capital for modernizing the production.

ITC PSPD Bhadrachalam Unit, will be the sole owner of the CERs generated from the project.

PricewaterhouseCoopers (P) Ltd. (PwC) is assisting the project sponsor in developing the Project Design Document (PDD) and will also assist in the defence of the PDD during Host Government Approval and validation procedure. PwC, formed by the global merger of Price Waterhouse and Coopers & Lybrand in 1998, is the world's largest financial and professional services organisation with 125,000 people in 142 countries and 867 offices worldwide.

Many other entities from Annex I countries can join as project participants. The list of such participants will be provided before the project is submitted for registration. The ITC PSPD Bhadrachalam Unit, shall be the principal contact for the CDM project activity.

The contact information of all project participants has been provided in Annex 1.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

>> India

A.4.1.2. Region/State/Province etc.:

>>Andhra Pradesh

A.4.1.3. City/Town/Community etc:

>>Sarapaka near Bhadrachalam town

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

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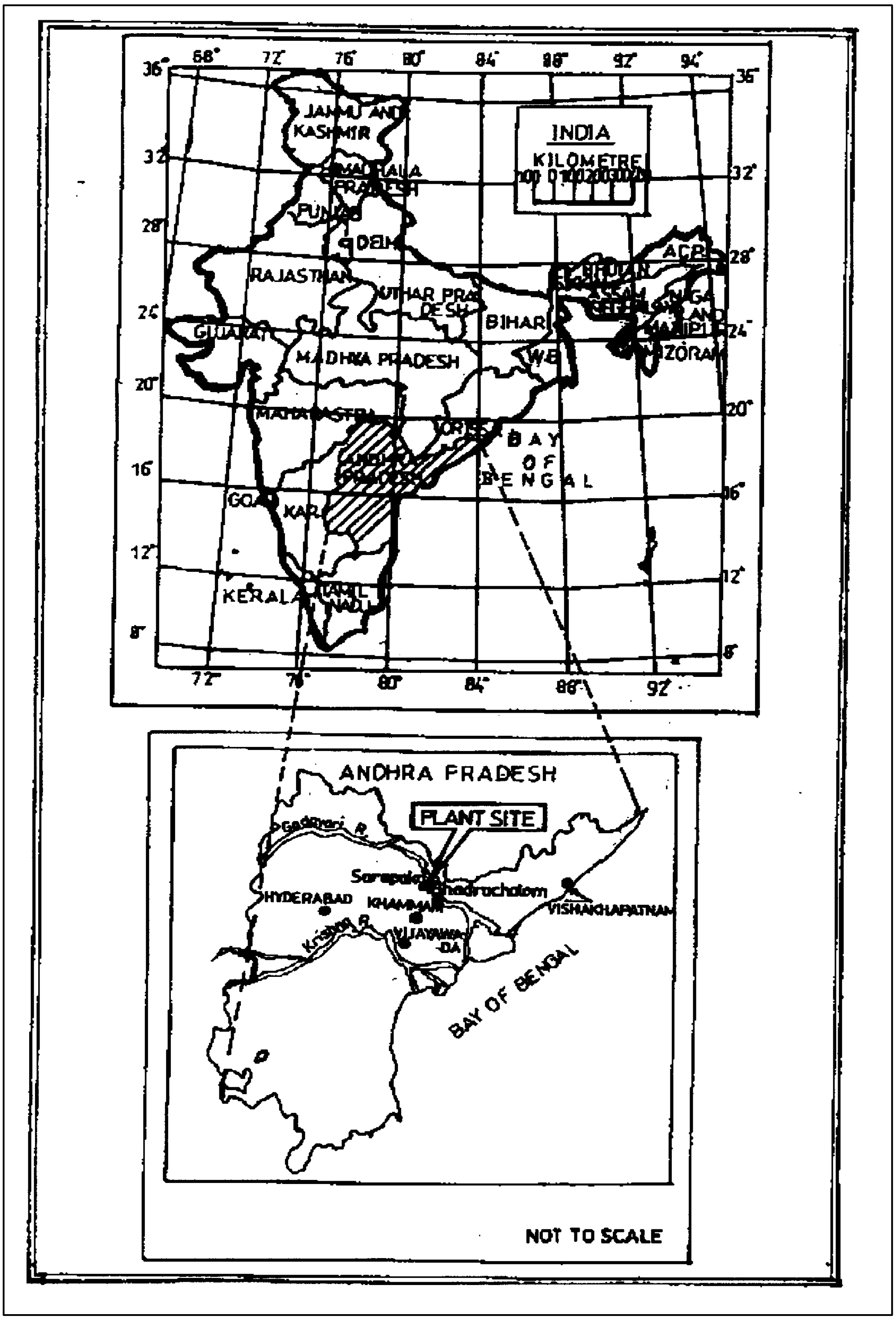
The project is proposed within the manufacturing complex of Paperboards & Speciality Papers Division, with approximate location 17°41'19"N latitude and 80°52'05"E longitude. The site is at a distance of 300 km from Hyderabad. The nearest railway station is Bhadrachalam Road at a distanced of 45 km.



A.4.2. Category(ies) of project activity:

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The project activity is applicable to 'Category 4 – Manufacturing industries', as per the CDM sectoral scope (CDM-ACCR-06). In the absence of an appropriate project category definition, a new project category may be considered titled "Recovery and use of waste biomass[2] from process streams".

A.4.3. Technology to be employed by the project activity:

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The project activity involves the following activities:

a) additional waste black liquor solids (BLS) recovery from blown pulp stream through ODL;
b) improvement the energy efficiency in FFFF evaporator to efficiently recover BLS;
c) more efficient utilization of BLS for steam generation at SRB;
d) combustion of all BLS generated at SRB.

ODL technology

ODL technology in the pulp industry involves improved and controlled delignification of the cooking pulp from pulp digester though washer prior to the chemical bleaching process. Oxidised white liquor is used for dissolving the extra lignin to the desired extent. The additional benefit derived from the project is the additional amount of black liquor generated the ODL waste outlet.

Delignification of the pulp, using oxygen prior to chemical bleaching, is a two-stage Oxygen De-lignification (ODL) process introduced to enhance the quality of pulp produced. ODL is followed by one step washing and new Free Flow Falling Film Evaporator (FFFF). At the FFFF evaporator, black liquor is concentrated upto 70% of solids (BLS) by using steam. BLS, which is a climate neutral biomass fuel (derived from raw material wood chips) is then fired at SRB for complete combustion and steam generation. ODL aids the process of elemental chlorine free (ECF) technology and leads to reduction in bleaching chemicals. These results in the removal of excess BLS from the process steam that would otherwise have been discharged as process effluent and becomes available as boiler fuel to generate steam. The steam and power generated from BLS firing are utilised in the pulping process and surplus steam is utilised in the paper mills or for other applications.

ODL consist of three main parts, a medium consistency reactor feed pump, a set of diffusers and mixers, and a reaction tower. Blown pulp of 115 m3/h with 12% consistency is introduced into the 340 L reactor made of stainless steel. Oxygen of 93% purity is mixed with the blown pulp in the reactor at a pressure of 3 kg/cm2 and 40^{o}C. The output from the reactor is then washed in a series of washers to segregate black liquor and pulp.

FFFF evaporator of 120 tph consumes steam of the order of 3 tonne/tonne of BLS generated at 70% concentration. The remaining solids are disposed in the waste stream for treatment. Enhanced energy efficiency of FFFF evaporator has resulted in steam and water conservation at washing steps and reduction in ETP volume loads.

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[2] Biomass in a process stream that in the absence of the project activity would otherwise have become a constituent of waste

From the evaporator , the SRB currently receives 625T of BLS/day as compared to 350T BLS/day in the pre-project stage. Increase in available solids attributable to the project activity has resulted in additional steam generation from SRB, thereby reducing consumption of steam from coal fired boilers (CFBs). The total steam generated at the CFBs has decreased with decrease in coal consumption by 2.4% although the production of unbleached pulp has increased from 76695 tonne to 105853 tonne. CFBs based steam generation consequently has also reduced by 5.6%.

An added benefit of the ODL is reduction in chemical consumption in bleaching process by 63%. A comparison of chemical usage per unit of blown pulp is presented in the table below.

Chemical	Unit	Pre-project	Post-project
chlorine gas	kg/tonne BP	450	0
chlorine hypo	kg/tonne BP	188	0
caustic	kg/tonne BP	353	143
H2O2	kg/tonne BP	12.38	5.87
CLO2	kg/tonne BP	99	233
sulphuric acid	kg/tonne BP	0	21.03
Total		**1102.38**	**402.9**

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

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Before Project scenario:

PSPD planned for process improvement in the year 2000 with the objective of increasing the energy generation from waste that would result in fossil fuel savings and increase the production of the facility. Before project implementation, PSPD was producing 350tpd of black liquor along with 225tpd of blown pulp. Two raising film evaporator were operated to concentrate the bla ck liquor and the maximum concentration attained was about 55%. The concentrated black liquor solids were fired into two SRBs with 50% boiler efficiency and 94.93% chemical recovery. Six coal fired boilers that consumed 236243 tonne/annum of coal were also being operated to meet the total requirement of steam and power of the unit. Thus there was significant GHG emission at the baseline (CO_2) from the CFB stacks. Further, substantial amount of additional bleaching chemical were being used at the bleaching unit to bleach the impure pulp with huge organic load (mainly un-dissolved lignin). The end-of-pipe ETP unit was also receiving effluent with high organic loads, thus requiring higher chemical and energy use.

After Project Scenario:

ODL along with FFFF evaporator with increased capacity was installed in 2002. ODL extracts additional lignin from the blown pulp dissolved in white liquor resulting in an additional 275tpd of black liquor. For optimal utilization of additional black liquor available from ODL, FFFF evaporator with an increased installed capacity of 625tpd of black liquor handling capacity replaced the rising film evaporators. This resulted in BLS recovery concentrations of 70%. In order to cater to the increased availability of biomass and to bring about efficiency in the steam generation, the two SRB boilers were replaced by one SRB boiler with 58% boiler efficiency and 97% chemical recovery potential against 50% boiler efficiency and 94.93% chemical recovery in the pre-project scenario. Thus, the total project initiative has resulted in an

increased availability of BLS by around 68%. BLS being a climate neutral biomass fuel is fired at SRB to generate steam that replaces steam generated from CFBs. Hence, with reduction in steam consumption, coal consumption at CFBs has reduced, resulting in an proportionate amount of CO_2 that was earlier being emitted into the atmosphere. The activities that resulted in reduction of coal consumption at the baseline are:

- Installation of ODL of installed capacity of 2.76tpd of blown pulp resulting in solids per tonne of blown pulp improvement from 1.6 tonne/tonne to 1.95 tonne/tonne;
- Installation of FFFF evaporator of installed capacity of 625tpd producing 70% concentrated BLS resulting in steam economy improvement in the evaporator from 221.4 kg/tonne of WBL (weak black liquor) to 133.4 kg/tonne of WBL;
- Installation of SRB of installed capacity of 750tpd with boiler efficiency of 58% and chemical recovery of 97%. This has led to improvement in enthalpy per tonne of black liquor solids from 1.894 mill kcal/tonne of BLS to 2.208 mill kcal/tonne of BLS

The total steam available from BLS has increased by 68% resulting into decrease in steam production at CFBs by 5.6% allowing coal saving of 2.5tonne/annum.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

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Annual emission reduction achieved by the project: **tCO2e/annum 64548**

The total emission reduction for 10yeras of crediting period projected: **tCO2e/annum 645480**

A.4.5. Public funding of the 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.

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

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In the absence of an approved baseline methodology for the project activity, a new methodology has been developed, in line with WRI/WBCSD GHG Protocol for the pulp and paper industries. The new methodology is called "Improvement in recovery of waste biomass from process streams and use of that biomass in energy generation"

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

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The methodology describes that the project consists of activities (a) and (b) with or without activities (b) and (d):

a) additional waste biomass recovery from process stream;
b) utilization of biomass for energy generation;
c) improvement the energy efficiency of waste biomass recovery from process stream;
d) improvement in utilization of biomass for energy generation.

As discussed above project activity includes:

a) additional waste black liquor solids (BLS) recovery from blown pulp stream;
b) improvement the energy efficiency in FFFF evaporator to efficiently recover BLS;
c) utilization of BLS for steam generation at SRB;
d) absolute combustion of BLS and improvement in steam enthalpy at SRB.

Therefore, project is line with the suggested project activity by the methodology.

Further, the proposed new methodology includes the following applicability issues, which are:

a) the local regulations / programs do not constrain the facility from using coal and other fossil fuels to generate steam;
b) the project is not a common practice in the industry sector for industries of a similar nature and size;
c) the proposed project activity generates additional waste biomass from process stream and use of which is not prohibited by the national regulations;
d) Energy would have otherwise been generated in a fossil fuel fired boiler under the controlled of the project operator;
e) the process output(e.g., quantity of pulp)can be directly correlated to waste biomass(e.g., black liquor) concentration in process stream
f) Biomass is not stored in the plant and is directly fired;

The project demonstrates the requirement of applicability criteria in following points:

a) There is no mandatory requirement for PSPD unit to cease the utilization of coal for steam and power generation for process requirement. PSPD has undergone energy efficiency improvement project as a voluntary effort to reduce energy consumption and optimise energy utilization from waste biomass.
b) The ECF technology introduced as project system is not a common technology being used in pulp and paper sector in India. Till date, only JK Industries at Raigarh in Orissa has similar ODL technology (implemented in the year 1999). However, before implementation of the project ITC PSPD unit visited JK Industries pulp and paper unit for a live demonstration of the technology and learned that JK Industries has only one-stage ODL and FFFF evaporators.
c) At present, there is no law and/or policy in India that restricts PSPD units from using BLS at the boilers to generate steam. BLS is a climate neutral biomass fuel generated out of delignification process of wood chips at the pulp mills. PSPD unit at Bhadrachalam has been continuously firing BLS at SRBs since it was established.
d) In the absence of this project the additional steam required by the PSPD facility would otherwise have been met through full capacity utilization of six CFBs.
e) Actual energy efficiency of evaporator equipment has increased due to the replacement of the rising film evaporator by FFFF evaporator by 50% and BLS availability at evaporator by 25%.
f) PSPD unit controls the operation of the total project and distribution of the steam and power generated by the project.
g) The final output of the project is total BLS solid fired at the SRB boiler. The BLS generated from combined ODL and FFFF evaporator is directly fired to the SRB boiler. There id no storing facility available at the project site and/or within the whole facility.
h) The SRB boiler fired with BLS, a climate neutral fuel. However, to maintain a conservative approach in the emission calculations, the project proposes to subtract the emissions occurring due

to additional steam and power consumed by the project over and above the baseline scenario assuming coal as the source of energy.

From the above discussion, it can be concluded that project meets all the applicability criteria of the proposed methodology and hence it is applicable to the project.

B.2. Description of how the methodology is applied in the context of the project activity:

>> The selected baseline methodology has been applied in the following steps:

Step 1: Demonstrating the additionality of the project

Within the scope of the adopted baseline methodology, additionality has been demonstrated by crossing certain barriers as per the steps indicated in the applied methodology and presented in section B.3 of this PDD. , As required by the methodology the additionality tests need to follow the recommendations of the CDM EB guidelines[3] and follows a step-wise logical approach as delineated in this guideline.

Step 2 : Selection of baseline

CDM modalities and procedures, decision 17/CP.7, document defines 'Baseline' as is the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases (GHG) that would occur in the absence of the proposed project activity. Further, the document suggests section of baseline from the three given options[4]. As suggested by the new baseline methodology, "The Existing actual or historical emissions" approach has been adopted. In this project, increased amounts of biomass recovered from the process as well as savings in energy due to increased efficiencies of waste biomass processing and utilization lead to higher generation of steam using biomass. In the absence of the project, steam would have continued to be generated from CFBs using coal as fuel. Therefore, with the given definition of baseline and approach for baseline selection, the baseline for the project is "equivalent amount of steam generation at the CFBs by using coal".

The baseline emission has been calculated based on the amount of coal required to produce equivalent amounts of steam generated by the project at baseline levels of production. The calorific value of coal and carbon content of coal used and efficiency of coal based steam generation were monitored in the baseline and would continue to be monitored in the project. All parameters suggested by the methodology have been used for the calculation of baseline emissions. They are:

Baseline scenario	Baseline parameter
Level of BLS recovery from blown pulp stream	BLS generated per tonne of blown pulp processed – average of last two years form 2001-2002 till date are available and same has been computed for

[3] As per "Tools for demonstration of additionality" by EB, UNFCCC.

[4] They are:
• Existing actual or historical emissions, as applicable; or
• Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment; or
• The average emis sions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category.

	differential amount of BLS produced compare to project.
Improvement the energy efficiency in FFFF evaporator to efficiently recover BLS	Energy consumption by FFFF evaporator per unit of BLS recovered
Utilization of coal for energy generation in absence of the project	Calorific value of coal in the baseline scenario Carbon percent of fossil fuel used Efficiency of energy generation using fossil fuel (heat rate of the boiler – average of the last two years) are available with the project,

Step 3 : Calculation of emission reduction

As required by the proposed methodology, the emission reduction calculation has been carried out by the project, details of which have been provided in Section E, and Annexure 2- baseline information.

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

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Steps for Additionality Check	Demonstration of crossing Barriers	Conclusion
Step 0 : Preliminary screening of projects started after 1 January 2000 and before 31 December 2005	*Evidence exists that the project proponents considered CDM seriously while planning for the project and such official documentation would be shared with the DOE* *Project started with implementation in January 2001.The project has commenced and started generating additional black liquor from August 2002.*	The project activity has crossed step 0 of additionality demonstration, and can move to step 1.
Step 1: Is the execution of the project based on legal obligation?	*No.* ✓ There is no mandatory requirement for PSPD unit under all applicable laws in the region of operation. ITC Bhadrachalam Unit has undertaken this project as a conscious effort to reduce energy consumption and optimal energy utilization from waste biomass.	The project activity has crossed step 2 of additionality demonstration, and can move to step 3(a) or 3(b).
Step 2: Does the project face financial or economic barriers?	*Yes.* ✓ Project has been fully sponsored by ITC PSPD Bhadrachalam unit. IRR without CDM benefits has been calculated for 20 years as 10% which is not considered an appreciable return on investment in the paper sector in India. The project sponsors, while evaluating the project's costs and benefits, laid more stress on their concern for the intangible benefits through	The project activity has crossed step 3(a) of additionality demonstration, and can move to step 4.

Steps for Additionality Check	Demonstration of crossing Barriers	Conclusion
	environmental preservation. IRR with CDM benefits has been calculated 11% for a 10 year crediting period.	
Step 3: Does the project face Other barriers?	*Yes.* ✓ Investment barriers, other than the economic/ financial barriers in Part 2 above: Before committing a large investment of INR 866.2 million in an otherwise un-tested technology in the paper sector India, ITC Bhadrachalam had to convince its boards on this bold step. The paper sector in India is poised for rapid growth and ITC Bhadrachalam had several other avenues to spend money on other projects that would have yielded higher returns, i.e. mergers and acquisitions, backward and forward integration etc. Moreover, had ITC Bhadrachalam not financed this project from internal accruals, it would have been difficult to find project finance from domestic or international lenders as the perceived technological uncertainties would have demanded unfavourable loan terms. ✓ Technological barriers: Two stage ODL is perhaps the first application in India in the paper sector. ODL together with the FFFF evaporator and the high efficiency soda recovery boiler are investments whose technological uncertainties were unknown at the time of deciding on this project. ITC Bhadrachalam has been modernizing its process control technology and including a new project within a new process control context was a daunting exercise. Raw material and pulp quality acceptable to his new technology was not certain as was the quality of pulp based on various permutation and combinations of ODL-FFFF configurations. ✓ Barriers due to prevailing practice:	The project activity has crossed step 3(b) of additionality demonstration, and can move to step 4.

Steps for Additionality Check	Demonstration of crossing Barriers	Conclusion
	Reduction of organic pollutant load is not a priority in the Indian paper industry which is constrained with multiplicity of market and product driven challenges. Consequently, no investment has gone to adopt world class technology aimed specifically at improving environmental footprints of paper. In this light, this project has certainly crossed the barrier due to prevailing practice.	
Step 4: Is the project common practice?	*No.* ✓ Till date only JK Industries at Raigarh in Orissa has similar ODL technology (implemented in the year 1999) which is a single stage ODL. However, before implementation of the project ITC PSPD unit visited JK Industries pulp and paper unit for live demonstration of the technology and to the extent evident at the source, JK Industries has only one-stage ODL and FFFF evaporators.	Based on the additionality analysis, it is clear that the project has demonstrated that it is not a business as usual case and is additional to the baseline scenario.
Step 5 Impact of CDM Registration	This project if registered for CDM would be a boost to the adoption of cleaner technologies in the Indian paper sector. Successful implementation of this technology would need CDM funds to strengthen process control and cover uncertainties and productivity loss if any. Once proven a success, this project would be benchmark for learning cleaner world class technology in India	The project is additional.

In the absence of the project, the increased steam requirement would have been met by coal fired boilers (CFBs) by producing steam using coal as fuel. Therefore, there would have been increased emission from increased coal combustion. It is estimated that there would have been a net emission reduction of 64548 tCO2e/annum

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

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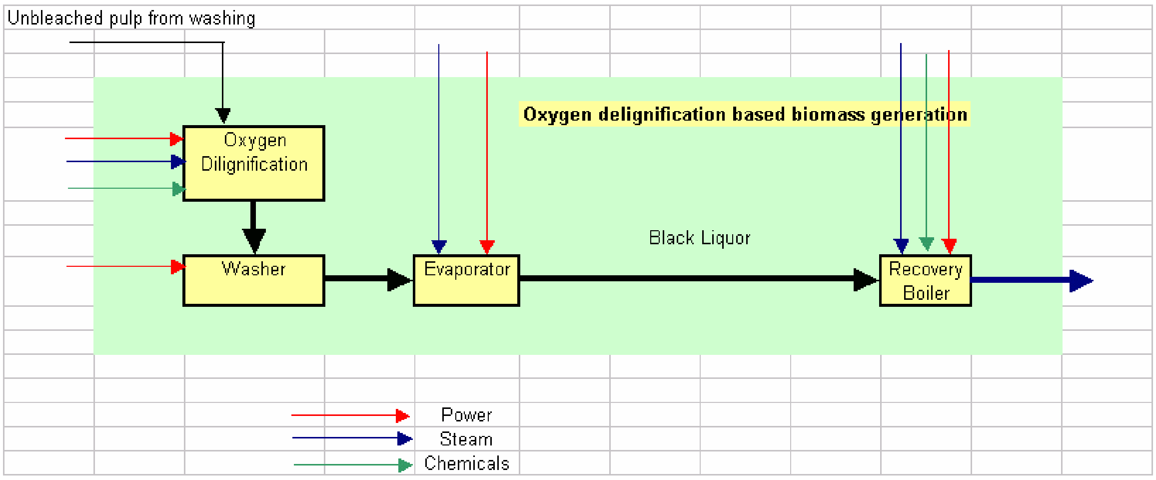
The project boundary encompasses the physical, geographical site of the ODL, FFFF evaporator, SRB and their auxiliaries at the project location specified in Section A.4.1.4 above. Project boundary starts from ODL inlet and extends upto steam generation metered by the project. Project boundary also includes steam and power consumption meters at the ODL, FFFF evaporator and SRB.



B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

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Dr. P Ram Babu of PricewaterhouseCoopers (P) Limited, whose contact information is set out in Annex 1 has assisted the project proponent in determining the baseline methodology.

The annexed baseline methodology determination is completed on February, 2005.

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>Project started during January 2001.

C.1.2. Expected operational lifetime of the project activity:

>>Project is expected to perform till coming 20 years.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

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C.2.1.2. Length of the first crediting period:

>>

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>> The project has commenced generation of emission reductions from August 2002.

C.2.2.2. Length:

>>10 years

SECTION D. Application of a monitoring methodology and plan

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

>>

In the absence of an approved baseline methodology for the project activity, a new methodology has been developed, in line with WRI/WBCSD GHG Protocol for the pulp and paper industries. The new methodology is called "Monitoring improvements in recovery of waste biomass from process streams and use of that biomass in energy generation"

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

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The new proposed methodology has laid down certain monitoring parameters that require to monitored and recorded to arrive to the emission reduction achieved by the project. They are:

a) Excesses biomass generated from the project activity per unit of process stream input.
b) Energy enthalpy improved in the process of biomass recovery
c) Benchmarking of process output at the baseline scenario
d) Excess of biomass used to generate energy
e) Energy enthalpy improved in utilization of biomass to generate steam
f) Additional increase in steam and power consumed by the project to recover and utilize excess biomass generated by the project
g) Fossil fuel required at baseline to generate the required energy enthalpy presently being generated by the project

Therefore in the following paragraphs it has been discussed as how project proposes to monitor the required parameters to determine project scenario and project emissions, baseline scenario and baseline emissions and leakages attributable to the project activity.

Project activity and project emission:

The project involves following activities and the associated emissions:

Project scenario	Project parameters
Additional waste black liquor solids (BLS) recovery from blown pulp stream;	Additional BLS generated per tonne of blown pulp processed – average of recent annual data are available and same has been computed for differential amount of BLS produced compare to project; Power and steam consumed by ODL subtracted as

	project emission
Improvement the energy efficiency in FFFF evaporator to efficiently recover BLS	Energy consumption by FFFF evaporator per unit of BLS recovered – 3tonne of steam/ tonne of BLS produced; Power and steam consumed by FFFF evaporator for recovery of additional BLS subtracted as project emission
Absolute combustion of BLS and improvement in steam enthalpy at SRB	It is ensured that the BLS produced by combined ODL and FFFF evaporator system in not stored anywhere in the PSPD facility; It is ensured that the total BLS produced in directly fired in the SRB; Efficiency improvement in steam generation using BLS at present SRB, i.e. heat rate of the boiler – average of recent annual data are available with the project.

Baseline scenario and baseline emission:
Baseline scenario has been determined by computing following baseline parameters:

Baseline scenario	Baseline parameter
Level of BLS recovery from blown pulp stream	BLS generated per tonne of blown pulp processed – average of last two years form 2001-2002 till date are available and same has been computed for differential amount of BLS produced compare to project.
Energy efficiency in raising evaporator to efficiently recover BLS	Energy consumption by raising evaporator per unit of BLS recovered – 6tonne of steam/ tonne of BLS produced.
Utilization of coal for energy generation in absence of the project	Calorific value of coal in the baseline scenario is 5093 tCOe; Carbon percent of fossil used at the baseline are known to the project activity as 50% Efficiency of energy generation using fossil fuel (heat rate of the boiler – average of the last three years) are available with the project,

Leakages
The leakages attributable to the project is the emissions occurring for generation of additional energy (in terms of steam and power) use increased else where for generation of sodium hydroxide and sodium sulphide. The mentioned chemicals are used in aqueous solution for dissolving lignin at ODL. However, it is difficult to compute the emissions for such additional energy demand increased and is outside the control of project sponsors. Further, chemical used in proceeding bleaching process has considerable decreased due to project activity. To such extend it is assumed that the energy increased has been nullified by energy decreased in process of bleaching chemical manufacturing process. Therefore, leakage has not been calculated.

Benchmarking of process production:

Project proposes to calculate all emission against process production at the baseline level of production as, there could be possible increase in blown pulp production which may/ may not lead to excess generation of BLS. Therefore to avoid such discrepancies, production level in the FY year of 2001-2002 has been benchmarked.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
PEy	Total project emissions	*Project*	*tCO_2e*	*E*	*continuous*	*100%*	electronic/ paper	
P_ENi	energy of type (i) used by ODL	*Project*	Kcal	*M*	*continuous*	*100%*	electronic/ paper	
Eff	Efficiency of CFBs	*Project*	*%*	*M*	*continuous*	*100%*	electronic/ paper	
FF_CV	Average calorific value Coal	*Project*	kcal/kg	*M*	*continuous*	*100%*	electronic/ paper	
C%	Percentage of Carbon in Coal	*Project*	*%*	*M*	*continuous*	*100%*	electronic/ paper	
ENPi	energy of type (i) used in by FFF evaporator and SRB	*Project*	*%*	*M*	*continuous*	*100%*	electronic/ paper	
ENBi	energy of type (i) used in the	*Project*	*%*	*M*	*continuous*	*100%*	electronic/ paper	

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
	raising film evaporator and two SRBs at baseline							
BIOB	BLS generation in baseline	*Project*	Tonne	*M*	*continuous*	*100%*	electronic/ paper	
BIOP	BLS generation in project	*Project*	Tonne	*M*	*continuous*	*100%*	electronic/ paper	

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

>>

Project emissions are considered even though the emissions can be shown to be “zero” i.e. based on emissions from a climate neutral, i.e. biomass source;

Total project emissions PEy = PE_new_y + PE_ex_y (6)

Step 1: For any new equipment / process in the project activity:

PE_new_y = (SP_ENi / Eff) / FF_CV *C% * 44/12 *(1/1000) (7)

Where,

P_ENi= energy of type (i) used by ODL (kcal)

Eff= Efficiency of CFBs (%);
FF_CV= Average calorific value of Coal (kcal/kg);
C% = Percentage of Carbon in Coal used (%);
44/12 = conversion of tC to tCO2 equivalent
1/1000 = conversion from kg to tonnes

Step 2: Incremental energy for other processes inside the project boundary

PE_ex_y = (DELTA_EN / Eff) / FF_CV *C% * 44/12 *(1/1000) (8)

Where,
DELTA_EN = (SENPi/BIOP- SENB/BIOB)*(BIOP-BIOB)
ENPi = energy of type (i) used by the FFFF evaporator and SRB
ENBi = energy of type (i) used by two raising film evaporator and two SRB in the baseline
BIOB = BLS generation in baseline (tonne)
BIOP = BLS generation in project (tonne)
Other parameters are as define above

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
BEy	*Baseline emission in the year "Y"*	*Project*	tCO_2e	*E*	*continuous*	*100%*	electronic/ paper	
EP	extra energy generated by the project using BLS as fuel	*Project*	Kcal	*E*	*continuous*	*100%*	electronic/ paper	

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
Eff	Efficiency of CFBs generating steam	*Project*	(%)	*M*	*continuous*	*100%*	electronic/ paper	
EP_bio	Energy generated from additional BLS available from the project	*Project*	Kcal	*E*	*continuous*	*100%*	electronic/ paper	
EP_proc	Energy saved due to efficiency improvements in BLS processing FFFF evaporator	*Project*	Kcal	*E*	*continuous*	*100%*	electronic/ paper	
EB_util	Energy saved due to efficiency improvements in biomass utilization for energy generation	*Project*	Kcal	*E*	*continuous*	*100%*	electronic/ paper	

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
SBIOB	Steam generated using BLS in baseline	*Project*	(tonnes)	*M*	*continuous*	*100%*	electronic/ paper	
SBIOP	Steam generated using BLS energy in project	*Project*	tonnes	*M*	*continuous*	*100%*	electronic/ paper	
Enth_ SBIOB	Enthalpy of steam generated using BLS in baseline	*Project*	kcal/tonne	*E*	*continuous*	*100%*	electronic/ paper	
Enth_ SBIOP	Enthalpy of steam generated using BLS in project	*Project*	Kcal/tonne	*E*	*continuous*	*100%*	electronic/ paper	
PB	Blown pulp attributable to waste BLS source in baseline	*Project*	tonne	*M*	*continuous*	*100%*	electronic/ paper	

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
PP	Blown pulp attributable to waste BLS source in project	*Project*	tonne	*M*	*continuous*	*100%*	electronic/ paper	
BIOB	BLS generation in baseline	*Project*	Tonne	*M*	*continuous*	*100%*	electronic/ paper	
BIOP	BLS generation in project	*Project*	tonne	*M*	*continuous*	*100%*	electronic/ paper	
EN_B	steam consumed to process biomass in baseline	*Project*	tonnes	*M*	*continuous*	*100%*	electronic/ paper	
EN_P	steam consumed to process biomass in project	*Project*	tonnes	*M*	*continuous*	*100%*	electronic/ paper	
BIOB	Biomass generation in baseline	*Project*	tonne	*M*	*continuous*	*100%*	electronic/ paper	
BIOP	Biomass generation in project	*Project*	tonne	*M*	*continuous*	*100%*	electronic/ paper	

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
SBIOB	steam generated using biomass energy in baseline	*Project*	tonnes	*m*	*continuous*	*100%*	electronic/ paper	
SBIOP	steam generated using biomass energy in project	*Project*	Tonnes	*M*	*continuous*	*100%*	electronic/ paper	
Enth_ SBIOB	Enthalpy of steam generated using biomass energy in baseline	*Project*	kcal/tonne	*E*	*continuous*	*100%*	electronic/ paper	
Enth_ SBIOP	Enthalpy of steam generated using biomass energy in project	*Project*	kcal/tonne	*E*	*continuous*	*100%*	electronic/ paper	
BIOB	Biomass generation in baseline	*Project*	Tonne	*M*	*continuous*	*100%*	electronic/ paper	
BIOP	Biomass generation in project	*Project*	tonne	*M*	*continuous*	*100%*	electronic/ paper	

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

>>

In the baseline the emissions are on account of energy generation using fossil fuel. The baseline emissions are calculated as follows :

The baseline emissions in any year 'Y' are computed as:

BEy = (EP / Eff) / FF_CV *C% * 44/12 *(1/1000) (1)

Where,

EP= the extra energy generated by the project using BLS as fuel (kcal)
Eff= Efficiency of CFBs generating steam (%);
FF_CV= Average calorific value of Coal (kcal/kg);
C% = Percentage of Carbon in Coal used (%);
44/12 = conversion of tC to tCO2 equivalent
1/1000 = conversion from kg to tonnes

Where,

EP = EP_bio + EP_proc+EP_util (2)

EP_bio= Energy generated from additional BLS available from the project (kcal);
EP_proc= Energy saved due to efficiency improvements in BLS processing FFFF evaporator (kcal); and
EP_util= Energy saved due to efficiency improvements in BLS utilization for energy generation (kcal).

Each of the above parameters has been calculated individually to arrive at the baseline emissions.

Step 1: Compute EP_bio

EP_bio = (increase in enthalpy of steam generated in project over baseline per unit of BLS generated)*(incremental BLS generated due to the project at baseline levels of production)

EP_bio = ((SBIOP* Enth_ SBIOP)/BIOP - (SBIOB* Enth_ SBIOB)/BIOB)*((BIOP/PP- BIOB/PB) * (PB)) (3)

Where,
SBIOB = steam generated using BLS in baseline (tonnes)
SBIOP = steam generated using BLS energy in project (tonnes)
Enth_ SBIOB = Enthalpy of steam generated using BLS in baseline (kcal/tonne)
Enth_ SBIOP = Enthalpy of steam generated using BLS in project (kcal/tonne)
PB = Blown pulp attributable to waste BLS source in baseline (tonne)
PP = Blown pulp attributable to waste BLS source in project (tonne)
BIOB = BLS generation in baseline (tonne)
BIOP = BLS generation in project (tonne)

Step 2 : Compute EP_proc

EP_proc = (incremental specific steam economy in project over baseline)*(BLS generated in baseline)
EP_proc = ((EN_B* Enth_ ENB/BIOB) – (EN_P* Enth_ ENP/BIOP))*BIOB (4)

Where,

EN_B = steam consumed to process BLS in baseline (tonnes)
EN_P = steam consumed to process BLS in project (tonnes)
Enth_ ENB = Enthalpy of steam used to process BLS baseline (kcal/tonne)
Enth_ ENP = Enthalpy of steam used to process BLS project (kcal/tonne)
BIOB = BLS generation in baseline (tonne)
BIOP = BLS generation in project (tonne)

Step 3 : Compute EP_util

EP_util = ((SBIOP* Enth_ SBIOP)/BIOP -(SBIOB* Enth_ SBIOB)/BIOB)*BIOB (5)

Where,

SBIOB = steam generated using BLS in baseline (tonnes)
SBIOP = steam generated using BLS in project (tonnes)
Enth_ SBIOB = Enthalpy of steam generated using BLA in baseline (kcal/tonne)
Enth_ SBIOP = Enthalpy of steam generated using BLS in project (kcal/tonne)
BIOB = BLS generation in baseline (tonne)
BIOP = BLS generation in project (tonne)

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

NOT APPLICABLE AS OPTION 1 HAS BEEN SELECTED

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

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

>>

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

Leakages

The leakages attributable to the project is the emissions occurring for generation of additional energy (in terms of steam and power) use increased else where for generation of sodium hydroxide and sodium sulphide. The mentioned chemicals are used in aqueous solution for dissolving lignin at ODL. However, it is difficult to compute the emissions for such additional energy demand increased and is outside the control of project sponsors. Further, chemical used in proceeding bleaching process has considerable decreased due to project activity. To such extend it is assumed that the energy increased has been nullified by energy decreased in process of bleaching chemical manufacturing process. Therefore, leakage has not been calculated.

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>>

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>> Annual Emission Reductions (**ER_Y**) from the project activity:

ERy = BEy – PEy – Leakage if any (Ley) (9)

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
All are plant related data	*Low*	*PSPD unit is a certified unit under ISO 9002:2000 by reputed accredited body. All data on the project and baseline forms a part of the quality system management and is regularly monitored and recorded as mentioned intervals. Further all meters are calibrated and undergo preventive maintenance at scheduled period.*

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

>>

The project will be operated and managed by ITC PSPD Bhadrachalam Unit who is also the project proponent. PSPD unit will ensure safety in operation of the plant; a project manager has been designated with the responsibility for ensuring that the safety issues are addressed..

The project will abide by all regulatory and statutory requirements as prescribed under the state and central laws and regulations. To ensure such performance PSPD unit as mentioned above will monitor all its activities and performance related to project emission and steam generation. PSPD unit has installed meters and where ever possible online monitoring is being carried out to measure and calculate actual creditable emission reduction in most transparent and relevant manner. Installed meters are calibrated according to the maintenance schedule programmed at the start of the operation and refreshed according to the plants performance requirement. All the monitoring data are being recorded and kept under safe custody of the power plant manager and or the board members. Also any changes within the project boundary, such as change in spares and or equipment are also recorded and any change in the emission reduction due to such alteration will also be studied and recorded.

Although it is being anticipated that there won't be any leakage from the CDM project, however, if any such condition arises, and leakage effect is found due to project activity, such leakage will be accounted accordingly as mentioned in the chosen applied baseline methodology.

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

>>

Dr. P Ram Babu of PricewaterhouseCoopers (P) Limited, whose contact information is set out in Annex 1 has assisted the project proponent in determining the monitoring methodology.

The annexed monitoring methodology determination is completed on February, 2005.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>>The GHG emission sources considered in the baseline and in the project are given in the following tables :

Project activity and project emission:

The project involves following activities and the associated emissions:

Project scenario	Project parameters
additional waste black liquor solids (BLS) recovery from blown pulp stream;	Additional BLS generated per tonne of blown pulp processed – average of recent annual data are available and same has been computed for differential amount of BLS produced compare to project; Power and steam consumed by ODL subtracted as project emission
Improvement the energy efficiency in FFFF evaporator to efficiently recover BLS	Energy consumption by FFFF evaporator per unit of BLS recovered – 3tonne of steam/ tonne of BLS produced; Power and steam consumed by FFFF evaporator for recovery of additional BLS subtracted as project emission
Absolute combustion of BLS and improvement in steam enthalpy at SRB	It is ensured that the BLS produced by combined ODL and FFFF evaporator system in not stored anywhere in the PSPD facility; It is ensured that the total BLS produced in directly fired in the SRB; Efficiency improvement in steam generation using BLS at present SRB, i.e. heat rate of the boiler – average of recent annual data are available with the project.

Baseline scenario and baseline emission:

Baseline scenario has been determined by computing following baseline parameters:

Baseline scenario	Baseline parameter
Level of BLS recovery from blown pulp stream	BLS generated per tonne of blown pulp processed – average of last two years form 2001-2002 till date are available and same has been computed for differential amount of BLS produced compare to project.
Energy efficiency in raising evaporator to efficiently recover BLS	Energy consumption by raising evaporator per unit of BLS recovered – 6tonne of steam/ tonne of BLS produced.
Utilization of coal for energy generation in absence of the project	Calorific value of coal in the baseline scenario is 5093 tCOe; Carbon percent of fossil used at the baseline are known to the project activity as 50% Efficiency of energy generation using fossil fuel (heat

	rate of the boiler – average of the last three years) are available with the project,

E.2. Estimated leakage:

>>There is no potential leakage from the project.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

>>

Project emissions	**Unit**	**01-02**	**03-04**	**CO2e emissions**
Power in ODL	kw		790	tCO2e
Total energy from ODL power	kwh		6252840	6784
Steam at ODL	tonnes/hr		3.33	
Total steam	tonnes/yr		26400	7920
Power in evap and SRB	lakh kwh	100.51	183	
solids fired in soda rec boiler	tonne	122833	206346	
power / unit bl solid fired	kwh/tonne	81.827	88.802	
incremental power	kwh		582566	632
Total project emissions				**15336**

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

>>

Coal saved due to additional BL solids generated and burnt			
	Unit	01-02	03-04
Unbleached pulp	tonne	76695	105853
solids fired in soda rec boiler	tonne	122833	206346
solids fired per tonne of blown pulp	tonne/tonne	1.60	1.95
steam generated	tonnes	302904	579746
quality of steam		42 ata 405C	62ata 450C
enthalpy	kcal/kg	768	786
total enthalpy	mill kcal	232630	455680
enthalpy per tonne BL solids	mill kcal/tonne	1.894	2.208
increase in solids firing	tonnes		26673
increase in steam enthalpy generation	mill kcal		58903
calorific value of coal	kcal/kg		5092
efficiency of thermal generation through coal	(% CFB 5)		76.79
coal avoided for this enthalpy of steam	tonnes		15064
carbon %			50
tCO2e/annum			**27618**

Emission reduction at evaporator	Unit	01-02	03-04
Weak BL processed	tonne	785227	1105644
steam consumption	tonne	173851	147524
steam economy	kg/tonne of WBL	221.4	133.4
Reduction in steam in FFFF evaporator	kg/tonne of WBL		88.0
reduciton in steam cons on old capacity	tonnes		69080
Enthalpy of LP steam - 5.5 kg/cm2 200C	kcal/kg		681
Total enthalpy of steam	mill kcal		47043
Eff of coal fired boier	%		80
energy input for steam	mill kcal		58804
calorific value of coal	kcal/kg		4704
carbon	%		45
coal saved	tonnes		12501
CO2e	tonnes		**20626**

Efficiency in soda recovery boiler	Unit	01-02	03-04
solids fired in soda rec boiler	tonne	122833	206346
steam generated	tonnes	302904	579746
quality of steam		42 ata 405C	62ata 450C
enthalpy	kcal/kg	768	786
total enthalpy	mill kcal	232630	455680
enthalpy per tonne BL solids	mill kcal/tonne	1.894	2.208
increase in the steam enthalpy per ton of BL fired	mill kcal/tonne		0.3145
Additional steam generated in baseline	mill kcal		38626
Eff of coal fired boier	%		80
energy input for steam	mill kcal		48282
calorific value of coal	kcal/kg		4704
carbon	%		45
coal saved	tonnes		10264.1
CO2e	tonnes		**16936**

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

>>

Emission reductions calculation		
Baseline emissions	tCO2e	
Coal saved due to additional BL solids generated and burnt	27618	
Emission reduction at evaporator	20626	
Efficiency in soda recovery boiler	16936	
Total baseline emissions	**65180**	A
Project emissions	**15336**	B
Leakage	0	C
Net Emission Reductions (A-B-C)	**49844**	

E.6. Table providing values obtained when applying formulae above:

>>Please see above

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

Environmental impact assessment has been carried out before implementation of the project and no significant adverse impact has been reported from the study. All impacts during construction period were temporary and have caused no damage to the surrounding environment. The additional environmental benefits derived from the project are:

- Reduction of resource wastage
- Reduction in raw material consumption
- Reduction in energy consumption
- Reduction in GHG emission
- Reduction in chemical usage
- Increase in waste recovery and utilization for waste energy
- Enrichment of renewable waste energy

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

Host country regulation does not require project to carry out any environmental impact assessment of the project as this is a developmental project within the existing PSPD unit premises below INR 25crore of investment.

SECTION G. Stakeholders' comments

>>

G.1. Brief description how comments by local stakeholders have been invited and compiled:

>>

Stakeholder consultation meeting will be carried out by the project in coming month. The notice for such meeting will be issued to the relevant stakeholders. However, since this process improvement has been undertaken within the existing premises of the PSPD unit. Employees as one group of stakeholders and government were involved in decision making process for this project. This project is presently being run the employee without any objection.

G.2. Summary of the comments received:

>>

Meeting of the stakeholder meeting will be made available after the meeting.

G.3. Report on how due account was taken of any comments received:

>>

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding has been sought for the project activity

Annex 3

BASELINE INFORMATION

As in part B of this document

Annex 4

MONITORING PLAN

As in part D of this document

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